

PROJECT MANUAL AND SPECIFICATIONS  
FOR  
SACRAMENTO CITY UNIFIED SCHOOL DISTRICT  
**PROJECT NAME**

TABLE OF CONTENTS

**DIVISIONS 00 AND 01 - BIDDING AND CONTRACT REQUIREMENTS**  
**(To be provided and edited by the Construction Manager and District)**

| <u>DIVISION</u> | <u>SECTION TITLE</u>                                             |
|-----------------|------------------------------------------------------------------|
| 00 01 01        | Project Title Page                                               |
| 00 01 10        | Table of Contents                                                |
| 00 01 15        | List of Drawings and Tables                                      |
| 00 01 20        | List of Schedules                                                |
| 00 11 16        | Notice to Bidders                                                |
| 00 21 13        | Instructions to Bidders                                          |
| 00 21 13.1      | Bidder Information and Forms                                     |
| 00 31 19        | Existing Conditions                                              |
| 00 31 32        | Geotechnical Data                                                |
| 00 41 13        | Bid Form and Proposal                                            |
| 00 43 13        | Bid Bond                                                         |
| 00 43 36        | Designated Subcontractors List                                   |
| 00 45 01        | Site Visit Certification                                         |
| 00 45 19        | Non-Collusion Declaration                                        |
| 00 45 19.01     | Iran Contracting Act Certification                               |
| 00 45 26        | Workers' Compensation Certification                              |
| 00 45 46.01     | Prevailing Wage and Related Labor Requirements Certification     |
| 00 45 46.02     | Disabled Veteran Business Enterprise Participation Certification |
| 00 45 46.03     | Drug-Free Workplace Certification                                |
| 00 45 46.04     | Tobacco-Free Environment Certification                           |
| 00 45 46.05     | Hazardous Materials Certification                                |
| 00 45 46.06     | Lead-Based Materials Certification                               |
| 00 45 46.07     | Imported Materials Certification                                 |
| 00 45 46.08     | Criminal Background Investigation/Fingerprinting Certification   |
| 00 45 46.09     | Buy American Certification                                       |
| 00 45 46.10     | Roofing Project Certification                                    |
| 00 45 46.11     | Federal Debarment Certification                                  |
| 00 45 46.12     | Federal Byrd Anti-Lobbying Certification                         |
| 00 45 49        | Registered Subcontractors List                                   |
| 00 45 90        | Post Bid Interview                                               |
| 00 51 00        | Notice of Award                                                  |
| 00 52 13        | Agreement Form – Stipulated Sum (Single-Prime Contract)          |
| 00 55 00        | Notice to Proceed                                                |
| 00 56 00        | Escrow Bid Documentation                                         |
| 00 57 00        | Escrow Agreement in Lieu of Retention                            |
| 00 61 13.13     | Performance Bond                                                 |

|             |                                                             |
|-------------|-------------------------------------------------------------|
| 00 61 13.16 | Payment Bond                                                |
| 00 63 40    | Allowance Expenditure Directive Form                        |
| 00 63 47    | Daily Force Account Report                                  |
| 00 63 57    | Proposed Change Order Form                                  |
| 00 63 63    | Change Order Form                                           |
| 00 65 19.26 | Agreement and Release of Any and All Claims                 |
| 00 65 36    | Guarantee Form                                              |
| 00 72 13    | General Conditions – Stipulated Sum (Single-Prime Contract) |
| 00 73 13    | Special Conditions                                          |
| 00 73 56    | Hazardous Materials Procedures and Requirements             |

DIVISION 1      GENERAL REQUIREMENTS

**(To be provided and edited by the Construction Manager and District)**

|             |                                                                                    |
|-------------|------------------------------------------------------------------------------------|
| 01 01 50    | Additional Requirements for DSA Projects                                           |
| 01 11 00    | Summary of Work                                                                    |
| 01 21 00    | Allowance                                                                          |
| 01 22 00    | Alternatives and Unit Prices                                                       |
| 01 25 13    | Product Options and Substitutions                                                  |
| 01 26 00    | Changes in the Work                                                                |
| 01 29 00    | Application for Payment and Conditional and Unconditional Waiver and Release Forms |
| 01 31 19    | Project Meetings                                                                   |
| 01 32 13    | Scheduling of Work                                                                 |
| 01 33 00    | Submittals                                                                         |
| 01 35 13.23 | Site Standards                                                                     |
| 01 41 00    | Regulatory Requirements                                                            |
| 01 42 13    | Abbreviations and Acronyms                                                         |
| 01 42 16    | Definitions                                                                        |
| 01 42 19    | References                                                                         |
| 01 43 00    | Materials and Equipment                                                            |
| 01 45 00    | Quality Control                                                                    |
| 01 50 00    | Temporary Facilities and Controls                                                  |
| 01 50 13    | Construction Waste Management and Disposal                                         |
| 01 52 13    | Field Offices                                                                      |
| 01 57 13    | Erosion Control (provide swppp)                                                    |
| 01 57 13    | Erosion Control (swppp provided)                                                   |
| 01 64 00    | Owner-Furnished Products                                                           |
| 01 66 00    | Product Delivery, Storage and Handling                                             |
| 01 71 23    | Field Engineering                                                                  |
| 01 73 29    | Cutting and Patching                                                               |
| 01 76 00    | Alteration Project Procedures                                                      |
| 01 77 00    | Contract Closeout and Final Cleaning                                               |
| 01 78 23    | Operation and Maintenance Data                                                     |
| 01 78 36    | Warranties                                                                         |
| 01 78 39    | Record Documents                                                                   |
| 01 91 00    | Commissioning                                                                      |

**DIVISIONS 02 THROUGH 48 - TECHNICAL REQUIREMENTS**

|                    |                                          |
|--------------------|------------------------------------------|
| <u>DIVISION 02</u> | <u>EXISTING CONDITIONS</u>               |
| 02 41 00           | Site Demolition                          |
| <u>DIVISION 03</u> | <u>CONCRETE</u>                          |
| 03 10 00           | Concrete Forming and Accessories         |
| 03 20 00           | Concrete Reinforcing                     |
| 03 30 00           | Cast-In-Place Concrete                   |
| <u>DIVISION 04</u> | <u>MASONRY</u>                           |
| 04 10 00           | Mortar and Grout                         |
| 04 22 00           | Concrete Unit Masonry                    |
| <u>DIVISION 05</u> | <u>METALS</u>                            |
| 05 50 00           | Metal Fabrication                        |
| 05 50 15           | Metal Ladders                            |
| <u>DIVISION 06</u> | <u>WOOD, PLASTICS AND COMPOSITES</u>     |
| 06 10 00           | Rough Carpentry                          |
| 06 41 00           | Architectural Casework                   |
| <u>DIVISION 07</u> | <u>THERMAL AND MOISTURE CONTROL</u>      |
| 07 21 00           | Thermal Insulation                       |
| 07 26 00           | Vapor Retarders                          |
| 07 52 16           | SBS Modified Bituminous Membrane Roofing |
| 07 54 19           | Polyvinyl-Chloride Roofing               |
| 07 60 00           | Flashing and Sheet Metal                 |
| 07 71 23           | Gutters and Related Flashings            |
| 07 90 00           | Joint Sealants                           |
| <u>DIVISION 08</u> | <u>OPENINGS</u>                          |
| 08 11 00           | Metal Doors                              |
| 08 14 00           | Wood Doors                               |
| 08 16 13           | FRP Doors                                |
| 08 31 00           | Access Doors and Panels                  |
| 08 43 00           | Storefronts                              |
| 08 71 00           | Door Hardware                            |
| 08 80 00           | Glazing                                  |
| 08 90 00           | Metal Wall Louvers                       |
| <u>DIVISION 09</u> | <u>FINISHES</u>                          |
| 09 29 00           | Gypsum Board                             |
| 09 51 00           | Acoustical Ceilings                      |
| 09 65 00           | Resilient Flooring – Tile                |
| 09 65 16           | Resilient Flooring – Sheet Vinyl         |

|          |                                 |
|----------|---------------------------------|
| 09 67 23 | Fluid-Applied Flooring-Epoxy    |
| 09 67 24 | Urethane Slurry Flooring System |
| 09 68 00 | Carpet                          |
| 09 91 00 | Painting                        |

|                    |                                        |
|--------------------|----------------------------------------|
| <u>DIVISION 10</u> | <u>SPECIALTIES</u>                     |
| 10 14 00           | Signage                                |
| 10 21 13           | Toilet Compartments and Cubicles       |
| 10 28 00           | Toilet, Bath, and Washroom Accessories |

|                    |                  |
|--------------------|------------------|
| <u>DIVISION 11</u> | <u>EQUIPMENT</u> |
| 11 68 00           | Play Structures  |

|                    |                    |
|--------------------|--------------------|
| <u>DIVISION 12</u> | <u>FURNISHINGS</u> |
| 12 20 00           | Window Treatments  |

|                    |                             |
|--------------------|-----------------------------|
| <u>DIVISION 13</u> | <u>SPECIAL CONSTRUCTION</u> |
|                    | Not Used                    |

|                    |                            |
|--------------------|----------------------------|
| <u>DIVISION 14</u> | <u>CONVEYING EQUIPMENT</u> |
|                    | Not Used                   |

|                    |                                            |
|--------------------|--------------------------------------------|
| <u>DIVISION 21</u> | <u>FIRE PROTECTION</u>                     |
| 21 00 50           | Basic Fire Sprinkler Materials and Methods |
| 21 10 00           | Fire Sprinkler Systems                     |

|                    |                                      |
|--------------------|--------------------------------------|
| <u>DIVISION 22</u> | <u>PLUMBING</u>                      |
| 22 00 50           | Basic Plumbing Materials and Methods |
| 22 05 53           | Plumbing Identification              |
| 22 10 00           | Plumbing Piping Systems              |
| 22 40 00           | Plumbing Fixtures                    |
| 22 50 00           | Plumbing Equipment                   |

|                    |                                                     |
|--------------------|-----------------------------------------------------|
| <u>DIVISION 23</u> | <u>HEATING VENTILATING &amp; AIR CONDITIONING</u>   |
| 23 00 50           | Basic HVAC Materials and Methods                    |
| 23 05 10           | Basic Mechanical Requirements                       |
| 23 05 15           | HVAC Equipment and Air Distribution System Cleaning |
| 23 05 53           | Mechanical Identification                           |
| 23 05 93           | Testing, Adjusting, and Balancing for HVAC          |
| 23 08 00           | Title 24 Commissioning                              |
| 23 09 23           | Energy Management Control Systems                   |
| 23 80 00           | Heating, Ventilating, and Air Conditioning          |

|                    |                               |
|--------------------|-------------------------------|
| <u>DIVISION 26</u> | <u>ELECTRICAL</u>             |
| 26 00 10           | Basic Electrical Requirements |
| 26 00 60           | Power System Study            |



|          |                                   |
|----------|-----------------------------------|
| 26 00 90 | Electrical Demolition             |
| 26 05 19 | Building Wiring and Cable         |
| 26 05 26 | Grounding and Bonding             |
| 26 05 29 | Electrical Hangers and Supports   |
| 26 05 31 | Conduit                           |
| 26 05 33 | Boxes                             |
| 26 05 43 | Underground Ducts and Structures  |
| 26 05 53 | Electrical Identification         |
| 26 09 42 | Digital Lighting Control          |
| 26 22 13 | Dry Type Transformers             |
| 26 24 13 | Switchboards                      |
| 26 24 16 | Panelboards                       |
| 26 26 53 | Electric Vehicle Charging Station |
| 26 27 19 | Surface Raceways                  |
| 26 27 26 | Wiring Devices                    |
| 26 27 36 | Energy Information Systems        |
| 26 28 16 | Overcurrent Protective Devices    |
| 26 28 19 | Disconnect Switches               |
| 26 31 00 | Photovoltaic Power System         |
| 26 43 13 | Surge Protection Devices          |
| 26 50 00 | Lighting                          |

DIVISION 27

COMMUNICATIONS

|          |                                      |
|----------|--------------------------------------|
| 27 00 00 | Communication Basic Requirements     |
| 27 05 00 | Common Work for Communications       |
| 27 10 00 | Structure Cabling                    |
| 27 21 00 | Data Communication Network Equipment |
| 27 41 00 | Audio Visual                         |
| 27 51 23 | Educational Intercom                 |
| 27 51 26 | Assistive Listening                  |
| 27 53 13 | Clock Systems                        |

DIVISION 28

ELECTRONIC SAFETY & SECURITY

|          |                      |
|----------|----------------------|
| 28 10 00 | Access Control       |
| 28 20 00 | Video Surveillance   |
| 28 31 00 | Intrusion Detection  |
| 28 46 00 | Fire Alarm Detection |

DIVISION 31

EARTHWORK

|          |                           |
|----------|---------------------------|
| 31 00 00 | Earthwork                 |
| 31 13 16 | Tree Protection           |
| 31 23 33 | Trenching and Backfilling |
| 31 32 00 | Soil Stabilization (lime) |

DIVISION 32

EXTERIOR IMPROVEMENTS

|          |                              |
|----------|------------------------------|
| 32 12 00 | Asphalt Paving               |
| 32 12 36 | Pavement Sealer and Striping |

TABLE OF CONTENTS  
DIVISION 0 - 6

|          |                                   |
|----------|-----------------------------------|
| 32 16 00 | Site Concrete                     |
| 32 31 13 | Chain Link Fences                 |
| 32 31 19 | Decorative Metal Fences and Gates |
| 32 80 00 | Irrigation                        |
| 32 90 00 | Landscaping                       |

|                    |                  |
|--------------------|------------------|
| <u>DIVISION 33</u> | <u>UTILITIES</u> |
| 33 00 00           | Site Utilities   |
| 33 40 00           | Site Drainage    |

END OF TABLE OF CONTENTS

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- This Erosion Control spec section is required if contractor is to prepare and permit the SWPPP.
- Confirm whether a full SWPPP or Erosivity Wavier can be permitted.
- Confirm with District if contractor is to provide Qualified SWPPP Practitioner (QSP) for monitoring and reporting during construction of these services will be completed by District Consultant.
- Confirm access routes and contractor laydown areas with District.

SECTION 01 57 13

EROSION CONTROL

**PART 1 - GENERAL**

1.01 SUMMARY

- A. General: Provide all materials, equipment and labor necessary to furnish and install straw wattles at locations shown on the Drawings and on Contractors Storm Water Pollution Prevention Plan.
- B. Storm Water Pollution Prevention Plan: Contractor will be required to prepare a Storm Water Pollution Prevention Plan (SWPPP), and submit to the State Water Resource Control Board to obtain Notice of Intent approval and a WDID number. Comply with State Water Resources Control Board requirements. The SWPPP shall be provided by the Contractor prior to the start of work. The SWPPP shall be tailored to the contractor's approach to the work in this contract. The SWPPP shall be prepared by a Qualified SWPPP Developer (QSD). The Contractor shall as a minimum address:
  - 1. Cut and fill operations.
  - 2. Temporary stockpiles.
  - 3. Vehicle and equipment storage, maintenance and fueling operations.
  - 4. Concrete, plaster, mortar and paint disposal.
  - 5. Dust control.
  - 6. Tracking of dirt, mud on off-site streets.
  - 7. Erosion Controls
  - 8. Sediment Controls

1.02 QUALITY ASSURANCE

- . General: Comply with governing codes and regulations.

1.03 SUBMITTALS

- A. SWPPP: Contractors Qualified SWPPP Developer (QSD) shall submit to the State Water Resources Control Board via Storm water Multi Application and Report Tracking System (SMARTS) and obtain a Notice of Intent and WDID number prior to beginning work on site.

**PART 2 - PRODUCTS**

2.01 MATERIALS

- A. Straw Wattles: Shall be new manufactured straw roles in compliance with state requirements for sediment control.
- A. Filter Bag: Shall be as required by local jurisdiction.

**PART 3 - EXECUTION**

3.01 INSTALLATION

- A. All BMPS shall be installed per the drawings, CASQA standards and as required by the SWPPP.

3.02 MAINTENANCE AND REMOVAL:

- A. General: Maintain and repair existing and new erosion control facilities throughout the construction period. Remove silt build up at straw wattles and/or silt fences as needed. Repair damage to earth slopes and banks. Erosion control measures shall be left in place until hydroseed is placed.
- B. Monitoring: Based on determined Risk Level of Contractor's SWPPP provide monitoring of erosion and sediment control measures before, during and after storm events. Site monitoring shall be performed by a Qualified SWPPP Practitioner. Update SWPPP continuously throughout construction period and provide reporting and testing as required by the current NPDES permit. Testing and reporting of turbidity and ph will be required for a project determined to be Risk Level 2. Contractor's QSD/QSP will be required to prepare AdHoc reports of all testing on the State Water Resources Control Board's SMARTS database
- C. Cleaning: Keep area clean of debris.
- D. Remove all sediment control measures following site stabilization.
- E. The Contractor's QSD and QSP will be responsible for preparing and gaining approval of the annual report(s) and Notice of Termination on the State Water Resources Control Board's SMARTS database following project completion.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- This Erosion Control spec section is required if SWPPP has already been prepared by consultant.
- Confirm whether a full SWPPP or Erosivity Wavier can be permitted.
- Confirm with District if contractor is to provide Qualified SWPPP Practitioner (QSP) for monitoring and reporting during construction of these services will be completed by District Consultant.
- Confirm access routes and contractor laydown areas with District.

SECTION 01 57 13

EROSION CONTROL

**PART 1 – GENERAL**

1.01 SUMMARY

- A. General: Provide all materials, equipment and labor necessary to furnish and install BMPs and required maintenance as shown on the Drawings and on the Storm Water Pollution Prevention Plan.
- B. Storm Water Pollution Prevention Plan: A Storm Water Pollution Prevention Plan (SWPPP) has been prepared by the [REDACTED]. Comply with State Water Resources Control Board requirements. The SWPPP will be provided to the Contractor prior to the start of work. The SWPPP shall be tailored to the contractor's approach to the work in this contract. The Contractor shall provide the following, but not limited to:
  - 1. Cut and fill operations.
  - 2. Temporary stockpiles.
  - 3. Vehicle and equipment storage, maintenance and fueling operations.
  - 4. Concrete, plaster, mortar and paint disposal.
  - 5. Dust control.
  - 6. Tracking of dirt, mud on off-site streets.
  - 7. Pipe flushing.
  - 8. Appropriate Erosion Controls
- C. General contractor shall provide all monitoring and reporting. Monitoring and reporting required to be completed by a qualified SWPPP practitioner. The Qualified SWPPP Practitioner shall provide the following, but not limited to:
  - 1. PH and turbidity sampling per current NPDES permit.
  - 2. Upload all AdHoc reports to the SWRCB SMARTS website.
  - 3. Prepare weekly BMP Inspection reports and storm event reports.
  - 4. Prepare Annual Report uploaded to the SMARTS system.
  - 5. Prepare Notice of Termination.

1.02 QUALITY ASSURANCE

- A. General: Comply with governing codes and regulations.

**PART 2 – PRODUCTS**

2.01 MATERIALS

- A. Straw Wattles: Shall be new manufactured straw roles in compliance with state requirements for sediment control.

- B. Filter Bag: Shall be as required by local jurisdiction.

### **PART 3 – EXECUTION**

#### **3.01 INSTALLATION**

- A. Straw Wattles: Shall be installed per the drawings and/or as required by the SWPPP.
- B. Filter Bags: Shall be installed as required by manufactures requirements.

#### **3.02 MAINTENANCE AND REMOVAL:**

- A. General: Maintain and repair existing and new erosion control facilities throughout the construction period. Remove silt build up at straw wattles and/or silt fences as needed. Repair damage to earth slopes and banks. Erosion control measures shall be left in place until final paving and landscaping are complete.
- B. Monitoring: Contractor's Qualified SWPPP Practitioner shall provide all site monitoring and recommendations to meet current NPDES requirements during construction.
- C. Cleaning: Keep area clean of debris.
- D. Remove erosion control measures prior to placing finish landscaping.

END OF SECTION



## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 2025-01-31 – Added language about the District wanting to salvage play equipment.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

SECTION 02 41 00

SITE DEMOLITION

**PART 1 – GENERAL**

1.01 SUMMARY

A. RELATED SECTIONS

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 01 50 00 - Construction Facilities and Temporary Controls.
3. Section 01 50 13 - Construction Waste Management and Disposal.
4. Section 31 00 00 - Earthwork.
5. Section 31 13 16 - Tree Protection.

1.02 REGULATORY REQUIREMENTS

- A. Conform to applicable jurisdictional authority regulations and codes for disposal of debris.
- B. Coordinate clearing Work with utility companies
- C. Maintain emergency access ways at all times.
- D. Contractor shall comply with all applicable laws and ordinances regarding hazardous materials, including contaminated soils, hazardous material transformers, and similar materials or components.

1.03 SUBMITTALS:

- A. Schedule: Submit a detailed sequence of demolition and removal work, including dates for shutoff, capping, and continuance of utility services.
- B. Procedures: Submit written procedures documenting the proposed methods to be used to control dust and noise.

1.04 EXISTING CONDITIONS

- A. Contractor shall acquaint himself with all site conditions. If unknown active utilities are encountered during work, notify Architect promptly for instructions. Failure to notify will make Contractor liable for damage to these utilities arising from Contractor's operations subsequent to discovery of such unknown active utilities.
- B. Conduct demolition to minimize interference with adjacent structures or items to remain. Maintain protected egress and access at all times.

## 1.05 PROTECTION

- A. Adequate protection measures shall be provided to protect workmen and passers-by on and off the site. Adjacent property shall be fully protected throughout the operations. Blasting will not be permitted. Prevent damage to adjoining improvements and properties both above and below grade. Restore such improvements to original condition should damage occur. Replace trees and shrubs outside building area disturbed by operations.
- B. In accordance with generally accepted construction practices, the Contractor shall be solely and completely responsible for working conditions at the job site, including safety of all persons and property during performance of the work. This requirement shall apply continuously and shall not be limited to normal working hours.
- C. Safety Precautions Prevent damage to existing elements identified to remain or to be salvaged, and prevent injury to the public and workmen engaged on site. Demolish roofs, walls and other building elements in such manner that demolished materials fall within foundation lines of building. Do not allow demolition debris to accumulate on site. Pull down hazardous work at end of each day; do not leave standing or hanging overnight, or over weekends.
  - 1. Protect existing items which are not indicated to be altered. Protect utilities designated to remain from damage.
  - 2. Protect trees, plant growth, and features designated to remain as final landscaping as shown on drawings.
  - 3. Protect benchmarks from damage or displacement.
- D. Trees: Carefully protect existing trees that are to remain. Provide temporary irrigation as necessary to maintain health of trees.
- E. Fire Safety: The contractor shall conform to chapter 33 of the California Fire Code (CFC), "Fire Safety During Construction and Demolition", at all times during the construction process. A copy of this chapter can be provided.
- F. Any construction review of the Contractor's performance conducted by the Geotechnical Engineer is not intended to include review of the adequacy of the Contractor's safety measures, in, on, or near the construction site.
- G. Surface Drainage: Provide for surface drainage during period of construction in manner to avoid creating nuisance to adjacent areas. The contractor shall make a reasonable effort on a daily basis to keep all excavations and the site free from water during entire progress of work, regardless of cause, source, or nature of water.
- H. Adjacent streets and sidewalks shall be kept free of mud, dirt or similar nuisances resulting from earthwork operations.
- I. The site and adjacent influenced areas shall be watered as required to suppress dust nuisance. Dust control measures shall be in accordance with the local jurisdiction.

## **PART 2 - PRODUCTS**

Not Used

## **PART 3 – EXECUTION**

### **3.01 EXAMINATION**

- A. Examine conditions of work in place before beginning work, report defects.
- B. Report existence of hazardous materials or unsafe structural conditions.

### **3.02 PREPARATION**

- A. Scheduling:
  - 1. General: Coordinate and schedule demolition work as required by the Owner and as necessary to facilitate construction progress.
- B. Hazardous Materials:
  - 1. General: Identify chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with demolition operations, and notify such jurisdictional agencies as may be required. Collect and legally dispose of such materials at official disposal locations away from the site.
  - 2. Asbestos: If asbestos or materials containing asbestos are encountered, stop work immediately and contact the Owner. Do not proceed with demolition until directed by Owner.
- C. Utility and Service Termination
  - 1. Locate and identify existing utility, service and irrigation system components affected by work of this contract. Review existing record drawings, conduct site investigations, contact Underground Service Alert and other qualified cable/pipe/line locator services, and implement all other means necessary to define the location of underground systems.
  - 2. Prior to beginning any demolition, properly disconnect all water, gas and electrical power supply at appropriate disconnect locations. Obtain all necessary releases and approvals from serving utility companies.
  - 3. Prior to demolition or disconnect, obtain Owner's approval that such system does not impact facilities or systems beyond the extent of this contract.
  - 4. Mark location of disconnected systems. Identify and indicate stub-out locations on Project Record Documents.
- D. Verify that existing plant life and features designated to remain are tagged or identified.
  - 1. The Architect will mark the features, trees, and shrubs to remain within the construction area. Contractor shall not commence clearing and grubbing operations until authorized by the Owner and all protective measures are in place.

- E. Coordinate the time and duration of all system disconnects with Owner.

### 3.03 DEMOLITION

#### A. General Requirements

1. Clear areas required for access to site and execution of Work, including pavements, structures, foundations, vegetation, trash and debris.
2. Coordinate with Owner the time of day and route to remove demolished materials from premises.
3. Remove demolished materials from site as work progresses. Upon completion of work, leave areas of work in clean condition.
4. Remove all buried debris, rubble, trash, or other material not deemed suitable by the Geotechnical Engineer.
5. Fill all voids or excavations resulting from clearing, demolition, or removal of vegetation with specified fill material.
6. See list below for other site specific buildings, structures, equipment that need to be walked with District prior to demolition for items to be salvaged:
  - a. TBD.

#### B. Fixture and Equipment Removal:

1. Remove existing fixtures and equipment as identified and shown on drawings and required by Architect.
2. Verify all service connections to fixtures and equipment designated for removal have been properly disconnected.
3. Remove all conductors from conduit at all abandoned circuits.

#### C. Play Equipment Removal:

1. Remove existing play equipment as identified and shown on drawings and required by Architect.
2. Coordinate salvage rights with District for individual components, fasteners, slides, etc. prior to demolition and removal from site.

### 3.04 UTILITY AND BUILDING SERVICES REMOVAL AND RE-INSTALLATION

- A. Where crossing paths and potential points of interference with existing utility services are shown or can be reasonably inferred from surface conditions or evidence of subsurface systems, such as meter boxes, vaults, relief vents, cleanouts and similar components.
  1. Review all contract documents showing crossing paths and potential points of interference.
  2. Pothole or determine by other means the accurate depth and location of such utilities.
  3. Incorporate all costs required to complete work under this contract, including additional trenching, re-routing of existing and new utilities, and all means necessary to construct work under this contract.

4. No additional cost to the Owner will be allowed for work necessary to accommodate utility conflicts where such crossing paths are shown on contract drawings or can be reasonably inferred from surface conditions or components.
- B. Remove all conductors from conduit at all abandoned electrical circuits.
- C. Seal off ends of all piping, drains and other components as directed by Architect and serving utility.
- D. Where necessary to maintain service to existing utility and building systems, relocate or redirect all conduit and conductors, piping, drains, and associated system components.
  1. Re-circuit all electrical as required.
  2. Re-circuit all landscape irrigation valving and control systems as required.
  3. Temporarily terminate landscape system components in approved boxes or with approved caps, suitable for re-connection or extension.
  4. Extend or otherwise modify all site drainage systems, including catch basins, drain inlets and piping. Fine grade to maintain proper drainage flow pattern to drains.
- E. Demolish structure in an orderly and careful manner.
  1. Use of explosives prohibited.

### 3.05 SITE PAVEMENT REMOVAL

- A. Remove sidewalk and curb where required for new construction as specified and as indicated on the Drawings.
  1. Remove all paving by saw-cutting.
  2. Remove concrete paving and curbing at locations shown on drawings. Locate closest adjacent expansion or weakened plane joint to define start of removal or saw-cutting.
- B. Remove asphalt concrete paving areas where required for new construction as specified and as indicated on the Drawings.
  1. Remove all paving by saw-cutting.
  2. Remove paving assembly as required to expose subgrade.

### 3.06 LANDSCAPE AND IRRIGATION SYSTEMS DEMOLITION AND RENOVATION

- A. Clearing, grubbing, and planting demolition.
  1. Remove grass and grass roots to a minimum depth of two inches below existing grade.
  2. Remove all shrubs, plants and other vegetation within the area of the work unless designated to remain. Grub and remove all roots of all vegetation to a depth of 24 inches below existing grade.
  3. Remove only those trees which are specifically designated for removal, or as shown on the drawings, within the construction area. Remove all stumps. Remove root ball and root systems larger than 1 inch in diameter to a depth of two feet below existing or finished grades,

whichever is lower and a minimum of five feet beyond the edge of paving, structure, wall or walkway.

4. Hand cut existing tree roots over 1 inch in diameter as necessary for trenching or other new construction, apply multiple coats of emulsified asphalt sealant especially made for horticultural use on cut or damaged plant tissues to cut faces and adjacent surfaces. Cover exposed roots with wet burlap to prevent roots from dying out until backfilling is complete.
5. Disking and mixing of vegetation, trash, debris, and other deleterious materials with surface soils prior to grading is not permitted.
6. Remove all buried debris, organic material, rubble, trash, or other material not deemed suitable by the Geotechnical Engineer.
7. Fill all voids or excavations resulting from clearing, demolition, or removal of vegetation with fill material in compliance with Section 31 00 00.
8. Selected equipment of such sizes and capacities that the existing environment is disturbed as little as possible, and to afford ease of mobility within limited and relatively confined work areas. Make every effort to preserve the topography in its natural state.
9. Keep drains, catch basins, surface drainage courses and related drainage system components clear of debris and construction materials.
10. Remove irrigation piping and appurtenances as necessary within area of work, unless noted otherwise to remain. Replace irrigation piping and appurtenances to irrigate new and/or existing landscaping. Contractor shall be responsible for temporary landscape irrigation until such time that irrigation system is restored and operational.

### 3.07 DISPOSAL

Demolished materials become property of the Contractor and shall be removed from premises, except those items specifically listed to be retained by Owner.

- A. Dispose of all demolished material, trash, debris, and other materials not used in the work in accordance with the regulations of jurisdictional authority.
- B. It is **recommended [EDIT OPTION required]** that all materials that are of a recyclable nature, be transported to a suitable legal recycling facility instead of a dump or refuse facility (unless they are one-in-the same).
- C. Burning and Burying of Materials: NOT ALLOWED.
- D. Haul Routes:
  1. Obtain permits as required by jurisdictional agencies. Establish haul routes in advance, post flagmen for the safety of the public and workmen.
  2. Keep streets free of mud, rubbish, etc.; assume responsibility for damage resulting from hauling operations; hold Owner free of liability in connection therewith.
- E. Remove demolished materials and debris from site on a daily basis.

### 3.08 CLEANING

- A. Upon completion of work of this Section promptly remove from the working area all scraps, debris.

- B. Clean excess material from surface of all remaining paved surfaces and utility structures.
- C. Power wash all concrete surfaces to remove stains, dried mud, tire marks, and rust spots.

END OF SECTION



## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

## SECTION 03 10 00

## CONCRETE FORMING AND ACCESSORIES

**PART 1 – GENERAL****1.01 SUMMARY****A. Section Includes:**

1. Formwork for cast-in-place concrete, with shoring, bracing, and anchorage.
2. Openings for other affected work.
3. Form accessories.
4. Stripping forms.

**B. Related Sections:**

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 03 20 00 – Concrete Reinforcing.
3. Section 03 30 00 – Cast-In-Place Concrete.
4. Section 32 16 00 – Site Concrete.

**1.02 REFERENCES**

- A. CBC - California Building Code, (CCR) California Code of Regulations, Title 24, Part 2, Chapter 19A.
- B. ACI 301 - Specifications for Concrete Construction.
- C. PS-1-95 - Construction and Industrial Plywood.

**1.03 SYSTEM DESCRIPTION**

- A. Design, engineer, and construct formwork, shoring, and bracing to meet design and code requirements, so that resultant concrete conforms to required shapes, lines, and dimensions.

**1.04 QUALITY ASSURANCE**

- A. Construct and erect concrete formwork in accordance with ACI 301.
- B. Regulatory Requirements:
  1. Conform to CBC - California Building Code, (CCR) California Code of Regulations, Title 24, Part 2.

**1.05 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.

**PART 2 – PRODUCTS****2.01 MATERIALS**

- A. Plywood: PS-1-95, BB Plyform grade, Class I, Exterior classification. Supply in large sheets of adequate thickness to support the imposed loads, but in no case less than 5/8" thick.
- B. Lumber: Douglas Fir species; construction grade; with grade stamp clearly visible. Forms may be used for concrete surfaces that are unexposed and require no further surface applied materials. Lumber, if used, shall be clean and sound 2x (height as required) No. 2 grade or better.
- C. Form Coating: Form shall be coated with nongrain-raising and non-staining types of form coating that will not leave a residual matter on the face of the concrete or adversely affect proper bonding of any subsequent paint or other surface applications. Form coating containing mineral oils or other non-drying materials will not be permitted for any concrete work.
- D. Form Ties: Snap off metal of fixed length: leaving no metal within 1-1/2 inches of surface and no fractures, spalls or other surface defects larger than one-inch diameter; manufactured by Burke, Dayton Superior, or accepted equal.
- E. Spreaders: Metal (no wood permitted).

**2.02 ACCESSORIES**

- A. Form Ties: Snap-off metal of adjustable length; cone type; 1 inch break back dimension; free of defects that will leave holes no larger than 1 inch diameter in concrete surface.
- B. Form Release Agent: Colorless material which will not stain concrete, absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete.
- C. Fillets for Chamfered Corners: Wood strips type; 3/4 x 3/4-inch size; maximum possible lengths.
- D. Flashing Reglets: 26-gauge thick galvanized steel; longest possible lengths; release tape sealed slots; with alignment splines for joints; securable to concrete formwork; Type CO reglet manufactured by Fry Reglet [www.fryreglet.com](http://www.fryreglet.com).
- E. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required; of strength and character to maintain formwork in place while placing concrete.

**PART 3 - EXECUTION****3.01 EXAMINATION**

- A. Verify lines, levels, and measurements before proceeding with formwork.

### 3.02 PREPARATION

- A. Obtain Architect's approval for use of earth forms for footings.
- B. Minimize form joints. Symmetrically align joints and make watertight to prevent leakage of mortar.
- C. Arrange and assemble formwork to permit stripping, so that concrete is not damaged during its removal.
- D. Arrange forms to allow stripping without removal of principal shores, where required to remain in place.

### 3.03 APPLICATION

- A. Form Release Agent
  - 1. Apply form release agent on formwork in accordance with manufacturer's instructions. Apply prior to placing reinforcing steel, anchoring devices, and embedded items.
  - 2. Do not apply form release agent where concrete surfaces are scheduled to receive applied coverings which may be affected by agent. Soak contact surfaces of untreated forms with clean water. Keep surfaces wet prior to placing concrete.

### 3.04 CONSTRUCTION

- A. Build and erect forms to conform to the required shapes, patterns, lines, grades and dimensions indicated. Forms shall be substantial and tight to prevent any leakage of mortar, properly braced and tied together to maintain their position and shape. Forms shall not deflect under the dead load weight of the plastic concrete or construction loads. Joints in forming material shall be butted tightly and shall bear on solid construction. Provide tool edges where indicated. Completed form work to be checked for grade and alignment to tolerances not exceeding 1/4" in 10'-0" for top of forms and not more than 1/4" in 10'-0" for vertical face.
- B. Cast-in Items: Set in formwork all new sleeves, inserts, anchors, and similar items furnished and required under the work of other sections. Brace, anchor and support cast-in-items to prevent displacements and distortions.
- C. Clean forms after each use and coat with release agent as required.
- D. Space clamps, ties, hangers, and other form accessories so that working capacities are not exceeded by loads imposed from concrete or concreting operations.
- E. Build openings into vertical forms at regular intervals if necessary to facilitate concrete placement, and at bottoms of forms to permit cleaning and inspection.
- F. Build in securely braced temporary bulkheads, keyed as required, at approved locations of construction joints.

- G. Slope tie-wires downward to outside of wall.
- H. During and immediately after concrete placing, tighten forms, posts, and shores. Readjust to maintain grades, levels, and camber.
- A. Inserts, Embedded Parts, And Openings
  - 1. Provide formed openings where required for work embedded in or passing through concrete.
  - 2. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.
  - 3. Install accessories in accordance with manufacturer's instructions, level and plumb. Ensure items are not disturbed during concrete placement.
- B. Earth Forms
  - 1. Construct wood edge strips at top sides of excavations as indicated on drawings.
  - 2. Provide forms for footings and foundation walls wherever concrete cannot be placed against solid earth.
  - 3. Remove loose dirt and debris from form area prior to concrete placement.
  - 4. Concrete for foundations may be placed directly into neat excavations provided the foundation trench walls are stable as determined by the Architect (Structural Engineer) subject to the approval of The Division of the State Architect.
  - 5. When earth formed foundations are used, the minimum formwork shown on the drawings is mandatory to insure clean excavations prior to and during concrete placement.
  - 6. Provide 3-1/2-inch-high starter wall for all concrete and masonry walls below grade.
- C. Form Removal
  - 1. Do not remove forms and bracing until concrete has sufficient strength to support its own weight and imposed loads.
  - 2. Do not damage concrete surfaces during form removal.
  - 3. Store reusable forms for exposed architectural concrete to prevent damage to contact surfaces.
  - 4. Remove formwork in same sequence as concrete placement to achieve similar concrete surface coloration.
  - 5. Forms shall remain in place for not less than the following periods of time. These periods represent minimum cumulative number of days during which temperature of air in contact with concrete is 60 degrees F and above.
    - a. Vertical forms of foundations and walls: 5 days.
    - b. Slab edge screens or forms: 7 days.

### 3.05 CLEANING

- A. Clean forms to remove foreign matter as erection proceeds.
- B. Ensure that water and debris drain to exterior through clean-out ports.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

SECTION 03 20 00

CONCRETE REINFORCING

**PART 1 – GENERAL**

**1.01 SUMMARY**

A. Section Includes:

1. Reinforcing steel bars, welded steel wire fabric fabricated steel bar or rod mats for cast-in-place concrete.
2. Support chairs, bolsters, bar supports, and spacers, for supporting reinforcement.
3. Fibrous secondary reinforcement for light weight concrete topping.

B. Related Sections:

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 03 10 00 – Concrete Forming and Accessories.
3. Section 03 30 00 – Cast-In-Place Concrete.
4. Section 32 16 00 – Site Concrete.

**1.02 REFERENCES**

- A. CBC - California Building Code, (CCR) California Code of Regulations, Title 24, Part 2, Chapter 19A (ACI 318).
- B. ACI 301 - Specifications for Concrete Construction.
- C. ACI 315 (SP-66) – Guide to Presenting Reinforcing Steel Design Details.
- D. ACI 318 - Building Code Requirements for Structural Concrete and Commentary.
- E. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
- F. ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement.
- G. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
- H. ASTM A706 - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
- I. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete.
- J. AWS D1.4 - Structural Welding Code - Reinforcing Steel.



- K. CRSI - Manual of Practice.
- L. CASI - Placing Reinforcing Bars.

1.03 QUALITY ASSURANCE

- A. Perform concrete reinforcement work in accordance with CASI Manual of Standard Practice.
- B. Conform to ACI 301 and ACI 315 (SP-66).
- C. Conform to CBC California Building Code, (CCR) California Code of Regulations, Title 24, Part 2.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Submit mill test certificates of supplied concrete reinforcing, indicating physical and chemical analysis, to testing laboratory.

**PART 2 – PRODUCTS**

2.01 MATERIALS

- A. Items as identified on the drawings and as otherwise specified herein.
- A. Reinforcing Bars: ASTM A615 / A615M-09b with Supplement S1, marked "S", Grade 60 for #4 bar and larger, Grade 40 for bars smaller than #4.
- B. Welded Reinforcement: ASTM A706, Grade 60, deformed bars, unfinished.
- C. Welded Steel Wire Fabric: ASTM A185 plain type; coiled rolls; uncoated finish. Furnish 6x6 W2.1xW2.1 welded wire fabric in flat sheets; rolls will not be allowed.
- D. Steel Wire: ASTM A82, plain, cold drawn steel.

2.02 ACCESSORIES

- A. Tie Wire: Minimum 16-gauge annealed type.
- B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during installation and placement of concrete including load bearing pad on bottom to prevent vapor barrier puncture. Comply with CRSI "Recommended Practice for Placing Bar Supports, Specifications and Nomenclature, Latest Edition".

- C. Chairs, Bolsters, Bar Supports, Spacers Adjacent to Architectural Concrete Surfaces: Plastic coated sized and shaped as required. Wood is not permitted as supports for reinforcing. Concrete dobies allowed at foundations and footings only.

## 2.03 FABRICATION

- A. Steel reinforcement shall not be bent or straightened in a manner that will injure the material. Bars with kinks or bends not shown on the Drawings shall not be used. Heating of the bars for bending will not be permitted.
  - 1. Spacers and chairs shall be as specified or detailed and spaced such that steel reinforcement will be carried without deflection. Chairs shall center reinforcing vertically at center of slab thickness.
  - 2. Concrete blocks may be used to support bottom layer of steel in floor slabs on grade
  - 3. Bars shall be in long lengths with laps and splices as shown. Offset laps 8'-0" in adjacent bars. Place steel with clearances and cover as shown. Bar laps shall be as indicated on the drawings. Tie all laps and all intersections with specified wire. Maintain clear space between parallel bars not less than 1-1/2 times nominal diameter for round bars, or twice side dimension for square bars, but in no case shall clear space be less than 1-1/2", nor less than 1-1/2 times maximum size concrete aggregate.
  - 4. Install welded wire fabric in lengths as long as possible. Lap adjoining pieces at least one full mesh and lace splices with wire ties. Offset laps of adjoining widths to prevent continuous laps in either direction.
  - 5. Cut bars true to length with ends square and free of burrs.
- B. Drawing Notes: Refer to notes on Drawings for additional reinforcement requirements.
- C. Welding of reinforcing bar shall be performed only where indicated on plans and in compliance with AWS D1.4. All welding of reinforcement is to be inspected in accordance with CBC Table 1705A.2.1, Item 5(b).
- D. Fabricate in accordance with ACI 315 (SP-66), providing concrete cover specified in Section 03 31 00.
- B. Locate reinforcing splices not indicated on Drawings at points of minimum stress. Indicate location of splices on shop drawings.
- C. Weld reinforcing bars in accordance with AWS D1.4.

## 2.04 SOURCE QUALITY CONTROL AND TESTING

- A. Source Quality Control and Testing will be performed under provisions of Section 01 45 00 and as required by the Division of the State Architect and District Inspector.

## PART 3 – EXECUTION

### 3.01 INSTALLATION

- A. Before placing concrete, clean reinforcement of foreign particles or coatings.
- B. Place, support, and secure reinforcement against displacement. Do not deviate from alignment or measurement.
- C. Mix fibrous reinforcement into concrete material according to Section 03 30 00.
- D. Do not displace or damage vapor barrier required by Section 03 30 00.

3.02 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01 45 00 and as required by the Division of the State Architect and District Inspector.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 09/30/2022 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- The use of colored concrete and/or textured concrete is generally frowned upon. Architect shall obtain written approval from District prior to specifying or detailing.

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

**PART 1 – GENERAL**

**1.01 SUMMARY**

**A. SECTION INCLUDES:**

1. Concrete Formwork.
2. Reinforcement of Concrete.
3. Concrete Placing and Finishing.

**B. RELATED SECTIONS**

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 03 10 00: Concrete Forming and Accessories.
3. Section 03 20 00: Concrete Reinforcing.
4. Section 03 35 45: Concrete Finishing – Polished Concrete.
5. Section 06 10 00: Rough Carpentry.
6. Section 07 26 00: Vapor Retarders.
7. Section 09 65 00: Resilient Flooring – Vinyl Composition Tile (for floor flatness requirements).
8. Section 09 65 19: Resilient Flooring – Sheet Vinyl (for floor flatness requirements).
9. Section 09 68 13: Carpeting (for floor flatness requirements).
10. Section 32 16 00: Site Concrete.

**1.02 REFERENCES**

- A. CBC - California Building Code, (CCR) California Code of Regulations Title 24, Part 2, Chapter 19A.
- B. CBC - California Building Code, (CCR) California Code of Regulations, Title 24, Part 2, California State Accessibility Standards.
- C. ACI 117-10 - Specification for Tolerances for Concrete Construction and Materials.
- D. ACI 211.1-91 - Standard Practice for Selecting Proportions for Normal Weight, Heavy Weight and Mass Concrete.
- E. ACI 301-16 - Specifications for Structural Concrete for Buildings.
- F. ACI 302.1R-15 - Guide to Concrete Floor and Slab Construction.
- G. ACI 304R-00 - Guide for Measuring, Mixing, Transporting and Placing Concrete.

- H. ACI 305R-10 - Hot Weather Concreting.
- I. ACI 306R-16 - Cold Weather Concreting.
- J. ACI 308-16 - Standard Practice for Curing Concrete.
- K. ACI 309R-05 - Guide for Consolidation of Concrete.
- L. ACI 318-14 - Building Code Requirements for Structural Concrete.
- M. ASTM A615 / A615M-09b - Deformed and Plain Billet Steel Bars for Concrete Reinforcement.
- N. ASTM C33 / C33M-08 - Concrete Aggregates.
- O. ASTM C94 / C94M-09a - Ready-Mixed Concrete.
- P. ASTM C114-09b - Methods of Chemical Analysis of Hydraulic Cement.
- Q. ASTM C150 / C150M-09 - Portland Cement.
- R. ASTM C260-06 - Air Entraining Admixtures.
- S. ASTM C289 - Standard Test Method for Potential Alkali-Silica Reactivity.
- T. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- U. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
- V. ASTM C494 / C49M-08a - Chemical Admixtures for Concrete.
- W. ASTM C567 - Standard Test Method for Determining Density of Structural Lightweight Concrete.
- X. ASTM C595/C595M-20 - Standard Specification for Blended Hydraulic Cements.
- Y. ASTM C618-19 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
- Z. ASTM C932 - Standard Specification for Surface-Applied Bonding Compounds for Exterior Plastering.
- AA. ASTM C989/C989M-18a - Standard Specification for Slag Cement for Use in Concrete and Mortars
- BB. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
- CC. ASTM C1602/C1602M-22 - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

- DD. ASTM D226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
- EE. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
- FF. ASTM E96 - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.
- GG. ASTM E1155 - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers.
- HH. ASTM E1155 - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers.
- II. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
- JJ. ASTM E1745 - Standard Specifications for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
- KK. ASTM F710 - Standard Practice for Preparing Concrete Floor to Receive Resilient Flooring.
- LL. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- MM. National Ready Mix Concrete Association - Plant Certification Program.

### 1.03 QUALITY ASSURANCE

- A. All Concrete for the project shall be controlled concrete of specified strengths, of uniform color, and free from defects liable to adversely affect strength, durability or appearance of the structure or its components.
- B. Requirements of Regulatory Agencies: The quality and design of structural concrete shall comply with the requirements of the California Building Code, except where more stringent requirements are specified.
- C. Workmanship: Materials and methods used for the production and placement of concrete shall be such as to assure the specified quality and shall conform to applicable requirements of the Building Code for Reinforced Concrete (ACI 318) of the American Concrete Institute, except as otherwise specified in this Section.
1. All materials, components, assemblies, workmanship and installation are to be observed by the Owner's Project Inspector. Work not so inspected is subject to uncovering and replacement at no expense to the Owner.

2. Proper installation of partitions and equipment requires the floor finish to be level and smooth throughout. Extreme care shall be exercised during all floating and troweling operations to check levels often.
  3. Any concrete work which does not comply with tolerances and elevations shown on drawings will be cause for rejection of all work affected, and, if so rejected, such work shall be removed and replaced at no increase in cost to the Owner.
- D. Removal and replacement of Defective Concrete Surfaces shall be done in the following manner when, in the opinion of the Architect, such defects may be removed and replaced at no additional cost to the Owner.
1. Rock pockets, voids, spalls, cracks (superficial and structural) and exposed reinforcing shall be removed and replaced.
  2. Floor surfaces which exceed the allowable variation in plane or level as specified herein shall be ground, filled, or replaced to obtain the level and plane required. Fill materials, where required, shall be of type approved by the Architect.
  3. Surfaces which are not plumb and square, or which do not conform to the lines and levels indicated shall be removed and replaced.
- E. Uniformity of Concrete: All aggregates shall be measured by weight and the proportion of water to cement shall be accurately controlled by either automatic measuring devices or calibrated containers. All concrete placed shall be uniform strength and color appearance as well as surface texture.
- F. Screeds shall be provided at all construction joints as required to ensure installation of concrete to lines and elevations noted.
- G. Ready-Mixed Concrete: ASTM C94 / C94M-09a except as otherwise specified herein. Mix and deliver in accordance with the requirements set forth in ASTM C94 and ACI 301. Continuous Batch Plant inspection is required per CBC Section 1705A.3.3. Contractor may request waiver of batch plant inspection in accordance with CBC Section 1705A.3.3.1 provided the following is met:
1. Approved Testing Laboratory shall check the first batching for each class of concrete and furnish mix proportions to the Licensed Weighmaster.
  2. Licensed Weighmaster to positively identify materials as to quantity and to certify to each load by ticket.
  3. Ticket shall be transmitted to Project Inspector by truck driver with load identified thereon. Project Inspector will not accept load without load ticket identifying mix and will keep daily record of pours, identifying each truck, its load and time of receipt and will transmit two copies of record to the Division of the State Architect (DSA).
  4. Do not add water at the site to concrete mixes with a maximum specified WCR unless the water content at batch time provides for a WCR less than specified and this provision, including the quantity of water which may be added at the site, is specifically noted on the Mix Design and Certification by the mix preparer.
  5. At end of project, Weighmaster shall furnish affidavit to DSA on form satisfactory to DSA, certifying that all concrete furnished conforms in every particular and to proportions established by mix designs.



- H. Concrete Preplacement Inspection: Concrete shall not be poured until the forms, reinforcement, and preparations are complete and have been reviewed by the Project Inspector.
- I. Tests: For structural concrete, the Testing Lab shall take four (4) test cylinders of concrete each day for every 50 cubic yards of concrete or fraction thereof being placed. Cylinders shall be made and stored as per instructions given by the testing laboratory and shall be in accordance with ASTM Specifications C-31 / C31M-09 and C-39 / C39M-09a. Cylinders shall be tested for ultimate compressive strength of concrete with one cylinder tested at the age of 7 days and two (from the same batch) to be tested at the age of 28 days, with one cylinder held as a spare for future testing if needed. Tests shall be made by a recognized test laboratory selected by the Owner and approved by the Architect.
  - 1. Cylinders not meeting the required design stresses shall indicate defective concrete and such concrete shall be removed and replaced at no increase in cost to the Owner. Core tests requested by the Contractor to establish design stresses, when cylinder tests indicate defective concrete, shall be paid for by the Contractor.
  - 2. Batch plant inspection as required by the DSA Structural Tests and Inspections Form SSS 103-1.
- J. Floor Flatness: Provide certification of floor slab flatness per the requirements of Part 3 below.
- K. Preinstallation Meetings.
  - 1. Preinstallation Conference: Conduct conference at Project site.
    - a. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
      - 1) Contractor's superintendent.
      - 2) Independent testing agency responsible for concrete design mixtures.
      - 3) Ready-mix concrete manufacturer.
      - 4) Concrete Subcontractor.
      - 5) Special concrete finish Subcontractor.
      - 6) Inspector.
      - 7) Owner's Representative.
      - 8) Architect.
    - b. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, methods for achieving specified floor and slab flatness and levelness, floor and slab flatness and levelness measurement, and concrete protection.
    - c. Sign-in sheet shall be provided at time of meeting to document attendees.

#### 1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.

- B. Manufacturer's Data: Submit manufacturer's product data with application and installation instructions for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, joint systems, chemical floor hardeners, and others as may be requested by the Architect.
- C. Shop Drawings: Shop drawings sheet size shall be 24" x 30" minimum.
  - 1. Reinforcing Steel: The correctness of the bending diagrams is the responsibility of the Contractor. Identify such shop drawings with a reference thereon to sheet and detail numbers from the contract drawings. No reinforcing steel shall be fabricated without approved shop drawings.
  - 2. Construction joint layout per Part 3 below. Contractor to submit plan based upon design team's layout as shown on drawings. Provide verification that the joint layout will limit the risk of slab cracking. Plans shall include control, and expansion joints.
- D. Concrete Mix Design: Submit proposed mix design prepared by concrete supplier. Mix design must be submitted to Owner for review and acceptance by a recognized independent testing lab, for all structural concrete.
- E. Historical test data on all proposed mix designs including 28-day strength reports, and verification of aggregate and concrete shrinkage.
- F. Test reports for Floor Flatness and Floor Levelness shall be submitted for review after first slab has been poured and prior to subsequent slabs being poured.

#### 1.05 JOB CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required by construction activities.

### PART 2 – PRODUCTS

#### 2.01 CONCRETE MATERIALS

- A. Portland Cement: ASTM C150 / C150M-09, Type II, low alkali. All cement used shall be of one manufacturer.
  - 1. Use Type IIA cement if pumping of concrete is selected and permitted for placing of concrete.
  - 2. All cement shall contain not more than 0.6 percent total alkali when calculated as sodium oxide as determined by "Methods of Chemical Analysis of Hydraulic Cement", ASTM C114-09b.
- B. Blended Cement: ASTM C595/C595M-20, Type IL (MS or (HS)).
  - 1. All cement shall not contain more than 0.6 percent total alkali when calculated as sodium oxide as determined by "Methods of Chemical Analysis of Hydraulic Cement", ASTM C114-09b.
- C. Supplementary Cementitious Materials:

1. ASTM C618-19 Class N or Class F materials (Class C is not permitted).
  2. ASTM C989/C989M-18a Ground Granulated Blast Furnace Slag.
- D. Water: ASTM C1602/C1602M-22 Clean and free from deleterious amounts of acids, alkalis, salts and organic matter.
- E. Concrete Aggregates: ASTM C33 / C33M-08 except as otherwise specified hereinafter. All aggregates shall be nonreactive and nondegenerative, and shall consist of sound crushed rock, washed gravel, or a combination of both.
1. Aggregate size for structural slabs shall be 1-1/2 inch. Aggregate size for other structural concrete shall be between 3/4 inch and 1-1/2-inch maximum.
  2. Aggregate shall be saturated surface dry by batch plant.
  3. Modify fine aggregates when air entrained concrete is used in accordance with Paragraph 4.2.4 of ASTM C33 / C33M-08.
  4. Aggregate shall result in shrinkage of concrete not exceeding .048 percent at 28 days. Testing lab shall verify aggregate and concrete shrinkage.
  5. Do not use fine or coarse aggregates that contain substances that are known to cause spalling or adverse reactions in the concrete.
- F. Cementitious Materials:
1. Fly Ash: 40 percent replacement maximum.
  2. Slag Cement: 50 percent maximum.
  3. Combined Fly Ash and Slag Cement: 50 percent replacement maximum.
- E. Air Entraining Agents shall be used in concrete at the contractor's option. The maximum entrained air content shall be no more than 4 percent + 1 percent by volume. Sika AER, Master Builders Micro Air, Darex AEA, Protex AEA or approved equal meeting ASTM C260/C260M.
- F. Admixtures: Except for air entraining agents, and water-reducing admixtures, no other admixtures shall be used without written approval from the Architect. Where such agents are permitted, they shall be a type approved and used only as directed by the Architect and at no increase in cost to the Owner.
1. Calcium chloride will not be permitted for use in concrete under any circumstances.
  2. Air Entraining Agents: ASTM C260. Use where specified. The maximum entrained air content shall be no more than 4 percent + 1 percent by volume unless noted otherwise. Approved air entraining agents are Sika AER, Master Builders Micro Air, Darex AEA, Protex AEA or approved equal.
  3. Water Reducing Admixtures: ASTM C494 Type A, D, E, F, or G and ACI 318, Section 3.6. Use where specified.
  4. *Or as otherwise required by project conditions.*

## 2.02 CRUSHED ROCK BASE:

- A. Under all new concrete ramps and paving, or as otherwise indicated on the Drawings, provide a minimum of 4 inches of crushed rock fill. Crushed rock fill shall be clean gravel of 1" max. size and have no material passing through a No. 4 sieve.

**2.03 JOINT MATERIAL:**

- A. Provide 3/8" wide fiber expansion joint material, Model No. 320-F, as manufactured by W.R. Meadows or approved equal.
- B. Provide Snap-Cap as manufactured by W.R. Meadows or approved equal. Snap-Cap shall have a top plastic edge that can be used for leveling concrete. Once concrete has set up, top edge of Snap-Cap can be pulled free and discarded. Joint shall then be sealed.
- C. Joint sealing material shall be a two-component, self-leveling, polyurethane elastomeric sealant. Product shall be Sikaflex 2cSL as manufactured Sika Corporation, or equal. Color shall be chosen by Architect from the full range of manufacturer's standard colors.

**2.04 RELATED MATERIALS**

- A. Concrete Adhesive and Bonding Agent: "Concresive #1001-LPL" (1-1/2-hour maximum pot life), an epoxy polysulfide type concrete adhesive as manufactured by Master Builders or approved equal.
- B. Liquid Curing Compound: W.R. Meadows, Product: "Vocomp-20" or approved equal.
- C. Bonding Adhesive: White Cap Glue, Burke Bondcrete-S or approved equal; use as a modifier for patching and overlays up to 1/2" thick or approved equal.
- D. Doweling Epoxy: Hilti "HIT-RE 500" (ICC-ES ESR-3814), Simpson Strong-Tie "SET-3G" Epoxy (ICC-ES ESR-4057) or approved equal.
  - 1. Anchor rods shall be furnished with a 45-degree chisel point on one end to allow for easy insertion into adhesive filled hole and manufactured to meet the requirements of ASTM A36. Nuts and washers shall be furnished to meet the requirements of the anchor rod specifications noted above.
  - 2. Install per manufacturer's recommendation; use stainless steel for all exterior work.
  - 3. Testing required as noted in the Structural Drawings.
- E. Vapor Barrier: Stego Wrap, 15 mil. vapor barrier system, with a Class A rating, and perm rating not to exceed 0.01 perms; by Stego Industries of San Juan Capistrano, CA (877) 464-7834, VaporGuard by Reef Industries (713) 507-4250., Sundance 15 mil Vapor Barrier by Sundance Inc. (855) 300-7156, or 15 mil Husky, Yellow Guard, Vapor Barrier by Poly-America (800) 527-3322. No other substitutions will be accepted. System to include Stego Mastic, Stego "Crete Claw Tape" and pipe boots, or approved equal by the specified manufacturers. Conform to ASTM 1745.
- F. Patching Mortar: Meadow-Crete GPS, one-component, trowel applied, polymer enhanced, shrinkage-compensated, fiber reinforced, cementitious repair mortar for horizontal, vertical and overhead applications as manufactured by W.R. Meadows or approved equal.
- G. Non-shrink Grout: Masterflow 713 Plus by Master Builders or approved equal. Premixed, non-metallic, no chlorides, non-staining, and non-shrinking per CRD-C621, Corps of Engineers Specification and ASTM C 1107, Grades B and C.

**2.05 CONCRETE DESIGN**

- A. The concrete mix shall be proportioned to produce a minimum ultimate compressive strength at 28 days of 3,000 psi for structural concrete and 3,000 psi for all other concrete (Section 32 13 00) unless otherwise noted.

*Note to designer...While 3,000 psi is the District standard for all structural concrete, designer may modify if required to suite project specific structural design conditions.*

1. Laboratory Mix Design: Concrete designs, using Methods B or C, Section 1905.1.1 of the CBC, Title 24, shall be reviewed by the Testing Laboratory. The concrete mix designs reviewed by the Testing Laboratory and approved by the Project Architect or Structural Engineer shall be used by the Contractor. Contractor shall provide samples of aggregates as required by the laboratory to review the mix designs. Laboratory shall also include shrinkage tests.
  2. Water Reducing Admixture: All concrete shall contain a water reducing admixture.
  3. Air Entraining Agent: Include in all concrete in all exterior concrete to result in concrete at point of placement having an air entrainment of 4% (+/- 1%).
  4. Maximum water - cement ratio at point of placement: 0.45.
- B. Ready-Mixed Concrete: ASTM C94 / C94M-09a except as otherwise specified herein.
1. Transit-mixed concrete shall be mixed for a period of not less than 10 minutes at a peripheral drum speed of approximately 200 feet per minute, and mixing shall be continued until discharge is complete. At least 3 minutes of the mixing period shall be at the job. Transit mixers shall be equipped with water measuring devices consisting of either accurately calibrated water tanks or water meters.
  2. When outside air temperature is between 85 degrees and 90 degrees, reduce mixing and delivery time from 90 minutes to 75 minutes. When outside air temperature is above 90 degrees, reduce mixing and delivery time to 60 minutes.
- C. Job Mixing: The capacity of the mixer shall be such that it will handle one or more full sack batches. No split sack batches will be permitted except when all materials are weighed. The rated capacity of the mixer shall not be exceeded. The mixing drum shall be equipped with an automatic timing and locking device and with an accurate water gauge for measuring the amount of water used. Mixing time of each batch shall be at least 1-1/2 minutes after all ingredients are in the mixer.
- D. Slump of Concrete: The slump of concrete as determined by the Standard Test Method for Slump of Hydraulic Cement Concrete ASTM Designation C-143 / C143M-09 shall be as follows:
1. All Concrete: 4 inches maximum, plus/minus 1 inch (5 inch maximum).

### PART 3 – EXECUTION

#### 3.01 CONCRETE PLACEMENT

- A. Surrounding Conditions: Before any concrete is placed, the following items of work shall have been completed in the area of placing.
1. Forms shall have been erected, braced, cleaned, sealed, lubricated if required, and bulkheaded where placing is to stop.

- a. Any wood forms other than plywood shall be thoroughly water soaked before placing any concrete. The wetting of forms shall be started at least 12 hours before concreting.
  2. Reinforcing steel shall have been placed, tied, supported, and, at time concrete is placed around it, shall be cleaned of rust, scale, mill scale or other coatings that will destroy or reduce bond.
  3. Embedded work of all trades shall be in place in the forms, tied and braced.
  4. The entire place of deposit shall have been cleaned of dirt, chips, sawdust, rubbish, debris, hardened concrete, and other foreign matter before concrete is deposited therein. No wooden ties nor blocking shall be left in concrete except where indicated for attachment of other work.
  5. Concrete surfaces to which fresh concrete is to be bonded shall be roughened as indicated. Surfaces shall be brush cleaned to remove all dust and foreign matter and to expose the aggregate, and then coated with the bonding adhesive herein specified.
- B. Conveying Concrete from mixer to forms shall be as rapid as possible.
1. Ready-mixed concrete shall be mixed and delivered in accordance with ASTM C94 / C94M-09a. A delivery ticket shall be furnished for each load of ready-mix or transit-mix concrete. A copy of each delivery ticket shall be handed to the job superintendent at the time of delivery and unloading. A record copy of the delivery tickets shall be forwarded to the Architect for their files.
  2. Conveying equipment shall be of a sufficient capacity to ensure a continuous flow of concrete to the placing point without separation or loss of materials. Carts and buggies shall be equipped with pneumatic tires. Runway supports shall not bear on reinforcing or fresh concrete. All conveying equipment shall be thoroughly cleaned before beginning and at frequent intervals during the placing of the concrete.
    - a. Chutes, if employed, shall slope not less than 4" or more than 6" per foot of horizontal run.
  3. Exercise care not to spill concrete on forms & reinforcing steel during the conveying operations. Where such spillage or splattering occurs, the surfaces shall be thoroughly cleaned before concrete hardens.
- C. Placing Concrete: Notify the Architect 48 hours in advance of beginning of pouring operations. Under no circumstances shall concrete that has partially hardened be deposited on the work. No concrete shall be placed during rainy weather without the Architect's approval.
1. The Project Inspector shall keep a record on the site of the time and date of placing the concrete in each portion of the structure in accordance with CBC Section 1705A.3.6. The record shall be kept until the completion of the structure and a copy provided to the Architect and DSA.
  2. Before starting new pour on or against concrete that has hardened, forms shall be retightened, and the hardened concrete roughened and thoroughly cleaned of foreign matter and any laitance by sandblasting. Just ahead of the new pour, slush joints with a 2" layer of grout of the designated concrete mix minus 50 percent of the large aggregate.
  3. Reinforcing steel exposed to the sun shall be cooled by a water spray prior to the placing of concrete.
  4. No adjustment of steel reinforcement will be permitted during the placement of concrete.

5. Concrete shall be scheduled so that the placing is a continuous operation for the completion of each section between predetermined construction joints. If a planned concreting operation cannot be carried on continuously, the concreting shall stop at temporary bulkheads. Locate where resulting construction joints shall be as shown on the Drawings or as approved by the Architect. Prior to placing of concrete for any concrete slabs, the moisture content of the subgrade below the slabs shall be adjusted to at least optimum moisture.
6. Deposit the concrete in forms as nearly as practicable in its final position to avoid flowing and maintain until completion of the unit an approximate horizontal plastic surface. Thoroughly compact all concrete during placing operations, thoroughly around reinforcement, embedded fixtures, or accessories, and into the corners of forms to eliminate air pockets and honeycombing. Compacting shall be done with mechanical vibrators. Vibrators shall not be used to cause concrete to flow horizontally. Thoroughly compact concrete to the forms to release the air and secure full contact of the concrete with the forms.
7. Hot Weather Concreting: Concrete placing and finishing operations during hot weather shall be done as quickly as possible. Ample personnel shall be available to manage and place the concrete immediately after its mixing or delivery to the site of the work. Concrete shall be placed in layers thin enough and over areas small enough to ensure complete bond and union of adjacent layers, and thus prevent "cold joints".
  - a. At air temperature of 80 degrees Fahrenheit or above, the following precautions should be taken:
    - 1) In no case shall the temperature of the concrete exceed 90 degrees Fahrenheit when placed in the work.
    - 2) If necessary, to produce and maintain concrete at an acceptable temperature, chopped or crushed ice shall be added directly into the mixer up to 50 percent by weight of the mixing water used, the weight of the ice being included in batch weight of the mixing water. The ice shall be added at such a rate and in such a manner that it will be completely melted by the time concrete is mixed.
    - 3) Stockpiled aggregates shall be saturated and kept surface moist by continuous fog spray or by intermittent sprinkling.
    - 4) Forms, reinforcements, and subgrade surfaces shall be wet down immediately before concrete is placed in contact therewith. Remove all excess water before placing concrete. Wetting down of areas around the work to cool the surrounding air and increase the humidity is recommended.
8. Cold Weather Requirements: Do not place concrete when ambient temperature is below 40 degrees Fahrenheit and falling.

### 3.02 CONCRETE FINISHING

- A. All Concrete Work, except as otherwise specified, shall be of a quality that will present a finished appearance upon the stripping of the forms. Only a minimum of patching and finishing should be necessary as required to fill holes left by form ties and to remove any fins or minor irregularities left by the joints in the forms. Except as otherwise specified, all concrete surfaces shall be finished as follows:
- B. Float finish: Begin float finish when bleed water sheen has disappeared, and the concrete surface has stiffened sufficiently to permit operations. Float surface with power driven floats, or by hand-

floating if area is small or inaccessible to power units. Finish surfaces to true planes within a tolerance as specified in 3.04-C. Cut down high spots and fill low spots. Refloat surface immediately to a uniform granular surface.

1. Final Finish: Provide a medium textured broom finish for all exterior surfaces by drawing a soft bristle broom across concrete surface perpendicular to line of traffic to provide a uniform fine line texture finish.
2. No magnesium bull floats allowed on non-air entrained concrete.

C. Floor Flatness and Floor Level Tolerances:

1. An independent testing agency will inspect finished slabs for compliance with specified tolerances.
2. Minimum F(F) Floor Flatness and F(L) Floor Levelness Values at slabs on grade and shored slabs:
  - a. Exposed to View and Foot Traffic: F(F) of 35; F(L) of 25.
  - b. Under Thick-Bed Tile: F(F) of 20; F(L) of 15.
  - c. Under Carpeting: F(F) of 25; F(L) of 20.
  - d. Under Thin Resilient Flooring and Thinset Tile: F(F) of 35; F(L) of 25.
3. Measure F(F) Floor Flatness and F(L) Floor Levelness in accordance with ASTM E1155 (ASTM E1155M), within 72 hours after slab installation; report both composite overall values and local values for each measured section.
4. Correct the slab surface if composite overall value is less than specified and if local value is less than two-thirds of specified value or less than F(F) 13/F(L) 10.
5. Correct defects by grinding, floating with leveling compound, or by removal and replacement of the defective work. Areas requiring corrective work to be identified by Contractor and a repair/replacement plan shall be submitted for review by Architect. Re-measure corrected areas by the same process.

D. Curb Finishing: Steel trowel as described for slab finishing above.

E. Final Tooling: Tool edges of paving, gutters, curbs, and joints formed in fresh concrete with a jointing tool to a radius of 1/4". Repeat tooling of edges and joints after applying surface finishes. Eliminate tools marks on all concrete surfaces.

F. Forms shall remain in place for not less than the following periods of time. These periods represent minimum cumulative number of days during which temperature of air in contact with concrete is 60 degrees F and above.

1. Vertical forms of foundations and walls: 5 days.
2. Slab edge screens or forms: 2 days.
3. Concrete columns and beam soffits: 28 days.

### 3.03 CONSTRUCTION JOINTS

A. NO SOFTCUT (SAWCUT) CONTROL JOINTS ALLOWED.



- B. Construct contraction, construction, and isolation joints true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to the centerline unless otherwise indicated.
  - C. Joints at Existing Concrete: All joints between existing concrete and new concrete or at sawcut locations through existing slabs are to include dowels at a minimum of #4 bars @ 4'-0" on center, 18" maximum from the ends, epoxy set into existing concrete a minimum of 6" in length at the centerline of existing concrete slab.
  - D. Contraction Joints (Control Joints): Provide weakened-plane contraction joints, sectioning concrete into areas indicated. Construct contraction joints for a depth equal to at least 1/4 of the concrete thickness unless otherwise noted on drawings. Form in fresh concrete by grooving and finishing each edge of joint with a radiused jointer tool. **Joints to be spaced at 10' on center maximum or as shown on the drawings.**
  - E. Construction Joints: Set construction joints at side and end terminations of concrete placement and at locations where placement operations are stopped for more than 1/2 hour unless placement ends at isolation joints.
    - 1. Provide preformed galvanized steel or plastic keyway-section forms or bulkhead forms with keys. Use Burke "Keyed Kold Joint Header Form" or approved equal. Embed keys at least 1 1/2" into concrete.
    - 2. Provide slip dowels across construction joints.
  - F. Isolation Joints (Expansion Joints): Form isolation joints of performed joint filler strips abutting concrete curbs, catch basin, utility access holes, inlets, structures, walks, other fixed objects, and where indicated.
    - 1. Extend joint fillers full width and depth of joint, not less than 1/2" or more than 1" below finished surface where a joint sealant is indicated. Place top of removable joint filler flush with finished concrete surface.
    - 2. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary, removable performed cap.
    - 3. After concrete has cured, remove cap exposing top edge of fiber joint filler, and apply joint sealant.
- 3.04 PUMPING OF CONCRETE (may be permitted for concrete, providing):
- A. The Contractor engages a testing laboratory to design concrete mixes for pumping. Trial batches shall be made and tested as required hereinbefore for typical concrete.
  - B. The quality and proportioning of aggregates for pumping conditions shall be determined in accordance with ACI, Recommended Practice 613. Aggregate proportioning must be tailored to the pump intended for use.
  - C. When starting a pump operation, actual pumping of concrete shall be preceded by a mortar mix (concrete without coarse aggregate) for the purpose of lubrication.
  - D. All mortar and concrete leakage resulting from pumping operations shall be removed from formwork, reinforcing steel and any finished surface.

### 3.05 CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperature. Comply with the recommendations of ACI 306R for cold weather protection and ACI 305R for hot weather protection during curing.
- B. Evaporation control is to be implemented in hot, dry and windy weather by protecting concrete from rapid moisture loss before and during finishing operations with an evaporation control material. Apply in accordance with manufacturer's instructions after screeding and bull floating, but not before floating.
- C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- D. Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination.
  - 1. For moisture-curing, keep surfaces continuously moist for not less than 7 days with water, a continuous water-fog spray, or absorptive cover kept wet continuously wet.
  - 2. For moisture-retaining-cover, cover concrete with moisture retaining cover with side and end laps sealed.
  - 3. For curing compound, apply in accordance with manufacturer's instructions. Recoat areas subjected to rainfall within 3-hours after initial application.

### 3.06 CLEANING AND PROTECTION

- A. Clean all surfaces and leave in satisfactory condition to receive final finish surface treatment.
- B. Protect concrete surfaces from damage by tools, equipment, material, and workers. No traffic, shoring or other loading will be permitted until concrete has hardened sufficiently to prevent injury to finish and strength, but at least 14 days.
  - 1. Remove surface stains and spillage of materials as they occur.
  - 2. Sweep concrete and wash free of stains, discolorations, dirt, and other foreign material prior to final inspection.

### 3.07 INSPECTION

- A. Approval of reinforcing steel, after installation, must be received from Project Inspector. Architect, Structural Engineer, and DSA must be notified 48 hours in advance of beginning concrete placement operations. Inspection of welding will be done by laboratory.
- B. There will be initial or preliminary inspection of the finished concrete slabs by the Project Inspector and/or Architect for overall finish.
- C. Slabs shall be measured for FF and FL as required by 3.02-C and findings submitted to Architect.
- D. New pours will be reviewed for cracks. If during this inspection, cracked sections are found and determined unacceptable by the District, that section should be removed and replaced.

- E. Final concrete inspection: Prior to occupancy, concrete will be reviewed by Owner and Architect. If any cracks, spalls, exposed finish layer separation, etc. are identified, that section(s) shall be removed and replaced.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2025-01-31 – Added new section needed to complement SS 04 22 00.
- 

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

## SECTION 04 10 00

## MORTAR AND GROUT

**PART 1 - GENERAL****1.01 SUMMARY****A. Section Includes:**

1. Provide all materials, labor and accessories as required and specified for complete mortar and grout installation in masonry walls.

**B. Related Work:**

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 03 20 00: Concrete Reinforcing.
3. Section 03 30 00: Cast-in-Place Concrete.
4. Section 04 22 00: Concrete Unit Masonry.
5. Section 31 16 00: Site Concrete.

**1.02 QUALITY ASSURANCE****A. Standards and References: (Latest Edition unless otherwise noted)**

1. ASTM C144, Aggregate for Masonry Mortar.
2. ASTM C150, Portland Cement.
3. ASTM C207, Hydrated Lime for Masonry Purposes
4. ASTM C404, Aggregates for Grout
5. ASTM C1019, Method of Sampling and Testing Grout
6. ACI 530/ASCE 5, Building Code Requirements and Specification for Masonry Structures
7. 2022 California Building Code (CBC), Volumes 1, 2, 3, with State of California Amendments

**B. Tests and Inspections:**

1. All tests and inspections herein are to be performed by an independent testing laboratory approved by the building official.
2. Mortar and Grout Tests: At the beginning of Masonry Work, at least 1 test sample each of mortar and grout shall be taken on 3 successive working days, then once per week with at least one sample taken for each 5000 square feet of wall area, or fraction thereof.
  - a. Test specimens shall be made in accordance with CBS Section 2105A.2.
  - b. Test specimens shall be continuously stored in moist air until tested.
  - c. Mortar shall show a compressive strength of not less than 1800 psi at 28 days. Grout shall show a compressive strength of not less than 2000 psi at 28 days.
3. A special inspector shall be employed per CBC Section 1704A.5 during the placement of all units, placement of all reinforcing steel, during all grouting operations and during taking of all test specimens.

**C. Submittals:**

1. Mix design for mortar and grout shall be submitted for review.
2. Supplier's certificates indicating materials comply with the specifications below. They shall include but are not necessarily limited to:
  - a. Aggregates
  - b. Cement
  - c. Admixtures
3. Color samples of manufacturer's full range of standard colors.

## **PART 2 - PRODUCTS**

### **2.01 MATERIALS**

- A. Cement: ASTM C 150, Type I or II, low alkali; natural gray.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Quicklime: ASTM C 5, non-hydraulic type.
- D. Lime Putty: Made from hydrated lime or quicklime.
  1. If made from quicklime, other than processed pulverized quicklime, slake lime and then screen through a No. 16 mesh sieve. Before using, store and protect slaked and screened lime putty for not less than 10 days.
  2. Processed pulverized quicklime shall be slaked for not less than 48 hours, and shall be cool when used.
  3. Lime putty prepared from hydrated lime may be used immediately after mixing.
  4. Lime putty prepared from quicklime or pulverized quicklime shall have a plasticity figure, after slaking and screening, of not less than 200, and shall weigh not less than 83 lbs. per cubic foot. Lime putty prepared from hydrated lime shall conform to ASTM C 207, Type S.
- E. Aggregate:
  1. For Mortar: ASTM C144.
  2. For Grout: ASTM C404, evenly graded with 3/8" maximum size.
- F. Admixture: "Sika Grout Aid"
- G. Water: Suitable for domestic consumption.
- H. Colorant: Basalite Color, Davis Color, or equal. Allow for multiple grout colors which shall correspond to each CMU type used. Unless otherwise indicated on the drawings, exposed grout shall best match adjacent CMU color. Grout colors will be selected by Architect at time of submittal.

### **2.02 MORTAR**

- A. Mortar shall be Type S having a 28 day compressive strength of not less than 1800 psi, and shall conform to ASTM C 270, Type S.
- B. Mortar shall be made with admixtures that are proportioned, added and mixed in strict accordance with manufacturer's directions.

- C. Mortar mix shall be proportioned by volume; one part portland cement, not less than 1/4 part nor more than 1/2 part lime putty, and sand totaling not less than 2 1/4 nor more than 3 times sum of volumes of cement and lime used.
  - 1. Total clay content shall not exceed 2% of sand content or 6% of cement content.
- D. Mortar at exposed, unfinished masonry shall be Basalite No. S296 (green) and S205 (white) to match or as otherwise selected by Architect to best match block colors.

## 2.03 GROUT

- A. Grout (per ASTM C476) shall have a 28-day compressive strength of not less than 2000 psi. Proportion by volume, and with sufficient water to produce consistency for pouring without segregation so that grout will flow into masonry joints. Grout shall conform to CBC Section 2103A.13.
- B. Fine Grout: 1 part portland cement, to which may be added not more than 1/10 part lime putty, and 3 parts sand.
  - 1. Fine grout shall be used for all grout spaces less than 3" wide.
- C. Coarse Grout: 1 part portland cement, to which may be added not more than 1/10 part lime putty, 3 parts sand and not less than 1 part nor more than 2 parts pea gravel (3/8" maximum aggregate size).
  - 1. Coarse grout shall be used in grout spaces 3" wide or more.
- D. Add "Sika Grout Aid" admixture to grout at the rate of 1 pound per 100 pounds cementitious material.

## PART 3 - EXECUTION

### 3.01 MIXING MORTAR AND GROUT

- A. Accurately measure materials in suitably calibrated devices; shovel measurements are not acceptable. Each 94lb. sack of portland cement will be considered as 1 cubic foot.
- B. Place sand, cement and water in mixer in that order and mix for at least 2 minutes; then add lime putty and continue mixing as long as necessary to secure a uniform mass, but in no case less than 10 minutes.
- C. Use mixers of at least 1 sack capacity; batches requiring fractional sacks will not be permitted unless cement is weighed for each batch.

### 3.02 GROUTING PROCEDURES

- A. Specified under Sections 04 22 00.

### 3.03 RETEMPERING

- A. When necessary to retemper mortar, add water and remix; retempering by dashing water over mortar will not be permitted.
- B. Any mortar or grout which is unused within 30 minutes after initial mixing and any mortar or grout that has begun to set shall not be used.

#### 3.04 DEFECTIVE MORTAR OR GROUT

- A. Should the strength of mortar or grout fall below that specified, remainder of Work shall be adjusted to reach required strength. Work in place representing inferior grout and mortar and indicating a strength less than the minimum specified shall be tested by taking and testing core samples. Number and location of cores shall be determined by Structural Engineer.
- B. Should compression tests of cores fail to meet required strength, masonry shall be deemed to be defective and shall be removed and replaced at no cost to Owner.
- C. Costs relative to taking and testing of core samples shall be paid by Owner and will be deducted from Contract Amount. Cost of patching core holes shall be borne by Contractor.

END OF SECTION



## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 2025-01-31 – Minor edits. Removed old astm information and means&methods requirements.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- District has no requirements for block sealer. Designer shall determine if block sealer is required for each project. References to sealer spec section is highlighted in spec section for coordination.

SECTION 04 22 00

CONCRETE UNIT MASONRY

**PART 1 - GENERAL**

**1.01 SUMMARY**

**A. Section Includes:**

1. Furnish and install all concrete unit masonry, reinforcement, and all required accessories and materials as shown on the Drawings and specified here.
  - a. Coordinate with other trades for embedded items, furnished under those sections and installed here.
  - b. Supervise setting of dowels for masonry furnished and installed under Section 03 21 00, Reinforcing Steel.

**B. Related Work:**

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Reinforcing Steel: Section 03 21 00.
3. Cast-in-Place Concrete: Section 03 30 00.
4. Mortar and Grout: Section 04 05 00.
5. Structural Steel: Section 05 12 00.
6. Water Repellants and Anti-Graffiti Coatings: Section 07 19 00.

**1.02 QUALITY ASSURANCE**

**A. Allowable Tolerances:** Place masonry in accordance with section 3.3B.

**B. Standards and References:** (Latest Edition unless otherwise noted):

1. California Building Code (CBC) with State of California Amendments.
2. TMS 402-16 – Building Code Requirements for Masonry Construction
3. TMS 602-16 – Specification for Masonry Structures
4. ASTM C90 – Specification for Loadbearing Concrete Masonry Units
5. ASTM C140 – Standard Test Methods for Sampling and Testing of Concrete Masonry Units and Related Units

**C. Manufacturer Qualifications:** Company specializing in manufacturing the type of products specified in this section with minimum three years of documented experience.

**D. Installer Qualifications:** Company specializing in performing work of the type specified and with at least three years of documented experience.

**E. Tests and Inspections:**

1. A testing program is required prior to start of construction. Testing program to be done in Compliance with the CBC requirements and in collaboration with Testing Laboratory, Design team, contractor, owner and submitted for review by the agency in charge of building

enforcement. Requirements below are minimum requirements; additional requirements may be required in final testing program.

2. All tests and inspections herein are to be performed by an independent testing laboratory approved by the enforcement agency.
3. Sample panel construction: For masonry governed by Level 2 or 3 Quality Assurance, construct sample panels of masonry walls per TMS 602 Article 1.6 D. The specifier has the option of permitting a segment of the masonry construction to serve as a sample panel or requiring a separate stand-alone panel.
4. Test three sample units prior to construction. Test also three sample units during construction for every 5,000 square feet of wall area.
  - a. Units will be tested for compressive strength on both the net and gross area per ASTM C140.
5. A special inspector shall be employed per CBC Section 1705A.4 to inspect the placement of all units, placement of all reinforcing steel, during all grouting operations and during taking of all test specimens.
6. Core Testing: Not less than two cores per 5,000 square feet of floor area or wall area, whichever is greater and at least two cores from each building or structure. Core in locations approved by the Architect and test per CBC Section 2105A.4. Repair holes as directed by the Architect.
7. See Section 03 21 00 for reinforcing steel tests and inspections.

#### 1.03 SUBMITTALS

- A. Product Data: Provide data for masonry units, fabricated wire reinforcement, and masonry accessories.
- B. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners.
- C. Samples: Submit four samples of decorative block units to illustrate color, texture, and extremes of color range.
- D. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
- E. Test Reports: Concrete masonry manufacturer's test reports for units with integral water repellent admixture where utilized.
- F. Manufacturer's Qualification Statement.
- G. Installer's Qualification Statement.
- H. Supplier's certificate indicating units comply with material standards indicated below:

#### 1.04 MOCK-UPS

- A. Sample panel construction: For masonry governed by Level 2 or 3 Quality Assurance, construct sample panels of masonry walls per TMS 602. The specifier has the option of permitting a segment of the masonry construction to serve as a sample panel or requiring a separate stand-alone panel.
- B. Locate where directed.

#### 1.05 PRODUCT HANDLING

- A. Store masonry units off the ground in a dry location, covered and protected from absorbing moisture.

- B. Store masonry accessories, including metal items, in such a way as to prevent corrosion or accumulation of dirt and oil.

## **PART 2 - PRODUCTS**

### **2.01 MASONRY UNITS**

- A. Masonry units shall be hollow load bearing masonry units conforming to ASTM C90 and CBC Section 2103A.1.
  - 1. Basis of Design: Basalite Concrete Products LLC, Dixon, California.
  - 2. Weight: Medium weight.
  - 3. Twenty-eight-day compressive strength of 2000 psi.
  - 4. Moisture controlled units.
- B. Unit Types – All block colors are from the Basalite Dixon, California plant:
  - 1. Type 1 – Body Color: 8" wide by 8" high x 16" long unless specified otherwise. Equal to Basalite No. D113, split face finish.
  - 2. Type 2 – Light Accent Color: 8" wide by 8" high x 16" long unless specified otherwise. Equal to Basalite No. D325 split face finish.
  - 3. Type 3 – Dark Accent Color: 8" wide by 8" high x 16" long unless specified otherwise. Equal to Basalite No. 498 ground face.
  - 4. Where block will be painted or otherwise completely unexposed on both sides, manufacturer's basic grey block may be used.
- C. Provide corners, ends and other specialty units at exposed locations to match block types specified herein and as required to match coursing patterns indicated on the Drawings.
- D. Provide bond beam units, open end units, lintel units and other special units as indicated. Use open end units at cells containing vertical reinforcement per CBC 2104A.1.3.1.2.1.
- E. Where smooth-faced block may be required to accommodate signage, light fixtures, fire alarm devices, or other components, the specified block pattern and unit locations may be modified, or the specified split-face blocks may also be ground at these locations. Confirm all proposed revisions to the indicate block pattern with Architect prior to installation.

### **2.02 MORTAR AND GROUT**

- A. Specified under Section 04 05 00.

### **2.03 ACCESSORY MATERIALS**

- A. Reinforcing Bars: ASTM A615, Grade 40 or 60, as indicated in Section 03 21 00, deformed bars. Where bars are to be welded, ASTM A706 Grade 60 bars shall be used.
  - 1. Tie Wire: Black annealed steel wire not lighter than 16 gauge.
- B. Ladder-type Joint Reinforcing: ASTM A951. Ladder-type joint reinforcing shall be comprised of 9-gauge side rods and 9-gauge cross-rods at 16" on center and shall conform to ASTM A951. Cross-rods

- are to be butt welded to side rods. Ladder-type joint reinforcement shall be hot dip galvanized or stainless steel.
1. Width: Fabricate joint reinforcement in units with widths a minimum of 2" less than nominal width of walls. Provide mortar coverage over joint reinforcement of not less than 5/8" on joint faces exposed to exterior and 1/2" elsewhere.
- C. Provide spacers to firmly hold reinforcement in place.
- D. Anchor Bolts: All anchor bolts cast in masonry shall be headed studs or headed bolts with cut threads conforming to ASTM F1554 Grade 36 or ASTM A307 or ASTM A36 as indicated on drawings.
- E. Expansion Anchors: All expansion bolts installed in masonry shall be Hilti Kwik Bolt 3 per ICC ESR-1385, Simpson Wedge-All per ICC ESR-1396 or Dewalt/Powers Power-Stud+ SD1 per ICC ESR-2966. See Structural Drawings for installation requirements, testing and special head requirements as applicable. Substitution of other brands or anchors shall proceed only after written approval from the Structural Engineer and the Building Official has been obtained.
- F. Adhesive Anchors: All drill and epoxy threaded rods shall be ASTM F1554 Grade 36 or Grade 50, as indicated on drawings, and installed in masonry with Hilti HIT-HY 270 per ICC ESR-4143, Simpson SET-XP per UES ER-265 or Dewalt / Powers AC100+ Gold per ICC ESR-3200. See Structural Drawings for installation requirements, testing and special head requirements as applicable. Substitution of other brands or anchors shall proceed only after written approval from the Structural Engineer and the Building Official has been obtained.
- G. Screw Anchors: All screw anchors installed in masonry shall be Hilti Kwik HUS-EZ per ICC ESR-3056, Simpson Titen HD per ICC ESR-1056 or Dewalt/Powers Screwbolt+ per ICC ESR-4042. See Structural Drawings for installation requirements, testing and special head requirements as applicable. Substitution of other brands or anchors shall proceed only after written approval from the Structural Engineer and the Building Official has been obtained.
- H. Anchor Finish:
1. Interior Exposure: All anchors, nuts and washers for use in interior environments free of potential moisture shall be manufactured from carbon steel and zinc coated.
  2. Exterior or Exposed Use: All anchors, nuts, and washers for use in exposed or potentially wet environments, or for attached of exterior cladding materials shall be galvanized or stainless steel. Galvanized anchors, nuts and washers shall conform to ASTM A 153. Stainless steel anchors shall be manufactured from 300 series stainless steel. and nuts and washers from 300 series or Type 18-8 stainless steel.
- I. Non-Metallic Expansion Joint Strips: Pre-molded, flexible cellular neoprene rubber filler strips complying with ASTM D1056, Grade RE 41E1, capable of compression up to 35% of width and thickness indicated.
- J. Pre-molded Control Joint Strips: Material as indicated below, designed to fit standard sash block and maintain lateral stability in masonry wall; size and configuration as indicated.
1. Pre-molded PVC Control Joint Strips. Strips shall be I chloride complying with ASTM D 2287, Type PVC 654-4 with a durometer hardness or 90.

## 2.04 JOINTS

- A. All joints shall be 3/8" thick joints for concrete block. Tool exposed interior and exterior joints and concealed exterior joints to produce a dense slightly concave surface that is well bonded to unit at edges. Tool joints behind room base, switches, and outlet plates to produce a smooth dense joint flush with the face of adjacent masonry units, where occurring on the job. Cut joints flush on concealed interior surfaces and surfaces to be plastered.

## 2.05 SEALER

- A. Refer to Section 07 19 00, Water Repellants and Anti-Graffiti Coatings for sealing requirements for all exterior exposed block surfaces.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Examine areas to receive masonry and verify following:
  - 1. That foundation surface is level to permit bed joint with range of 1/4 minimum to 3/4 inch maximum for partially grouted or 1-1/4" maximum for fully grouted.
  - 2. That edge is true to line to permit projection of masonry to less than 1/4 inch.
  - 3. That projecting dowels are free from loose scale, dirt, concrete, or other bond inhibiting substances and properly spaced and located.
- B. Do not begin work before unsatisfactory conditions have been corrected.

### 3.02 PREPARATION

- A. Clean concrete surfaces to receive masonry. Remove laitance or other foreign material lodged in surfaces by sandblasting or other means as required. Joints between concrete and masonry shall be considered construction joints. See Concrete specifications.
- B. Ensure masonry units are clean and free from dust, dirt, or other foreign materials before laying. Do not use damaged masonry units, damaged components of structure, or damaged packaged materials.
- C. Establish lines, levels, and coursing. Protect from disturbances.
- D. Provide temporary bracing during erection of masonry work. Maintain in place until masonry has set to provide permanent bracing.

### 3.03 COURSING

- A. Erect masonry in accordance with CBC Section 2104A.1.
- B. Place masonry to lines and levels indicated to the following tolerances:
  - 1. Variation from Unit to Adjacent Unit: 1/32 inch max.
  - 2. Variation from Plane of Wall: 1/4 inch in 10 feet.
  - 3. Variation from Plumb: 1/4 inch.
  - 4. Variation from Level Coursing: 1/8 inch in 3 feet; 1/4 inch in 10 feet; 1/2 inch maximum.
  - 5. Variation of Joint Thickness: 1/8 inch in 3 feet.

- C. Bond: Block shall be laid in a stacked bond pattern with vertical and horizontal joints aligned.
- D. Maintain masonry courses to uniform width. Make vertical and horizontal joints equal and of uniform thickness.
- E. Preserve the vertical continuity of cells in concrete unit masonry per Article 3.3E of TMS 602.

#### 3.04 PLACING AND BONDING

- A. Do not install cracked, broken or chipped masonry units.
- B. Lay only dry concrete masonry units. Do not wet concrete masonry prior to laying up units unless written permission is obtained from the Engineer.
- C. Lay masonry in full bed of mortar, properly jointed with other work. Deep or excessive furrowing of mortar joints is not permitted.
  - 1. Block Cap: Lay with full mortar coverage on horizontal and vertical joints.
  - 2. Install grout cap where and as indicated.
- D. Fully bond intersections and external and internal corners.
- E. Do not shift or tap masonry units after mortar has taken initial set. Where adjustment must be made, remove mortar and replace.
- F. Remove excess mortar.
- G. Perform job-site cutting with proper tools to provide straight unchipped edges. Take care to prevent breaking masonry unit corners or edges. Install cut units with cut surfaces and, where possible, cut edges concealed.
- H. Step back unfinished work for joining with new work. Do not use toothing.
- I. Provide cleanouts as indicated in "grouting" below.
- J. Matching Existing Masonry Work: Match coursing, bonding, color and texture of new masonry work with existing work wherever possible.

#### 3.05 JOINTS

- A. Horizontal and vertical joints at masonry units shall be 3/8 inch wide and as follows:
  - 1. Point joint tight in unpurged masonry below ground.
  - 2. All end joints shall be fully filled with mortar and joints squeezed in bed joints shall be held back approximately 1/8 inch from cell to provide positive bond with grout.
  - 3. Joints shall be struck flush at all areas to receive plaster, stucco and any other finish material other than paint.

#### 3.06 MASONRY REINFORCEMENT

- A. Place reinforcement in accordance with Article 3.4 B of TMS 602.

- B. Reinforcing steel shall not be bent or straightened in a manner that will damage the material. Bars with kinks or bends not shown on the plans shall not be used. Heating of bars for bending is not permitted.
  - 1. Bars shall conform accurately to the sizes, shapes, lines and dimensions shown on drawings and with hooks and beds made as detailed. Bars shall be placed as indicated on the drawings and centered on grout space.
  - 2. At the time grout is place around it, reinforcing steel shall be clean of mill scale or other coatings that will destroy or reduce bond.
  - 3. All vertical reinforcing steel shall be installed in one piece whenever practical, full height of wall, and braced throughout its height in a manner that will retain the steel in proper position and provide the proper clearance.
- C. Foundation dowels that interfere with unit webs are permitted to be bent to a maximum of 1 inch horizontally for every 6 in of vertical height.
- D. Reinforcing steel shall be secured to all foundation dowels and held in place at spacing not to exceed 192 bar diameters.

### 3.07 GROUTING

#### A. General Requirements:

- 1. All cells shall be grouted solid.
- 2. Use low lift or high lift grouting at Contractor's option.
- 3. Use grout pump, hopper or bucket to place grout.
- 4. Place grout in final position within 1 1/2 hours after introduction of mixing water.
- 5. Stop grout approximately 1½ inches below top of last course, except at top course bring grout to top of wall. Do not form grout keys within beams.

#### B. Low Lift Grouting:

- 1. Do not lay units higher than 48 inches before grouting.
- 2. If mortar has been allowed to set prior to grouting, remove all fins protruding more than ½ inch into grout space.
- 3. Conform to requirements of CBC Section 2104A.1.3.1.2.2.
- 4. Consolidate each lift with mechanical vibration twice per Article 3.5 E of TMS 602. Once while placing grout and once more after initial absorption of water but before set.

#### C. High Lift Grouting:

- 1. Conform to requirements of CBC Section 2104A.1.3.1.2.3 and DSA IR 21-2.13.
- 2. Lay up walls, subject to maximum height limitations of Table 6 under Article 3.5 of TMS 602.
- 3. Provide clean out holes at the bottom of every pour in cells containing vertical reinforcement per CBC 2104A.1.3.1.1.2.3. Construct clean out courses with open bottom bond beam units inverted to permit cleaning of all cells by flushing. Cleanouts shall be not less than 3x4inch openings cut from one face shell. Do not plug clean out holes until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected.
- 4. Clean mortar droppings from the bottom of the grout space and from reinforcing steel. Remove mortar fins protruding more than ½ inch into the grout space by dislodging the projections with a



rod as the work progresses or by washing the grout space at least twice a day during erection using a high-pressure stream of water.

5. Do not place grout in hollow unit masonry until mortar joints have set for at least 24 hours and clean out plugs have cured 24 hours.
6. Place grout in lifts not to exceed 4 feet in height, with a waiting period between lifts, dependent on weather and absorption rate of the masonry, in order to place the succeeding lift after the preceding lift becomes plastic but prior to initial set. The first lift shall be consolidated using mechanical vibrators. After the required waiting period, place the second lift and consolidate with the vibrator, reconsolidating the lift below to a depth of 12 to 18 inches. Repeat the waiting, placing and consolidating process until the top of the grout pour is reached. Reconsolidate the top lift after the required waiting period. The high lift grouting of any section of wall between lateral flow barriers shall be completed to the top of a pour in one working day unless a new series of clean out holes is established and the resulting horizontal construction joint cleaned.

### 3.08 WEATHER PROVISIONS FOR CONSTRUCTION

- A. Cold Weather Construction to be in accordance with Article 1.8 C of TMS 602.
- B. Hot Weather Construction to be in accordance with Article 1.8 D of TMS 602.

### 3.09 EXPANSION AND CONTROL JOINTS

- A. See drawings for type and location of expansion and/or control joints.
- B. Where control joints are not indicated on the drawings the Contractor shall submit a proposed control joint layout for Architect and Engineer approval. General guidelines for control joint locations are as follows:
  1. At major changes in wall height.
  2. At changes in wall thicknesses.
  3. At corresponding control joints in foundations, floors, or roof construction.
  4. Near wall intersections.
  5. At column centerlines.
- C. Maximum Spacing: Maximum control joint spacing in concrete masonry construction shall be such that the ratio of wall length to height shall not exceed 1.5 with a maximum spacing of 25 feet.

### 3.10 BOND BEAMS

- A. Bond beams shall be located where shown and detailed on the drawings, and shall be reinforced as indicated and as herein after specified.

### 3.11 BUILT IN WORK

- A. Miscellaneous Embedded Items: All items indicated to be embedded in masonry shall be carefully located and anchored to prevent movement during grouting operations. Solidly grout spaces around built-in items. Consult other trades in advance and make provisions for installation of their work to avoid cutting and patching. Install chases minimum of one full masonry unit length for jambs.

### 3.12 CUTTING AND FITTING

- A. Obtain approval prior to cutting or fitting any area not indicated or where appearance or strength of masonry work may be impaired.

### 3.13 REPAIR, POINTING AND CLEANING

- A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units.
- B. Pointing: During the tooling of joints, enlarge any voids or holes and completely fill with mortar.
- C. Dry brush masonry surface after mortar has set at each day's work and after final pointing.
- D. Leave work and surrounding surface clean and free of mortar spots and droppings.
- E. Cleaning: Upon completion of masonry installation, repair all holes. Defective joints shall be cut out and rejointed. Exposed masonry surfaces shall be cleaned free of mortar, green stain and efflorescence.

### 3.14 SEALER

- A. Refer to Section 07 19 00, Water Repellants and Anti-Graffiti Coatings for sealing requirements for all exterior exposed block surfaces.

### 3.15 DEFECTIVE MASONRY

- A. Materials or workmanship not conforming to appearance or strength specified, will be deemed defective and shall be removed and replaced at no cost to Owner.
- B. Defective mortar and grout, as defined under Section 04 05 00; "Mortar and Grout" shall constitute defective masonry.

END OF SECTION 04 22 00

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

SECTION 05 50 00

METAL FABRICATION

**PART 1 - GENERAL**

1.01 SUMMARY

A. Section Includes

1. Shop fabricated ferrous metal items, galvanized and prime painted.
2. Schedule of metal fabrications.

B. Related Sections:

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. 09 91 00 - Painting.

1.02 REFERENCES

- A. ASTM A36 - Standard Specification for Carbon Structural Steel.
- B. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- C. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- D. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- E. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
- F. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- G. ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- H. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
- I. AWS D1.1 - Structural Welding Code - Steel.
- J. SSPC - The Society for Protective Coatings.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable. Provide specific submittal for all ramp and sloped walk guide rails, handrails, and guardrails prior to fabrication clearly showing spacing of rails and embed details.
- C. Indicate welded connections using standard AWS A2.1 welding symbols. Indicate net weld lengths.

#### 1.03 QUALITY ASSURANCE

- A. Welders' Certificates: Submit under provisions of Section 01 33 13, certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.
- B. Field Measurements
  - 1. Verify that field measurements are as indicated on Drawings.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS

- A. Steel Sections: ASTM A36.
- B. Steel Tubing: ASTM A500, Grade B.
- C. Plates: ASTM A36.
- D. Pipe: ASTM A53, Grade B, Schedule 40.
- E. Bolts, Nuts, and Washers: ASTM A307 galvanized to ASTM A 153 for galvanized components.
- F. Welding Materials: AWS D1.1; type required for materials being welded.
- G. Shop and Touch Up Primer: SSPC 15, Type 1, red oxide.
- H. Touch-Up for Galvanized Surfaces: Zinc rich galvanizing paint. Must contain either between 65% to 69% metallic zinc by weight or greater than 92% metallic zinc by weight in dry film. "Brite" sheen required at exposed galvanized finish. Spray application not acceptable; brush applied only.

#### 2.02 EQUIPMENT SUPPORT SYSTEM

- A. Provide galvanized Unistrut, or other approved.
  - 1. Main Runner: P5500 channel at 8-foot centers.
  - 2. 5/8-inch hanger rods at 48 inches on centers and hanger clamps.
  - 3. Cross Runner: P3000 channel at 4-foot centers.

4. P3047 "U" shaped fittings.
5. Provide and size pipe clamps as required.
6. Provide hardware and accessories as required.

## 2.03 FABRICATION

- A. Fit and shop assemble in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Continuously seal joined members by continuous welds unless indicated otherwise.
- D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

## 2.04 FINISHES

- A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- B. Do not prime surfaces in direct contact with concrete or where field welding is required.
- C. Prime paint items with one coat.
- D. At surfaces scheduled to be galvanized: Galvanize assembled items to minimum 1.25 oz/sq ft zinc coating in accordance with ASTM A 123. Apply brush applied zinc-rich galvanizing paint over field welds and adjacent areas where hot dipped galvanizing has been damaged. "Brite" sheen required at exposed galvanized finishes.
- E. Repair damaged galvanized surfaces in accordance with ASTM A780 Method A2.
- F. Finish: Site paint exposed to view prime painted and galvanized items under provisions of Section 09 91 00.

# PART 3 - EXECUTION

## 3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Beginning of installation means erector accepts existing conditions.

### 3.02 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply items required to be cast into concrete or embedded in masonry with setting templates, to appropriate sections.

### 3.03 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Field weld components indicated on Drawings.
- D. Perform field welding in accordance with AWS D1.1.
- E. Obtain Architect approval prior to site cutting or making adjustments not scheduled.
- F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

#### G. WELDING

- 1. Except for modifications indicated on drawings and specified herein, AISC Code of Standard Practices for Steel Buildings, and AWS Code for Fusion Welding and Gas Cutting in Building Construction, both as amended to date, govern materials, fabrication and erection of work under this Section.
- 2. Make welds in accordance with best standard practice. Perform welding on unexposed sides to prevent pitting, discoloring, weld-halo and other surface imperfections. Thoroughly clean surfaces to be welded. Welds must show a uniform section and reasonable smoothness without distortion. No exposed spot welding permitted. Dress and finish exposed surfaces of welded joints to produce invisible connections. Furnish welding alloys in the same color and character as the surfaces of the metals joined.

### 3.04 CONSTRUCTION

- A. Insofar as possible, fit and shop assemble work ready for erection. Accurately make jointing and intersections in true planes, and with adequate fastenings. Make exposed joints even and smooth. Grind exposed weld joints smooth and flush.
- B. Provide holes of proper size and in correct location for attachment of work of other trades. Cut, tape, and drill as required. Finished items must be free from kinks, twists, burrs and open joints. Damaged or distorted materials are not acceptable.

- C. Provide work to be built in concrete or masonry of proper form required for anchorage, or provide with concealed anchors.
- D. Form work true to detail, with clean, straight and sharply defined profiles. Close fit exposed joints and make where least conspicuous.
- E. Install supporting members, fastenings, frames, hangers, bracing, brackets, bolts, angles, and the like as required to set and connect items of miscellaneous metal to concrete, steel or wood framing.
- F. Countersink holes for exposed screwheads. Provide necessary lugs, brackets, and clips so work can be assembled and installed in a neat and suitable manner.
- G. Conceal fastenings where possible. Unless otherwise indicated, provide flathead or countersunk oval bolts and screwheads as best suited for the purpose.
- H. Weld in place plates for mounting item(s) of finish hardware.
- I. Provide bolts, anchors, inserts, and other miscellaneous steel and iron fastenings in forms before concrete is poured; or as to be built into masonry, as indicated on drawings, details or schedules, or as necessary to complete the work. Examine and check the Architectural, Structural, Mechanical and Electrical Drawings for number, type and locations of each item.

J. MISCELLANEOUS ITEMS

- 1. Furnish, fabrication, and install miscellaneous angles, channels, bent plate, clips, anchors, and other miscellaneous metal work required and as indicated on drawings. Form as detailed or if not detailed, as required for location and purposes served, and in accordance with the applicable provisions specified herein. Furnish and install miscellaneous metal items not specifically mentioned herein, or in other sections, but which are customarily considered as part of the work, the same as if fully specified herein and detailed on drawings.
- 2. Furnish and install light steel structural items not noted on Structural Drawings or called for under "Structural Steel" section but which are shown on the other drawings.
- 3. Furnish and install sleeves through masonry or concrete walls and footings. Fabrication of standard weight steel section of size sufficient to allow ¼ inch clearance between the sleeve and item to be inserted.
- 4. Furnish and install anchors, brackets, and plates or suitable steel where required in connection with steel, masonry, wood and concrete construction.
- 5. Fabricate steel channel and angle frames for doors, duct openings, scuttles, mechanical equipment, louvers, and other frames as shown and detailed to exact size required and in accordance with approved shop drawing. Neatly join corners, weld and grind smooth. For securing to concrete or masonry, weld concealed anchors on the back. Secure bar stops to frames with countersunk flathead screws or plug weld from the back. Prepare steel frames to receive necessary hardware. Where mechanical equipment such as fans, blowers, etc., and sheet metal are shown or specified to be attached in steel frames, the drilling, tapping and attachment must be done by trade involved.



6. Furnish corner guards, bumpers, etc., of sizes and shapes indicated and with anchors welded to the backs and of sizes and spacing shown.
7. Provide hot-dipped galvanized steel and iron for exterior use.

K. FINISH

1. Except where indicated, or specified to be galvanized, clean miscellaneous steel and iron of any grease, rust, mill scale, or other foreign matter, and give one shop coat of the specified primer: Do not prime material to be embedded in concrete.
2. After welding is completed, repair damage to the galvanizing by applying a minimum of two coats of liquid galvanizing compound in accordance with manufacturer's instructions to provide a coating equal to original finish.

3.05 SCHEDULE

- A. The Schedule is a list of principal items only. Refer to Drawing details for items not specifically scheduled.
- B. Miscellaneous Framing and Supports: Steel not a part of structural steel framework as required to complete work; galvanized prime paint finish.
- C. Joist Hangers: Joist strap anchors, galvanized prime paint finish.
- D. Ledge and Shelf Angles, Channels and Plates Not Attached to Structural Framing: For support of metal decking, joists, masonry, galvanized, and prime paint finish.
- E. Lintels: As detailed; galvanized prime paint finish.
- F. Metal Gates and Fences: Welded tubular steel as detailed, complete with all necessary hardware; hot-dipped galvanized, primed with paint finish.
- G. Steel pipe railing: hot-dipped galvanized at exterior, primed and painted at interior.
- H. Pipe rail wall support brackets: hot-dipped galvanized at exterior, primed and painted at interior.
- I. Steel pipe downspouts and downspout support brackets: hot-dipped galvanized and painted.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

SECTION 05 50 15

METAL LADDERS

**PART 1 – GENERAL**

1.01 SUMMARY

A. Section Includes:

1. Prefabricated aluminum roof access ladders.
2. Rest platforms at roof.
3. Ladder safety post.

B. Related Sections:

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. 06 10 00 – Rough Carpentry.
3. 08 29 00 – Gypsum Board.
4. 09 91 00 – Painting.

1.02 REFERENCES

- A. AWS D1.2 - Structural Welding Code - Aluminum.
- B. OSHA - Standards of Occupational Safety and Health Administration.
- C. ANSI ASC A14.3 / ANSI/ASSE A1264.1 - Safety Requirements for Fixed Ladders and Workplace Surfaces.
- D. ASTM B221 – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

1.03 QUALITY ASSURANCE

- A. Verify actual dimensions on site prior to fabrication.
- B. Contractor shall be responsible for a complete installation of all components required.

**PART 2 – PRODUCTS**

2.01 MANUFACTURERS:

- A. Fixed access ladders, stairs and related components listed below are those as manufactured or distributed by Industrial Ladder and Scaffolding Inc., 8152 Belvedere Avenue, Sacramento CA 95826 or (916) 452-0231 / (800) 262-0231 or approved equal.

- B. Alaco Aluminum Ladders, [www.alacoladder.com](http://www.alacoladder.com).
- C. Dur-Red Products, [www.dur-red.com](http://www.dur-red.com).
- D. Lapeyre Stair, Inc., [www.lapeyrestair.com](http://www.lapeyrestair.com).
- E. Precision Ladders, LLC, [www.precisionladders.com](http://www.precisionladders.com).
- F. Substitution: Under provisions of Section 01 25 13.

## 2.02 MATERIALS

- A. Rungs shall be round or square and a minimum of 1-1/8 inch in section, formed from aluminum extrusion, ASTM 8221 alloy 6061-T6, and shall be deeply serrated on all sides to provide maximum foot grip and traction. Rungs shall be able to withstand a 250-pound loading without failure. Space rungs 12 inches o.c. as indicated.
- B. Channel side rail shall be minimum 3 inch by 1 inch by 1/8-inch aluminum extrusions, ASTM B221 6061-T6 alloy.
- C. Rest platform shall be 0.063-inch-thick aluminum grip strut grating, ASTM B221 6061-T6 alloy.
- D. Welding Materials: AWS D1.2.
- E. Ladder Safety Post: "Ladder Up" safety post attachment for roof ladders as manufactured by Bilco Company or approved equal.
- F. Finish:
  - 1. Clear natural anodized finish for all interior ladders.
  - 2. Factory finish all exterior ladders with manufacturers standard powder coating in color as selected by Architect.

## 2.03 ACCESSORIES

- A. Anchorage devices and bolts necessary for installation as required by manufacturer's recommendations.
- B. Fixed Access Ladder (Aluminum Ladder): Heavy-duty, one piece, mill finish aluminum, fixed access ladder tested to 1,200 pounds with a 300-pound minimum duty rating.
  - 1. Rungs: 1 ¼ inch minimum diameter by 18 ½ inches long, formed from deeply serrated tubular aluminum alloy 6063-T5 extrusion spaced at 1 foot 0 inches apart.
  - 2. Side Rails: 1 5/8-inch by 3 ½-inch aluminum, I Beam design.

- C. Wall Brackets (stand offs): 3/8 inch by 2 ½ inch aluminum flat bar with pre-drilled holes at 16-inches on center. Bracket stand-off is 7 inches clear minimum from center of rung to face of wall or other projection mounted to wall. Provide wall brackets at 4 feet 0 inches O.C. maximum along length of ladder.
- D. Floor Brackets: 5 ½-inches Length by 2 ½-inches Length by 2 ½-inches Wide by ¼ inch thick aluminum flat bar angles predrilled.
- E. Security Doors
  - 1. 7 feet 0 inches minimum height by ladder width with bottom mounted at first rung height. Door shall be formed using 1/8-inch-thick aluminum sheet, alloy 5005. Security panels shall extend on both sides, perpendicular to the door face, to within 2 inches of the wall so as not to permit climbing of the ladder from the backside. Security door shall be furnished completed with continuous aluminum piano hinge and heavy-duty forged aluminum locking hasp.

## 2.04 FABRICATION

- A. Materials used shall be new stock, straight within industry tolerances and free of any defects in finish or structure.
- B. Cutting of stock shall be by mechanical means to assure a smooth square and true working edge.
- C. Mechanical Connections: Bolted connections shall be made with cast aluminum connectors and stainless-steel anchorage devices.
- D. Welded Connections: In accordance with AWS D1.2 requirements.
- E. Protection of aluminum from dissimilar materials:
  - 1. Dissimilar metals except stainless steel, white bronze, and solid zinc, shall be painted with a heavy brush coat of zinc-chromate primer and one coat of aluminum paint.
  - 2. Aluminum surfaces in contact with mortar, concrete, plaster or other masonry materials shall be given one heavy brush coat of bituminous paint.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Verify proper timing for ladder installation to prevent undue delay in job progress.
- B. Installation of ladder units shall be considered as acceptance by the Contractor of the adjacent construction as substantially conforming to the intended details and capability of supporting the ladder unit.

### 3.02 INSTALLATION

- A. Secure ladders in position as indicated on the Drawings and as required by manufacturer's specifications.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 2025-01-31 – Minor edits to references section.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

SECTION 06 10 00

ROUGH CARPENTRY

**PART 1 – GENERAL**

**1.01 SUMMARY**

**A. Section Includes:**

1. Description of requirements for materials, fabrications and installation of rough carpentry and associated items (except that which is specified elsewhere) indicated on Drawings and necessary to complete the work. Items include, but are not necessarily limited to, the following:
  - a. Blocking, Backing, Stripping, Furring, and Nailers.
  - b. Rough Hardware.
  - c. Wood Framing.
  - d. Plywood Sheathing.
  - e. Preservative Treatment.
  - f. Metal Fabrications.

**B. Related Sections**

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 03 30 00: Cast-in-Place Concrete.
3. Section 05 50 00: Metal Fabrications.
4. Section 06 17 00: Shop-Fabricated Structural Wood.
5. Section 06 20 00: Finish Carpentry.

**C. References**

1. Chapter 23, California Building Code (CBC), 2019, as adopted by the California Division of the State Architect (DSA).
2. American Society for Testing and Materials (ASTM).
3. Lumber: West Coast Lumber Inspection Bureau (WCLIB), Rule 17, Standard Grading Rules for West Coast Lumber.
4. Lumber: Western Wood Products Association (WWPA); Western Lumber Grading Rules.
5. Plywood: American Plywood Association (APA) Plywood Specifications and Grades and Voluntary Product Standard DOC PS 1 "Construction and Industrial Plywood".
6. Wood Preservative: American Wood Protection Association (AWPA), Standard U1.
7. AWC NDS – National Design Specification for Wood Construction.
8. AWC SDPWS – Special Design Provisions for Wind and Seismic.



## 1.02 QUALITY ASSURANCE

- A. Manufacturer data: Submit product data for all materials specified under this section and as applicable to each site.
- B. Coordinate the work of all trades to ensure proper placement of all materials, anchors, etc., as well as providing for openings and anchors for the installation of surface mounted materials and equipment.
- C. Qualifications of Workmen: Provide sufficient skilled workmen and supervisors who shall be present at all times during execution of this portion of the work and who shall be thoroughly familiar with the type of construction involved and the materials and techniques specified.
- D. Rejection: In the acceptance or rejection of rough carpentry, no allowance will be made for lack of skill on the part of the workmen.
- E. Design Criteria: Pressure treatment shall not adversely affect application, permanence, or appearance of finish paint system.

## 1.03 SUBMITTALS

- A. Submit per the requirements of the General Conditions.
- B. Certification:
  - 1. Pressure Treated Wood: Certification for water-borne preservative that moisture content was reduced to 19% maximum, after treatment.
  - 2. Pressure Treated Wood: Submit certification by treating plant stating the chemicals and process used, net amount of salts retained, and conformance with applicable standards.

## 1.04 JOB CONDITIONS

- A. Environmental Requirements: Maintain uniform moisture content of lumber at 19 percent or less prior to close-in.
- B. Sequencing: Coordinate details with other work supporting, adjoining, or fastening to rough carpentry work.

## 1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Protection, General: Protect wood from moisture while being stored and while work is in progress.
- B. Protection:
  - 1. After delivery, store all materials in such a manner as to ensure proper ventilation and drainage and to protect against damage and the weather.

2. Keep all material clearly identified with all grade marks legible; keep all damaged material clearly identified as damaged, and separately store to prevent its inadvertent use. Do not allow installation of damaged or otherwise non-complying material.
  3. Use all means necessary to protect the installed work and materials of all other trades.
- C. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

## PART 2 – PRODUCTS

### 2.01 MATERIALS

#### A. Wood:

1. Lumber (Blocking, Backing, Stripping, Furring, and Nailers): WCLIB Construction.
2. Lumber (Wood Framing): Meet requirements of following minimum grades, and as noted on Structural Drawings.

| Item   | Species | Grade             | Reference  |
|--------|---------|-------------------|------------|
| Studs  | D.F.    | No. 1             | WCLIB 121  |
| Plates | D.F.    | No. 1             | WCLIB 123b |
| Beams  | D.F.    | Select Structural | WCLIB 130b |
| Joists | D.F.    | No. 1             | WCLIB 123b |
| Posts  | D.F.    | Select Structural | WCLIB 131b |

3. 3x and larger lumber shall be free of heart center.
4. 2x6 T & G Douglas Fir No. 1.

#### B. Plywood:

1. Roof and Wall Structural Sheathing: PS-1 Structural 1, CDX APA with exterior glue.
2. Thickness and type shall be as indicated on Drawings.

#### C. Pressure-Treated Lumber:

1. Douglas Fir, pressure treated.
  - a. Required for cast-in-nailers, sills or anywhere wood is in contact with concrete, masonry, or grout.
  - b. Required for all rooftop blocking.

#### D. Building Paper: Fed. Spec. UU-B-790a, Type I, Grade B (15 lb. min.).

#### E. Preservative Treatment

1. Furnish pressure treated Douglas Fir in accordance with AWP, Standard U1. Each piece is required to bear AWP stamp.

2. Field treat cut edges and holes frilled in factory treated lumber with an approved AWP Standard U1 preservative product.
  3. For fastener requirements, see Paragraph 2.01-F-8.
- F. Rough Hardware Fastenings and Connections: All types including bolts, lag screws, nails, spikes, screws, washers, framing devices and other rough hardware, or kinds that may be purchased and that require no further fabrication, shall be furnished, and installed for all finish and rough carpentry. All exterior hardware shall be hot-dipped galvanized per ASTM A123 / A123M-09 Standards.
1. Nails: ASTM F1667 Common wire nails or spikes; box nails not permitted.
  2. Wood Screws: Wood Screws: ANSI Standard B18.6.1; use galvanized type for exterior work.
  3. Lag Screws: Conform to ASTM A307-07b and ANSI Standard B18.2.1. Dimensions and installation shall conform to requirements described in the National Design Specification (NDS), current edition.
  4. Bolts: ASTM A307-07b, Grade A, hexagonal heads, unless noted otherwise.
  5. Washers: Washers for bearing against wood shall be provided under all bolt heads and nuts. Washers shall be as indicated on Drawings.
  6. Powder Driven Fasteners: Tempered steel pins with special corrosive-resistant plating or coating. Pins shall have guide washers to accurately control penetration, minimum 1-1/8 inch. Fastening shall be accomplished by low-velocity pistol-driven powder activated tool. Pins and tool shall be as manufactured by Hilti Fastening Systems; Impex Tool Corporation; or approved equal. ICBO approved.
  7. Fabricated Sheet Metal Timber Framing Connectors: CBC approved. Fabricate from hot-dipped galvanized steel. Connectors shall be at least 18 gauge minimum material (1/8" plate materials where welded, unless otherwise noted), punched for nailing. Nails and Nailing shall conform to the manufacturer's instructions with a nail provided for each punched hole. Types as noted on Drawings, manufactured by Simpson Co. or approved substitute. All framing connectors shall be stamped with manufacturer's logo, and model designation.
  8. All fasteners into preservative-treated and fire-retardant-treated wood shall be of hot dipped zinc-coated galvanized steel, stainless steel, silicon bronze or copper per CBC 2304.10.5. The coating weights for zinc-coated fasteners shall be in accordance with ASTM A 153. Fasteners other than nails, timber rivets, wood screws and lag screws shall be permitted to be of zinc coated steel with coating weights in accordance with ASTM B 695, Class 55 minimum.
- G. Exterior Trim and Fascia: RIS Grade Stamped, Redwood, B Heart, Vertical Grain, Kiln Dried, surfaced sizes as indicated on the drawings.

## 2.02 FABRICATION

### A. Lumber:

1. Air- or kiln-dry to maximum 19 percent moisture content, prior to installation. Lumber must be 19 percent moisture content prior to close-in and finish.
2. Furnish S4S unless otherwise noted.
3. Size to conform with rules of governing standard. Sizes shown are nominal unless otherwise noted.

## 2.03 SOURCE QUALITY CONTROL

- A. Grade Mark each piece of lumber. Marking must be done by recognized agency. Lumber Manufacturer's Association Certificates may be accepted in lieu of such grade and trademarks.
  - 1. Douglas Fir shall bear WCLIB grade stamp.
- B. Plywood Sheathing: Each panel shall be legibly identified as to type, grade, and specie by APA grade. If plies are spliced, the slope of the scarf shall not be steeper than 1:8. White pockets will not be permitted in face plies.
- C. Each piece of preservative treated lumber shall bear AWP stamp.

## 2.04 WOOD PRESERVATIVE TREATMENT

- A. Preservative treatment: Comply with applicable requirements of AWP standards C2 for lumber and C9 for plywood. After treatment, kiln dry lumber to a maximum moisture content of 19 percent, and plywood to 15 percent.
  - 1. Pressure treat members connected with roofing, flashing and weatherproofing; including but not limited to cants, nailers, curbs, equipment supports and blocking.
  - 2. Pressure treat members that are concealed and in contact with masonry or concrete, including, but not limited to, sills, nailers, blocking, furring and studs.

## PART 3 – EXECUTION

### 3.01 SURFACE CONDITIONS

- A. Inspection:
  - 1. Prior to all work of this Section, carefully inspect the installed work of all other trades, and verify that all such work is complete to the point where this installation may properly proceed.
  - 2. Verify that rough carpentry may be performed in strict accordance with the original design and all pertinent codes and regulations.
- B. Selection of Lumber Pieces: Carefully select all members. Select individual pieces so that knot and obvious defects will not interfere with placing bolts or proper nailing or making proper connections. Cut out and discard all defects which will render a piece unable to serve its intended function.
- C. Lumber may be rejected by the Architect, whether or not it has been installed, for excessive warp, twist, bow, crook, mildew, fungus, or mold, as well as for improper cutting and fitting. No load carrying member shall be exposed to earthen materials.
- D. Shimming: Do not shim any framing component.

### 3.02 FASTENING

- A. Nailing: Except as otherwise indicated on Drawings or specified, all nailing shall be as scheduled on Drawings:
  - 1. Nails or Spikes shall be common wire unless noted otherwise. Penetration of nails or spikes shall be one-half the length of the nail or spike into the piece receiving the point. However, to connect pieces 2 inches in thickness, 16d nails shall be used unless noted otherwise.
    - a. Bore holes for nails wherever necessary to prevent splitting.
    - b. Use finish or casing nails for finish work.
    - c. Use of nailing guns is as limited by CBC and must be approved by Architect and DSA. Submittal of guns and nails is required.
- B. Bolts: Bolts shall be of sizes indicated. Drive fit with washers under nuts. Tighten all bolts and screws before closing in.
- C. Framing Devices: As specified under Products, sizes as indicated. Use half-length nails where required.
- D. Lag Screws: Pre-Bore lead holes and install per NDS, current edition.

### 3.03 FRAMING AND ROUGH CARPENTRY

- A. Sills: Shall be in long lengths of sizes shown, fastened with anchor bolts at exterior walls and with powder driven fasteners at interior walls as indicated, a minimum of two (2) fasteners per piece and a bolt within 9" but not nearer than 6" from end of piece. Place malleable iron or steel plate washers (but not cut washers) under nuts bearing on wood. Set sills level and true and bed exterior wall sills and interior bearing wall sills on 1/2 inch dry-pack or non-shrink grout.
- B. Studs, Posts and Columns: Shall be full length. Corners shall be as detailed. Partitions or walls containing plumbing, heating or other piping shall be so formed as to give proper clearance for materials. Cut members as required to provide full bearing at ends. Connect to structure as indicated.
- C. Plates: Shall be in long lengths and spliced as shown.
- D. Blocking: Shall be same thickness and width of studs or joists unless shown otherwise. Blocking shall not be spaced over 8'-0" o.c. Install fire blocking in accordance with CBC, Section 717. Install blocking at all plywood joints unless otherwise noted on the drawings. Install blocking for fastening all surface applied items.
- E. Joists and Beams: Shall be in long lengths and spliced over bearings unless shown otherwise. Install with crown side up. Beams or headers indicated to be built up of two or more joists shall be fabricated on the job using full length members. For two-piece members, stitch nail pieces together with 16d common nails spaced not over 12" o.c. and staggered. Clinch nails protruding through members.

1. Provide double joists and headers at all openings through floors and roofs unless otherwise shown on Drawings.
  2. Provide typical headers at all openings through walls where one or more studs are required to be cut. For penetration through walls narrower than stud spacing, provide solid backing on all sides for fastening finish materials.
- F. Plywood Structural Sheathing: Install to pattern indicated and provide blocking at joints where noted on the drawings. Center all joints overbearing supports. Nail to framing as indicated. Install plywood with face plies perpendicular to joists or studs unless indicated otherwise.
- G. Wood Furring, Stripping and Grounds: Install as shown or required to provide nailing of materials or passage of pipes, conduits, etc., not otherwise accommodated.
- H. Bridging: Space not over 8'-0" o.c. for spans over 16'-0". Spans over 8'-0" and under 16'-0" shall have bridging placed at midspan. Bridging shall be two 2 x 3's or solid blocking as indicated. Joists 8" or less in depth shall not require bridging unless specifically indicated.
- I. Backing: Shall be provided for all wall and ceiling finishes and for supporting of fixtures and equipment for all trades, including toilet partitions, toilet room accessories, frames, case work, mirrors, trim, applied wall finishes, etc. Coordinate placement of backing and supports with manufacturer or supplier of mounted items.
- J. Building Paper: Install two layers in all exterior locations. Install with weather lap edges a minimum of 2 inch horizontal and 6-inch vertical laps. Continue building paper minimum 6 inches around inside and outside corners. Fasten in place with appropriate staples.
- K. Cuts or holes in preservative treated wood shall be treated in accordance with AWPB standard M4 in the field.

### 3.04 MISCELLANEOUS HARDWARE

- A. Finish hardware is specified in Section 08 71 00. All other hardware indicated or required but not specified elsewhere shall be furnished and installed hereunder, including appropriate screws or other fastening devices.

### 3.05 MISCELLANEOUS CARPENTRY WORK

- A. Miscellaneous Carpentry Work not included under other sections shall be furnished and installed hereunder as indicated. Carefully locate and securely anchor such items to structure.
- B. Drypack: Drypack shall consist of 1 part high early strength Portland cement to not more than 3 parts of sand by volume. Add only a minimum amount of water to hold the mixture in shape while packing and to provide hydration. Solidly ram drypack into place to provide uniform bearing and cure with moist sacks or cloths for a period of at least three (3) days.

- C. Plywood Backing for electrical, telephone, and similar types of wall mounted equipment shall be provided hereunder where required. Plywood shall be 3/4" thick exterior A-C plywood with 'A' face exposed.
- D. Shoring and Bracing: Shore or brace for temporary support of all work as required during the construction period except any shoring and bracing specified and included under other sections of these specifications.
- E. Temporary Enclosures: Provide and maintain all barricades and enclosures required to protect the work in progress.
- F. Protect all work in progress and all work installed, as well as the work of all other trades. Any work damaged as a result of the work under this section shall be corrected to its original condition or replaced if directed by the Architect and at no increase in cost to the Owner.
- G. Protection Devices: Pedestrian walkways, barricades, lights, shoring and other protective structures and devices necessary for the protection of pedestrians shall conform in all respects to the requirements of CBC, Section 3303, Title 24 and to the requirements of the Department of Public Works.

### 3.06 FRAMING TOLERANCES

- A. Maximum variation from true flatness: 1/4 inch in ten feet in any direction.

### 3.07 CLEAN-UP

- A. Upon completion of the work of this Section, remove all surplus materials, rubbish, and debris from the premises.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 2025-01-31 – Minor revisions. Added door thickness info.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Additional countertop and casework surfacing materials not specified herein can be recommended by the Designer on a project-by-project basis.
- Do not select obscure laminates that cannot be matched in the future or are not readily available.



SECTION 06 41 00

ARCHITECTURAL CASEWORK

**PART 1 – GENERAL**

**1.01 SUMMARY**

A. Section Includes:

1. Special fabricated cabinet units.
2. Countertops.
3. Preparation for utilities.
4. Cabinet hardware.

B. Related Sections:

1. A. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. 06 10 00 - Rough Carpentry.
3. 09 65 00 - Resilient Flooring.
4. 09 65 16 - Resilient Flooring.
5. 09 68 13 - Carpeting.

**1.02 REFERENCES**

- A. North American Architectural Woodwork Standards (NAAWS).
- B. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- C. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- D. ASTM C615 - Standard Specification for Granite Dimension Stone.
- E. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
- F. CBC - California Building Code, (CCR) California Code of Regulations, Title 24, Part 2.

**1.03 SUBMITTALS**

- A. Submit shop drawings and product data under provisions of Section 01 33 00.
- B. Include materials, component profiles, fastening methods, assembly methods, joint details, accessory listings, and schedule of finishes. Provide WI Certified Compliance label on first page of

each set. Shop drawings will be rejected until reviewed by the assigned Woodwork Institute inspector and label has been issued.

- C. Product Data: Manufacture literature for all hardware to be provided.
- D. Samples:
  - 1. Finishes for color selection.
  - 2. Hardware: drawer pulls, hinges, locks and other hardware accessories.
  - 3. Identification tag and fasteners.
  - 4. Submit two physical samples and product data sheets of drawer pulls, hinges, locks, ID tags, and other specified hardware accessories, illustrating hardware type and finish.

#### 1.04 QUALITY ASSURANCE

- A. Manufacture casework items in accordance with quality standards of the NAAWS.
- B. All millwork and the installation of millwork shall be monitored for compliance under the scope of the WI Certified Compliance Program (CCP).
- C. Provide WI Inspection Service at the millwork fabricator. Provide to Architect a written report showing the results of the inspection.
- D. Issue WI Certified Compliance Certificate to Architect prior to delivery of millwork and provide WI Certified Compliance Labels on all items of casework and countertops.
- E. Provide WI Reinspection Service at the job site prior to installation. Provide to Architect a written report showing the results of the reinspection.
- F. Self-Certification by the millwork fabricator or inspection by other than an authorized representative of The Woodwork Institute is not acceptable.
- G. Upon completion of the installation, provide a WI Certified Compliance Certificate.
- H. Regulatory Requirements
  - 1. Conform to CBC requirements for flame spread classification.
  - 2. Conform to Flame Spread Classifications of Interior Millwork contained within the Appendix of the NAAWS for flame spread ratings as tested according to ASTM E84.
- I. Mockup
  - 1. Prepare mockup under provisions of Section 01 33 00.

2. Provide full size base cabinet and upper cabinet of each type indicated, in specified finish with hardware installed.
3. Units will be examined to ascertain quality and conformity to NAAWS.
4. Units will establish a minimum standard of quality for this work.
5. Approved units may be used as part of the Work.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from moisture damage, and deter their erection from damage of any character. Work damages through neglect or failure to provide protection shall be made good by the contractor and without additional cost to the Owner.

#### 1.06 FIELD MEASUREMENTS

- A. Verify that field measurements are as shown on shop drawings.
- B. Field verify existing finish floor conditions to ensure specified finish countertop heights and knee space clearances at accessible stations are maintained. If shimming is required to level units, this shall be taken into account in base cabinet construction.

#### 1.07 COORDINATION

- A. Coordinate the work with electrical rough-in, to assure orderly and efficient sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

### **PART 2 – PRODUCTS**

#### 2.01 MANUFACTURERS

- A. See schedule of manufacturers, patterns, and colors.
- B. Active member of the Woodwork Institute licensed by WI to provide WI Certified Compliance Certificates and Labels for the products and materials specified in this section [www.woodworkinstitute.com](http://www.woodworkinstitute.com).
- C. Substitutions: Under provisions of Section 01 25 13.

#### 2.02 MATERIALS

- A. Individual cabinets are indicated on the drawings by the NAAWS Appendix Cabinet Design Series (CDS) numbering system.
- B. Wood materials shall be Forest Stewardship Council (FSC) certified.
- C. Composite wood shall be free of added urea formaldehyde.
- D. Modular Casework - Laminated Plastic Covered

## 1. Fabricate in accordance with Section 10 of the NAAWS:

- a. NAAWS Grade: Custom
- b. Type: Type 1
- c. Construction: Style A-Frameless
- d. Joinery: Frameless
- e. Cabinet Backs: Dadoed (Detail 2C and 78 of Millwork Man.) Type A. Type B for glass
- f. Cabinet Door Type: Type A. Type B for glass
- g. Cabinet Door Thk.: 3/4 inch.
- h. Shelves:
  - All shelving less than 25" to be 3/4-inch-thick melamine covered Industrial Board.
  - All shelves between 25" to 34" to be 1" inch thick melamine covered Industrial Board.
  - All shelves between 34" to 46" to be 3/4" inch thick HPL covered Veneer Core DF Plywood.
  - All shelves over 46" to be 1" inch thick HPL covered Veneer Core DF Plywood.
- i. Shelf Edge Bands:
  - 1mm PVC in color to match shelf at three concealed sides. 3mm PVC at exposed leading edge.
- j. Door and Drawer Edge Bands:
  - 3 mm PVC radiused 1/8 inch at edge. Solid color as selected by Architect.
- k. Exposed Surfaces (including shelves and interior of open front cabinets):
  - .045-inch thick high pressure plastic laminate.
- l. Semi-Exposed Surfaces (behind doors and inside drawers):
  - Low pressure decorative polyester or melamine laminate ALA-85.
- m. Security and Dust Panels: Particle board, 3/4 inch thick at all lockable drawers.

## E. Countertops - Laminated Plastic

## 1. Fabricate in accordance with Section 11 of the NAAWS:

- a. NAAWS Grade: Premium
- b. Core Thickness: .075 inch minimum
- c. Laminate Thickness: 1.50 inch or .042 inch for postformed use
- d. Edge Covering: --
- e. Backsplash: Square butt
- f. Top of Back Splash: Square self-edge
- g. Colors and Pattern: To be selected by Designer

## G. Hardware

- 1. Finish: Satin Aluminum.
- 2. Shelf Standards: Knappe and Vogt 255ZC (bright zinc plated).
- 3. Shelf Supports: Knappe and Vogt 256ZC (bright zinc plated).
- 4. Shelf Fastener Supports: Knappe and Vogt 243ZC (bright zinc plated) 2 each shelf.
- 5. Shelf Supports: Hettich "Sekura" or approved equal all metal construction with 80 lb load rating. Retention pins only required at front shelf support clips. Rear clips may be non-retention pin type. Clips set in drilled holes spaced 32 mm on center.
- 6. Drawer and Door Pulls: 5 inch Epco 'U-shaped' wire pulls, Hafele, or approved equal. Pulls shall comply with CCR Section 11178.6(4) and 11258.4.

7. Cabinet Locks: National Lock C8123, Corbin 0737, K and V 986, or equal. Install on all cases unless otherwise noted.
8. Drawer Slides for Drawers 24 inch Wide or Less: Accuride 7432.
9. Drawer Slides for Drawers over 24 inch wide: Accuride 3640.
10. Drawer slides for File Drawers: Grant No. 329 heavy duty ball bearing full extension slides with 100 lbs. capacity at large flat file drawers use Accuride No. 3640, 200 lbs., full extension, ball bearing, rail mount slides.
11. Hinges: Rockford Process Control, No. 851, heavy duty wrap-around, tight pin butts of steel, 2-3/4-inch minimum width with companion magnetic door catch capable of a minimum 10-pound pull capacity. Hinges per leaf: 3 feet 0-inch-high doors – two (2) hinges, 3 feet 0 inch to 5 feet 0-inch-high doors – three (3) hinges, 5 feet 0 inch to 7 feet 4-inch-high doors – four (4) hinges, 7 feet 0 inch to 8 feet 0 inch – five (5) hinges.
12. Magnetic Door Catch: Ives 326, or Hafele 246.43 .758.
13. Sliding Door Track Assemblies: Grant 2023N sheaves and Grant 2011 track.
14. Grommets: Hafele No. 429.99.128, 3-inch diameter or as noted on drawings.
15. Seismic Shelf Lip: 1/4 inch thick by 3-inch-high acrylic plastic or PVC edging of color selected by Architect. Ease all edges of plastic.
16. Remainder of hardware required shall be as listed in the Hardware Supplement to Sections 14 and 15 of the Manual of Millwork.
17. Substitutions: Under the provisions of Section 01 25 13.

## 2.08 FABRICATION

- A. Shop assemble casework for delivery to site in units easily handled and to permit passage through building openings.
- B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.
- C. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and other fixtures and fittings. Verify locations of cutouts from on-site dimensions. Seal contact surfaces of cut edges.
- D. Provide all supports and required inserts for laboratory type sink units.
- E. Install plastic grommets in the field in plastic laminate casework and Owner furnished furniture as directed by the Owner's Representative and/or Architect.
- F. Install seismic shelf lips on all exposed edges of open laboratory shelving with flathead countersunk wood screws spaced 6 inches on center. Finish exposed screw heads to match color of shelf lip.
- G. Install one (1) adjustable shelf for each 1 foot 0 inch of height for all wall mounted cabinets.
- H. Provide stretcher at top face of all door and drawer fronts.
- I. Provide locks on all doors and drawers.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Verify adequacy of backing and support framing.

3.02 INSTALLATION

- A. Set and secure casework in place rigid, plumb, and level.
- B. Install casework in accordance with Section 10 and the Appendix of the NAAWS.

3.03 ADJUSTING AND CLEANING

- A. Adjust doors, drawers, hardware, fixtures and other moving or operating parts to function smoothly and correctly.
- B. Clean casework, counters, shelves, hardware, fittings and fixtures.

3.04 SCHEDULE

| FINISH INDICATOR | MANUFACTURER | PATTERN | COLOR | REF # | FINISH | LOCATION |
|------------------|--------------|---------|-------|-------|--------|----------|
| PL-1             | x            | -       | x     | x     | x      | x        |
| PL-2             | x            | -       | x     | x     | x      | x        |

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Insulation is a very project specific material that can and will be used in a myriad of different applications, thicknesses, rated and non-rated conditions. Therefore, designer shall provide necessary products to complete the design.
- Interior acoustic wall treatment as required to meet NRC and STC ratings.
- All exterior walls to be filled full depth of wall cavity or as required to meet Title 24.
- Where used, exposed insulation shall be held in place with a paintable sheet membrane.

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.



SECTION 07 26 00

VAPOR RETARDERS

**PART 1 – GENERAL**

**1.01 SUMMARY**

**A. SECTION INCLUDES**

1. Concrete Vapor Emission Control System for remediation of excessive slab moisture and / or alkyd levels.
2. Repairs and preparation of concrete substrate and to install the concrete vapor emission control system.
3. Subfloor testing after concrete treatment.

**B. RELATED SECTIONS**

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Bid Form: Bid Allowance with Unit Cost for potential slab treatment.
3. Section 00 72 00: General Conditions.
4. Section 00 72 00: Exhibit C: Abatement of Hazardous Materials.
5. Section 33 13 13: Concrete Work: Subfloor surface.
6. Section 06 10 00: Rough Carpentry: Subfloor surface.
7. Section 09 65 00: Resilient Flooring.
8. Section 09 65 43: Linoleum Floor Coverings.
9. Section 09 96 56: Epoxy Flooring and Base System.
10. Section 09 68 00: Carpet.

**C. REFERENCES**

1. ASTM C920-14 – Elastomeric Joint Sealants.
2. ASTM E96 / E96M-16 – Test Method for Water Vapor Transmission of Materials.
3. ASTM F710-11-Practice for Prepping Concrete Floors to Receive Resilient Flooring.
4. ASTM F1869-16 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
5. ASTM F2170-16 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

**1.02 QUALITY ASSURANCE**

**A. Manufacturer Qualifications:**

1. Ten-year experience in producing moisture vapor control emission products.
2. Minimum \$5-million product liability insurance policy from an A-rated carrier.

3. A warranty program covering coats associated with repair or replacement of concrete vapor emission control system and finish floor covering or coating, including repair or replacement labor.

B. Installer Qualifications:

1. Installer shall have experience in the installation of floor covering or floor coatings and shall have experience in the installation of concrete vapor emission control systems.
2. Floor covering installer must be factory trained and certified for the installation of the specific products being installed.
3. Installer to provide project inspector proof of certification prior to starting work.
4. Certified installer must be present on job site while work is in progress.

C. Testing Laboratory Qualifications:

1. Certified, bonded, qualified and experienced agency to perform pH and moisture vapor emission tests.

D. Pre-installation Meeting:

1. Contactor to notify Construction Manager with a minimum of 5-days' notice when anticipated to be ready for pre-installation meeting.
2. Contractor, installer and manufacturer representative are required to attend pre-installation meeting. Contractor is responsible for coordinating and scheduling their attendance.
3. Construction Manager will schedule meeting with Contractor team, Project Inspector, and Architect.
4. Purpose of Meeting: To review subfloor condition and test results; determination of appropriate treatment system(s) and location(s); and review installation requirements.

### 1.03 SUBMITTALS

- A. Provide a complete submittal package with all components required within this section. Submit per Section 00 72 00.
1. Product Data: Provide product data describing physical and performance characteristics, material safety data sheets, certificates, warranty information and manufacture's installation instructions for proposed product.
  2. Submit product manufacturer's field reports and test reports with warranty certification.
  3. Submit anhydrous calcium chloride testing according to ASTM F1869 and RH Probe Tests results according to ASTM F2170. Submit substrate pH readings. Tests shall be performed by the Owner's Inspector and results provided to the Architect, Owner, General Contractor, flooring installer and Water Vapor Reduction System Manufacturer's Representative.

#### 1.04 DELIVERY, STORAGE AND HANDLING

- A. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Store products in an approved ventilated dry area; protect from dampness, freezing, and direct sun light. Product should not be stored in areas with temperatures in excess of 90 °F or below 50 °F.

#### 1.05 ENVIRONMENTAL REQUIREMENTS

- A. Areas to receive Vapor Emission Control System shall be clean, fully enclosed, weather tight with the permanent HVAC set at a uniform temperature per manufacturer's recommendation.
- B. Maintain ambient temperature required by manufacturer three days prior to, during, and 24 hours after installation of Vapor Emission Control System.
- C. Do not apply moisture vapor reduction system to unprotected surfaces or when water is accumulated on the surface of the concrete.
- D. Do not apply water vapor reduction system when temperature is lower than 50° F or expected to fall below this temperature within 24 hours from time of application.
- E. Protection: Protect water vapor reduction system to prevent damage from topical water for a minimum period of 24 hours from time of application.

#### 1.06 WARRANTY

- A. Contractor shall file a pre-installation checklist with the manufacturer (as required) and receive written confirmation of the approval to proceed in order to obtain full warranty.
- B. Emission control system warranty must be from the manufacturer, in writing, and cover the cost of system materials, cementitious compounds and labor costs of application and preparation. In addition, the warranty must extend to the flooring material, adhesive and installation labor.
- C. Warranty period shall be no less than ten years or the life of the flooring covering whichever comes first.
- D. Warranty exclusion shall be limited to:
  - 1. Moisture failure due to topical intrusion of plumbing failure or other substances entering from the surfaces.
  - 2. Seismic damage occurring after installation.
  - 3. Replacement of flooring during warranty period as removal of flooring could damage emission control system.
  - 4. Aggregate found to be defective (expansive and reactive aggregate are examples).
- E. Warranty shall not exclude cracks visible at time of installation nor "improper installation".

- F. Manufacturer to provide evidence of a product liability insurance policy. Insurer shall have no less than an "A" rating from one of the four major rating services. A certificate of insurance shall be delivered to the Owner and shall name the Owner, Architect and General contractor as co-insured. Liability shall be in the amount of \$5 million per occurrence.

## **PART 2 – PRODUCTS**

### **2.01 MATERIALS**

- A. Vapor Emission Control System: The appropriate system(s) shall depend on the existing slab moisture and pH levels and the requirements of the specific floor covering product. The determination of which of the following systems would be most appropriate and the extent of treatment area(s) shall be made by the Owner's representative once the existing slab testing results are known.
1. Koester VAP1 2000 System. 100% solids epoxy.
  2. Mapei Planiseal VS System. An alkali-resistant, two-component, 100%-solids epoxy coating that effectively stops moisture-related problems with floor coverings.
  3. ARDEX MC™ RAPID.100% solids epoxy system.

### **2.02 MIX DESIGNS**

A. VAP1 2000:

1. Use clean containers and mix thoroughly as per Manufacturer's requirements to obtain a homogeneous mixture. Use a low-speed motor less than 400 rpm and a two bladed Jiffy mixing blade only. DO NOT AERATE. Mix ratios are measured by volume.
2. VAP I® 2000 Mix Ratio: Mix Component A and B at a ratio of 2.4:1 by volume.

B. Mapai Planiseal VS:

1. Premix Part A to a homogenous consistency (2 to 3 minutes) using a low-speed mixer (at 300 to 450 rpm) and a "jiffy" (paint mixer) mixing paddle.
2. Pour Part B into Part A container and mix thoroughly to a smooth, homogenous consistency. Do not mix at high speeds, which can trap air within the mixed material.
3. Pour and spread the entire unit of any mixed Planiseal VS onto the substrate within 5 minutes of mixing.

C. ARDEX MC PLUS:

1. Each individual unit of ARDEX MC RAPID™ Red and ARDEX MC RAPID™ Green contains separate, pre-measured quantities of the hardener (Part A) and the resin (Part B). The hardening agent (Part A) is added to the resin (Part B).
2. ARDEX MRP and/or ARDEX K 301 are mixed in 2-bag batches at one time. Mix each bag of powder with the prescribed amount of water using an ARDEX Mixing Paddle and a 1/2" heavy-

duty drill (min. 650 rpm). Mix thoroughly for approximately 2-3 minutes to obtain a lump-free mixture. Follow written installation instructions for each material.

3. For mix designs related to the use of ARDEX underlayment's and toppings, refer to the standard mixing instructions for installation over concrete as shown in the manufacturer's installation instructions.
4. For instructions on the filling of dormant cracks and joints, follow the written instructions of the selected epoxy manufacturer.

### **PART 3 – EXECUTION**

#### **3.01 EXAMINATION**

##### **A. Calcium Chloride, RH Probe and pH test requirements:**

1. Anhydrous calcium chloride testing shall be performed by the Owner's Inspector.
2. Provide anhydrous calcium chloride tests according to ASTM F1869 protocol.
3. Provide RH Probe Tests according to ASTM F2170 protocol.
4. Only conduct calcium chloride tests at the same temperature and humidity expected during normal use. If this is not possible then follow the F1869 method for non-acclimated spaces. Maintain these conditions 48 hours prior to and during tests. Water vapor transmission levels are directly affected by ambient room temperature and readings conducted without a sustained ambient temperature and humidity are NOT acceptable.
5. Provide substrate surface pH readings.
6. Owner's Inspector shall provide test results with a marked-up floor finish plan showing test result. Inspector shall provide a written clarification on status of the ambient air temperature and humidity before and during the testing procedures.

##### **B. Concrete Slab Inspection**

1. Existing concrete slabs - Testing for concrete deficiencies and contaminates such as un-reacted silicates, chlorides, A.S.R. (alkali-silica reaction), oil contamination, etc. is recommended by Koster to avoid bonding issues. These conditions can cause bonding concerns with all epoxy and finished floor coatings, including the Koster VAP 1 2000. This testing is not required by Koster. This testing should be performed by the owner's independent testing agency using utilizing standard coring methods and review of the history of the slab installation if available. Concrete should conform to ACI Committee 201 Report "Guide to Durable Concrete."
2. New concrete slabs - Review Section 03 30 00 curing compounds. Silicate based curing compounds should be avoided.

#### **3.02 PREPARATION**

- A. Inspect all surfaces with regard to their suitability to receive moisture vapor reduction system with manufacturer's representative.
- B. Clean all surfaces to receive moisture vapor reduction system. Shot blast all floors to a CPS #3 or #4 and clean surfaces with vacuum and remove all residue off the concrete. Grinding is allowed only in

areas not accessible by shot blasting. Do not acid etch. Remove ALL defective materials, and foreign matter such as dust, adhesives, gypsum based patching and leveling compounds, paint, dirt, un-reacted sprayed on silicates, floor hardeners, bond breakers, oil, grease, curing agents, form release agents, efflorescence, laitance, shot blast bee bees, etc. Repair all cracks, expansion joint, control joints, and open surface honeycombs and fill in accordance with Manufacturers recommendations. Inform vapor reduction system manufacturer if concrete additives like silicates or chlorides or any other soluble compounds that have been used in the concrete mix or topically applied. Reinforcing fibers that are visible after shot blasting must be removed and vacuumed leaving no fibers left on the concrete surfaces. Provide uncontaminated, sound surface.

- C. Repair concrete prior to moisture vapor reduction system. Consult with vapor reduction manufacturer to determine suitable products for concrete repair.
- D. Shot blast a small test area and review surface profile with the finished flooring applicator. As the moisture vapor reduction system is not a leveling material make sure the flooring installer is aware that a feather finish or leveling material may be utilized to "flatten" the concrete after the application of the moisture vapor reduction system and prior to the flooring installation.
- E. Clean substrate surfaces to receive system treatment and treat surface irregularities with a 100% Portland Cement based patching compounded and cementitious fill compatible with prescribed system treatment as recommended by the manufacturer of the moisture control system.
- F. At all treated locations under finish goods i.e. carpet, VCT, etc., install self-leveling material to provide a smooth and uninterrupted concrete substrate for proper installation of floor finish.

### 3.03 JOINT AND CRACK PREPARATION

#### A. VAP1 2000:

- 1. Fill cracks, control joints, voids and deteriorated concrete with CTS Cements Rapid Set Cement All, Mortar Mix, Concrete Mix or Skim Coat prior to the VAP I 2000 application. Allow the products to cure according to Rapid Set's requirements before applying the VAP products over the repaired area. Do not use gypsum based cementitious patching, leveling and repair mortars under the VAP I 2000 systems. Cracks should be opened up to at least 1/4" x 1/4" to allow for a proper amount of Rapid Set materials to fill the voids. Any cracks/voids that may be contaminated by known or unknown substances should be routed out to remove any contaminants.
- 2. Expansion joints should be repaired per the detail on the VAP I 2000 data sheets. A fumed silica epoxy thickening agent (Aerosil or Cabosil) can be added to the VAP I 2000 products and used in place of cementitious materials for control joints and cracks if needed.
- 3. Consult with Koster America for crack general repair guidelines.

#### B. Mapai Planiseal VS:

- 1. Repair cracks before application of the Planiseal VS using an appropriate high-modulus epoxy (Planibond EBA or Planibond CR 50) mixed with sand if required (depending on the size of crack under repair). Cracks narrower than 1/8" (3mm) may typically be filled with Planiseal VS neat. Cracks wider than 1/8" (3mm) are to be repaired with suitable high-modulus epoxy such as

Planibond EBA or Planibond CR 50 (consider an epoxy mortar if appropriate) filled to 1/8" to 1/4" (3 to 6mm) shy of the substrate surface (just below flush).

2. Avoid overfilling of cracks with high-modulus epoxies that will lead to epoxy spilling onto substrate. Any epoxy that spills onto the substrate surface must be removed, and any remaining residue must be fully seeded with sand. The subsequent application of the Planiseal VS must take place after all loose sand have been vacuumed up off the floor, and fully encapsulate the epoxy utilized for crack repair.
3. Contraction, control or saw-cut joint treatment – Dormant control joints may typically be filled with Planiseal VS, or with Planibond EBA or Planibond CR 50 (consider an epoxy mortar if appropriate) filled to 1/8" to 1/4" (3 to 6mm) shy of the substrate surface (just below flush).

C. ARDEX MC:

1. Moving Joints – honor all expansion and isolation joints up through the ARDEX Moisture Control System, and underlayment or topping.
2. Saw cuts, control joints and dormant cracks –To ensure that a continuous barrier to moisture emissions is created over the entire surface, ARDEX recommends the use of a two-part, low viscosity rigid epoxy crack and joint filler to fill small, non-moving cracks and saw-cut joints in existing concrete substrates. Cracks greater than a hairline in width [1/32" (0.79 mm)] and saw-cuts must be filled in strict accordance with the installation instructions provided by the ARDEX Technical Department. Once the dormant cracks and saw-cuts have been properly filled, allow these areas to cure thoroughly in accordance with the epoxy manufacturer's recommendations prior to proceeding with the ARDEX MC™ RAPID installation.
3. Saw Cuts, Control Joints and Dormant Cracks – fill all non-moving joints and cracks greater than 1/32" with a rigid, low-viscosity, two-part epoxy joint sealant. Once the cracks and joints have been properly filled, broadcast a sand layer to refusal and allow these areas to cure as recommended by the epoxy manufacturer prior to proceeding with the installation of the ARDEX MC™ RAPID.

3.04 INSTALLATION (per manufacturer's guidelines or as follows)

- A. The coverage rates vary by system. Follow manufacturer recommendations for the specific project application.
- B. Application of moisture reduction system shall be in strict accordance with manufacturer recommended methods and installation information.
- C. Cementitious underlayment with suitable primer is recommended if required by the Owner, floor covering installer, or the floor covering manufacturer to smooth and/or level surfaces after shot blasting and installation of the moisture reduction system. No underlayment or feather finish system is allowed under the moisture reduction system material. When water-based adhesives are utilized in the floor covering installation, use an approved cementitious underlayment system with primer prior to the installation of the flooring system. Contact the adhesive manufacturer for their minimum recommended thickness of cementitious underlayment to absorb excess moisture in the adhesive. Typically, a minimum of 1/8" is required. Note this is only for some water-based adhesives.

3.05 PROTECTION

- A. Prohibit any traffic or any activity that generates dust or debris from contaminating the treated slab until finished flooring is installed.
- B. Do not install finished flooring until the vapor control system has fully cured in accordance with manufacturer's recommendations.

END OF SECTION



## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 2023-01-12 – Revised description of material in Article 2.03-G-1.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Designer shall choose which roof insulation adhesive shall be used.

## SECTION 07 52 16

## SBS MODIFIED BITUMINOUS MEMBRANE ROOFING, HOT-APPLIED

**PART 1 – GENERAL****1.01 SUMMARY****A. Section Includes:**

1. Hybrid Styrene-butadiene-styrene (SBS) modified bituminous membrane roofing system on building substrate (DESIGNER to modify as required for different substrate), including:
  - a. Roof insulation.
  - b. Roof insulation cover board.
  - c. Roof membrane and membrane base flashings.
  - d. Hybrid, built-up asphalt (glass-fiber) roofing ply sheets.
  - e. Granule-surfaced SBS-modified bituminous cap sheet.
  - f. Cool Roof coating.

**B. Related Sections:**

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 06 10 00 – Rough Carpentry for wood cants, nailers, curbs, and blocking.
3. Section 07 60 00 – Flashing and Sheet Metal for shop- formed sheet metal roof flashings and counter-flashings, including formed copings and roof edge metal items.

**1.02 DEFINITIONS**

- A. Roofing Terminology: Refer to ASTM D1079 "Standard Terminology Relating to Roofing and Waterproofing" and glossary in applicable edition of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" for definition of terms related to roofing work in this Section.
- B. Hot Roofing Asphalt: Roofing asphalt heated to its equi-viscous temperature, the temperature at which its viscosity is 125 centipoise for mop-applied roofing asphalt and 75 centipoise for mechanical spreader-applied roofing asphalt, within a range of plus or minus 25 degree F. measured at the mop cart or mechanical spreader immediately before application.

**1.03 SUBMITTALS****A. Action Submittals**

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

**B. Informational Submittals**

1. Contractor's Product Certificate: Submit notarized certificate, indicating products intended for Work of this Section, including product names and numbers and manufacturers' names, with statement indicating that products to be provided meet the requirements of the Contract Documents.
2. Qualification Data: For Installer, Manufacturer, and Roofing Inspector.
  - a. Include letter from Manufacturer written for this Project indicating approval of Installer.
3. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
  - a. Product Compatibility: Indicate manufacturer has verified compatibility of roofing system components, including but not limited to: Roofing membrane, flashing sheets, adhesives, and sealants.
4. Warranties: Unexecuted sample copies of warranties.
5. Field Quality Control Reports: Reports of Roofing Inspector. Include weather conditions, description of work performed, tests performed, defective work observed, and Contractor's corrective actions taken to correct defective work.
  - a. Submit reports within 48 hours after installation.

C. Closeout Submittals

1. Maintenance Data: To include in maintenance manuals.
2. Warranties: Executed copies of warranties.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and certified by manufacturer, including a full-time on-site supervisor with a minimum of five years' experience installing products comparable to those specified, able to communicate verbally with Contractor, Architect, and employees, and qualified by the roofing system manufacturer to install manufacturer's product and furnish warranty of type specified.
- B. Manufacturer Qualifications: Approved manufacturer with UL listed and FM Global approved roofing systems comparable to those specified for this Project, with minimum five years' experience in manufacture of comparable products in successful use in similar applications, and able to furnish warranty with provisions matching specified requirements.
- C. Roofing Inspector Qualifications: A technical representative of manufacturer not engaged in the sale of products and experienced in the installation and maintenance of the specified roofing system, qualified to perform roofing observation and inspection specified in Field Quality Control Article, to determine Installer's compliance with the requirements of this Project, and approved by the manufacturer to issue warranty certification. The Roofing Inspector shall be one of the following:
  1. An authorized full-time technical employee of the manufacturer.
- D. Manufacturer's Installation Instructions: Obtain and maintain on-site access to manufacturer's written recommendations and instructions for installation of products.
- E. Preinstallation Meetings

1. Preinstallation Roofing Conference: Conduct conference at Project site.
  - a. Meet with Owner, Architect, roofing Installer, roofing system manufacturer's representative, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
  - b. Review drawings and specifications.
  - c. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
  - d. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - e. Examine substrate conditions and finishes for compliance with requirements, including flatness and fastening.
  - f. Review structural loading limitations of roof deck during and after roofing.
  - g. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
  - h. Review governing regulations and requirements for insurance and certificates if applicable.
  - i. Review temporary protection requirements for roofing system during and after installation.
  - j. Review roof observation and repair procedures after roofing installation.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. 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.
- B. 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.
  1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. 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.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

#### 1.07 PROJECT / 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. Daily Protection: Coordinate installation of roofing so insulation and other components of roofing system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.

1. Provide tie-offs at end of each day's work to cover exposed roofing and insulation with a course of roofing sheet securely in place with joints and edges sealed.
2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing.
3. Remove temporary plugs from roof drains at end of each day.
4. Remove and discard temporary seals before beginning work on adjoining roofing.

#### 1.08 WARRANTY

- A. Manufacturer's Warranty: Manufacturer's standard or customized form, in which manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period. Failure includes roof leaks.
  1. Single manufacturer's warranty includes roofing membrane, base flashings, fasteners, roofing membrane accessories and other components of roofing system specified in this Section.
  2. Warranty Period: 20 years from date of Substantial Completion.
- B. Manufacturer Inspection Services: By manufacturer's technical representative, to report maintenance responsibilities to Owner necessary for preservation of Owner's warranty rights. The cost of manufacturer's inspections is included in the Contract Sum.
  1. Inspections to occur in following years: 2, 5, 10, 15 following completion of work.
- C. Installer's Warranty: Submit roofing Installer's warranty, on warranty form, signed by Installer, covering the Work of this Section and related Sections indicated above, including all components of membrane roofing such as roofing membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:
  1. Warranty Period: Two years from date of Substantial Completion.
- D. Warranties specified in this Section include the following components and systems specified in other sections supplied by the roofing system Manufacturer, and installed by the roofing system Installer:
  1. Sheet metal flashing and trim, including roof penetration flashings.
  2. Manufactured copings, roof edge, counter-flashings, and reglets.
  3. Roof curbs, hatches, and penetration flashings.
  4. Roof and parapet expansion joint assemblies.
  5. Metal roof, wall, and soffit panels and trim.

## PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Basis-of-Design Manufacturer/Product:

1. Tremco, Inc. (specified).
  2. Or approved equal.
- B. Source Limitations: Obtain components for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.

## 2.02 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.
1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
  2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746/D3746M, ASTM D4272/D4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.
- B. Flashings and Fastening: Provide base flashings, perimeter flashings, detail flashings and component materials and installation techniques that comply with requirements and recommendations of the following:
1. NRCA Roofing Manual (Sixth Edition) for construction details and recommendations.
  2. SMACNA Architectural Sheet Metal Manual (Seventh Edition) for construction details.
- C. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.
- D. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E1980, based on testing identical products by a qualified testing agency.
- E. Energy Performance: Roofing system shall have an initial solar reflectance index of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.

## 2.03 MATERIALS

- A. General
1. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.
- B. Roof Membrane Materials
1. Hybrid System Asphalt (Glass Fiber) Ply Sheets:

- a. Asphalt and glass-fiber roofing ply sheet for hot-applied built-up roofing systems, ASTM D2178 Type IV.
  - 1) Basis of design product: Tremco, THERMglass Type IV.
  - 2) Net Dry Mass of asphalt impregnated glass felt, ASTM D146: 7.5 lb/100 sq ft.
  - 3) Breaking Strength, ASTM D146: 44 lbf/in.
  - 4) Pliability, 1/2 inch, ASTM D146: Pass.
2. SBS Modified Bituminous Cap Sheet:
  - a. SBS-modified asphalt-coated glass-fiber-reinforced sheet, granular surfaced, ASTM D6163 Type I Grade G.
    - 1) Basis of design product: Tremco, POWERply Standard FR.
    - 2) Exterior Fire-Test Exposure, ASTM E108: Class A.
    - 3) Tensile Strength at 77 degree F, minimum, ASTM D5147: Machine direction 80 lbf/in; Cross machine direction 75 lbf/in.
    - 4) Tear Strength at 77 degree F, minimum, ASTM D5147: Machine direction, 100 lbf; Cross machine direction 108 lbf.
    - 5) Elongation at 77 degree F, minimum, ASTM D5147: Machine direction 7 percent; Cross machine direction 8 percent.
    - 6) Low Temperature Flex, maximum, ASTM D5147: -15 degree F.
    - 7) Thickness, minimum, ASTM D5147: 0.120 inch.
3. Flashing Backer Sheet:
  - a. Asphalt and glass-fiber roofing ply sheet for hot-applied built-up roofing systems, ASTM D2178 Type IV.
    - 1) Basis of design product: Tremco, THERMglass Type IV.
    - 2) Net Dry Mass of asphalt impregnated glass felt, ASTM D146: 7.5 lb/100 sq ft.
    - 3) Breaking Strength, ASTM D146: 44 lbf/in.
    - 4) Pliability, 1/2 inch (13 mm), ASTM D146: Pass.
4. Flashing Sheet:
  - a. SBS-modified asphalt-coated glass-fiber-reinforced sheet, granular surfaced, ASTM D6163 Type I Grade G.
    - 1) Basis of design product: Tremco, POWERply Standard FR.
    - 2) Exterior Fire-Test Exposure, ASTM E108: Class A.
    - 3) Tensile Strength at 77 degree F, minimum, ASTM D5147: Machine direction 80 lbf/in; Cross machine direction 75 lbf/in.
    - 4) Tear Strength at 77 degree F, minimum, ASTM D5147: Machine direction, 100 lbf; Cross machine direction 108 lbf.
    - 5) Elongation at 77 degree F, minimum, ASTM D5147: Machine direction 7 percent; Cross machine direction 8 percent.
    - 6) Low Temperature Flex, maximum, ASTM D5147: -15 degree F.
    - 7) Thickness, minimum, ASTM D5147: 0.120 inch.
5. Detailing Fabric:
  - a. Woven Glass Fiber Mesh, Vinyl-Coated: Non-shrinking, non-rotting, vinyl-coated woven glass mesh for reinforcing flashing seams, membrane laps, and other roof system detailing.
    - 1) Basis of design product: Tremco, BURmesh.

- 2) Tensile strength, 70 degree F, min ASTM D146: Warp, 65 lbf/in; fill, 75 lbf/in.
- 3) Color: Aqua green.

#### C. Asphalt Materials

1. Asphalt primer, water-based, polymer modified.
  - a. Basis of design product: Tremco, TREMprime WB.
  - b. Volatile Organic Compounds (VOC), maximum, ASTM D3960: 2 g/L.
  - c. Color: Brown/black.
2. Hot-melt asphalt adhesive, ASTM D312 Type IV.
  - a. Basis of design product: Tremco, Premium IV Adhesive.
  - b. Softening Point, min/max, ASTM D36: 215–225 degree F.
  - c. Ductility at 77 degree F, minimum, ASTM D113: 1.5 cm.
  - d. Penetration at 77 degree F, min/max, ASTM D5: 15–25 dmm.

#### D. Auxiliary Membrane Roofing Materials

1. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing membrane.
  - a. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
2. Asphalt Roofing Cement / Mastic:
  - a. Seam Sealer and Patching Sealer: Acrylic elastomeric sealer, single-component, high solids, low-VOC, formulated for compatibility and use with specified roofing and wall substrates.
    - 1) Basis of design product: Tremco, SOLARGARD Acrylic Sealer.
    - 2) Volatile Organic Compounds (VOC), maximum, ASTM D3960: 50 g/L.
    - 3) Tensile Strength, minimum, ASTM D412: 450 psi.
    - 4) Hardness, Shore A: 45.
    - 5) Elongation, minimum, ASTM D412: 300 percent.
    - 6) Impact Resistance, minimum: 160 in/lb.
  - b. Roof Cement, Asphalt-Based: ASTM D4586, Type II, Class I, fibrated roof cement formulated for use in installation and repair of asphalt ply and modified bitumen roofing plies and flashings; UL-classified for fire resistance.
    - 1) Basis of design product: Tremco, ELS.
    - 2) Volatile Organic Compounds (VOC), maximum, ASTM D3960: 190 g/L.
    - 3) Non-Volatile Matter, ASTM D4586: 85 percent.
    - 4) Resistance to sag ASTM D4586: 1/8 in.
3. Stripping Reinforcing Fabric:
  - a. Polyester Reinforcing and Protection Fabric: 100 percent stitch-bonded mildew-resistant polyester fabric intended for reinforcement of compatible fluid-applied membranes and flashings and as a protection layer under pavers or stone aggregates.
    - 1) Basis of design product: Tremco, Permafab.
    - 2) Tensile Strength, Minimum, ASTM D1682: 50 lbf avg.
    - 3) Elongation, Minimum, ASTM D1682: 60 percent.
    - 4) Tear Strength, Minimum, ASTM D1117: 16 lbf avg.



5) Weight: 3 oz./sq. yd.

4. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FM Global 4470, designed for fastening roofing components to substrate, tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.
5. Metal Flashing Sheet: Metal flashing sheet is specified in Division 07 Section "Sheet Metal Flashing and Trim."
6. Miscellaneous Accessories: Provide miscellaneous accessories recommended by roofing system manufacturer.

E. Roof Insulation Materials

1. Roof Insulation, General: Preformed roof insulation boards manufactured or approved by roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated.
  - a. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated, not less than two times the roof slope.
2. Roof Insulation:
  - a. Board Insulation, Polyisocyanurate: CFC- and HCFC- free, with recycled content glass-fiber mat facer on both major surfaces, ASTM C1289 Type II Class 1.
    - 1) Compressive Strength, ASTM D1621: Grade 2: 20 psi.
    - 2) Conditioned Thermal Resistance at 75 degree F: 14.4 at 2.5 inches thick.

F. Accessories

1. Roof Insulation Cover Board:
  - a. Gypsum panel, glass-mat-faced, primed, ASTM C1177/C1177M.
    - 1) Basis of design product: Tremco/GP Gypsum DensDeck Prime.
    - 2) Thickness: 1/2 inch.
2. Roof Insulation Adhesive:
  - a. Urethane adhesive, bead-applied, low-rise two-component solvent-free low odor, formulated to adhere roof insulation to substrate.
    - 1) Basis of design product: Tremco, Low Rise Foam Insulation Adhesive.
    - 2) Flame Spread Index, ASTM E84: 10.
    - 3) Smoke Developed Index, ASTM E84: 30.
    - 4) Volatile Organic Compounds (VOC), maximum, ASTM D3960: 0 g/L.
    - 5) Tensile Strength, minimum, ASTM D412: 250 psi.
    - 6) Peel Adhesion, minimum, ASTM D903: 17 lbf/in.
    - 7) Flexibility, 70 degree F (39 degree C), ASTM D816: Pass.
  - b. Hot-melt asphalt adhesive, ASTM D312 Type IV.

- 1) Basis of design product: Tremco, Premium IV Adhesive.
  - 2) Softening Point, min/max, ASTM D36: 215–225 degree F.
  - 3) Ductility at 77 degree F minimum, ASTM D113: 1.5 cm.
  - 4) Penetration at 77 degree F, min/max, ASTM D5: 15–25 dmm.
3. Insulation Cant Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.
  4. Tapered Edge Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.
  5. Insulation Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

#### G. Surfacing Materials

1. Cool Roof Acrylic Emulsion Flashing Coating Material:
  - a. Acrylic Roof Coating, Highly-Reflective Elastomeric: high-solids acrylic latex elastomeric roof coating formulated for use on bituminous roof surfaces; water-based, Energy Star qualified, CRRRC listed and California Title 24 Energy Code compliant.
    - 1) Basis of design product: Tremco, ICE Coating.
    - 2) Volatile Organic Compounds (VOC), ASTM D3960: 39 g/L.
    - 3) Emissivity, minimum, ASTM C1370: 0.83.
    - 4) Solar Reflectance Index (SRI), ASTM E1980: 103 (initial) 75 (3 year aged).
    - 5) Reflectance, minimum, ASTM C1549: 84 percent.
    - 6) Solids, by volume, ASTM D5201: 65 percent.
    - 7) Minimum Thickness: 45 mils dry film thickness.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
  1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.
  2. Verify that, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation. wood cants
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.02 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. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

### 3.03 INSTALLATION

#### A. General

1. Install roofing system in accordance with manufacturer's written instructions, approved shop drawings, and Contract Documents.
2. Install wood cants, blocking, curbs, and nailers in accordance with requirements of Division 06 Section "Miscellaneous Rough Carpentry."
3. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

#### B. Insulation Installation

1. Comply with built-up roofing manufacturer's written instructions for installing roof insulation.
2. Coordinate installing membrane roofing system components, so insulation is not exposed to precipitation or left exposed at the end of the workday.
3. Cant Strips: Install and secure preformed 45-degree cant strips at junctures of built-up roofing with vertical surfaces or angle changes greater than 45 degrees.
4. Tapered Insulation and Crickets: Install tapered insulation under area of roofing to conform to slopes indicated.
  - a. Where crickets are indicated or required to provide positive slope to drain, make slope of crickets minimum of two times the roof slope, not less than 1/4 inch in 12 inches (1:48).
5. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
6. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.
7. Adhered Insulation Application Method: Install each layer of insulation and adhere to substrate as follows:
  - a. Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
8. Cover Board Installation: Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction. Loosely butt cover boards together. Tape joints if required by roofing manufacturer.
  - a. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining board-in place.

#### C. Hot-Applied Roofing Membrane Installation, General

1. Install roofing membrane system according to roofing system manufacturer's written instructions and applicable recommendations in NRCA's "Quality Control and Quality-assurance Guidelines for the Application of Membrane Roofing" and as follows:
  - a. Number of Asphalt (Glass-Fiber) Ply Sheets: Three.

- 1) Adhering Method: Mopped.
- b. Granular-Surfaced SBS-Modified Asphalt Cap Sheet:
  - 2) Adhering Method: Mopped.
2. Start installation of roofing membrane in presence of roofing system manufacturer's technical personnel.
3. Cooperate with testing agencies engaged or required to perform services for installing roofing system.
4. Coordinate installation of roofing system so insulation and other components of the roofing membrane system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.
  - a. Provide tie-offs at end of each day's work to cover exposed roofing membrane sheets and insulation with a course of coated felt set in compatible roofing cement/mastic or hot roofing asphalt, with joints and edges sealed.
  - b. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing.
  - c. Remove temporary plugs from roof drains at end of each day.
  - d. Remove and discard temporary seals before beginning work on adjoining roofing.
5. Hot Roofing Asphalt Heating: Heat asphalt to its equi-viscous temperature, measured at the mop cart or mechanical spreader immediately before application. Circulate asphalt during heating. Do not raise asphalt temperature above equi-viscous temperature range more than one hour before time of application. Do not exceed asphalt manufacturer's recommended temperature limits during asphalt heating. Do not heat asphalt within 25 degree F of flash point. Discard asphalt maintained at a temperature exceeding finished blowing temperature for more than four hours.
  - a. Apply hot roofing asphalt within plus or minus 25 degree F. of equi-viscous temperature and adhere components to asphalt heated to not less than 425 degree F.
6. Hot Roofing Asphalt Heating, SEBS-Modified Asphalt: Heat and apply SEBS-modified elastomeric roofing asphalt according to roofing system manufacturer's written instructions.
7. Substrate-Joint Penetrations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

#### D. Ply Sheet Installation

1. Install ply sheets according to roofing system manufacturer's written instructions starting at low point of roofing system. Align base-ply sheets without stretching. Extend sheets over and terminate beyond cants.
  - a. Shingle side laps of ply sheets uniformly to ensure that required number of ply sheets covers substrate at any point. Shingle in direction to shed water.
  - b. Embed each glass-fiber ply sheet in a continuous void-free mopping of hot roofing asphalt to form a uniform membrane without glass-fiber ply sheets touching.

#### E. SBS-Modified Bituminous Membrane Installation

1. Install modified bituminous roofing membrane cap sheet according to roofing manufacturer's written instructions, starting at low point of roofing system. Extend roofing membrane sheets over and terminate beyond cants, installing as follows:

- a. Unroll roofing membrane sheets and allow them to relax for minimum time period required by manufacturer.
- b. Adhere to substrate in a solid mopping of hot roofing asphalt applied at not less than 425 degree F.
2. Laps: Accurately align roofing membrane sheets, without stretching, and maintain uniform side and end laps. Stagger end laps. Install roofing membrane sheets so side and end laps shed water. Completely bond and seal laps, leaving no voids.
  - a. Repair tears and voids in laps and lapped seams not completely sealed.
  - b. Apply roofing granules to cover exuded bead at laps while bead is hot.

#### F. Flashing And Stripping Installation

1. Base Flashing Installation, General: Install base flashing over cant strips and other sloped and vertical surfaces, at roof edges, and at penetrations through roof; secure to substrates according to roofing system manufacturer's written instructions, and as follows:
  - a. Extend base flashing up walls or parapets a minimum of 12 inches above modified bituminous roofing and 6 inches onto field of roof membrane.
  - b. Prime substrates with asphalt primer if required by roofing system manufacturer.
  - c. Backer Sheet Installation:
    - 1) Backer Sheet Application: Install backer sheet and adhere to substrate in a solid mopping of hot roofing asphalt.
  - d. Flashing Sheet Installation:
    - 1) Adhere flashing sheet to substrate in a solid mopping of hot roofing asphalt. Apply hot roofing asphalt to back of flashing sheet if recommended by roofing system manufacturer. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.
  - e. Flashing Sheet Top Termination: Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.
    - 1) Seal top termination of base flashing with a metal termination bar and a continuous bead of joint sealant.
  - f. Flashing Sheet Bottom Termination: Adhere flashing sheet to roof membrane sheet continuously along bottom of flashing sheet.
2. Install roofing membrane cap-sheet stripping where metal flanges and edgings are set on membrane roofing according to roofing system manufacturer's written instructions.
3. Install stripping, according to roofing manufacturer's written instructions, where metal flanges and edgings are set on built-up roofing.
4. Flashing-Sheet Stripping: Install flashing-sheet stripping in a continuous coating of compatible mastic/adhesive sealer, as recommended by roofing manufacturer, and extend onto roofing membrane. Apply number of courses recommended by manufacturer.
5. Roof Drains: Set 30 by 30-inch square metal flashing in bed of compatible mastic/adhesive sealer on completed roofing membrane. Cover metal flashing with roofing membrane cap-sheet stripping and extend a minimum of 6 inches beyond edge of metal flashing onto field of roofing membrane. Clamp roofing membrane, metal flashing, and stripping into roof-drain clamping ring.
  - a. Install stripping according to roofing system manufacturer's written instructions.

G. Surfacing And Coating Installation

1. Acrylic Emulsion Coating:
  - a. Apply Cool Roof coating to the roof and flashings in two coat process at 2 gallons per square per coat.
  - b. Back-roll 2nd coat for clean finish with no spray lines.

3.04 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation at commencement and upon completion.
  1. Notify Architect and Owner 48 hours in advance of date and time of inspection.
- B. Repair or remove and replace components of built-up roofing where test results or inspections indicate that they do not comply with specified requirements.
  1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.05 PROTECTING AND CLEANING

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

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

## SECTION 07 54 19

## POLYVINYL-CHLORIDE (PVC/TPA) ROOFING

**PART 1 – GENERAL**

## 1.01 SUMMARY

## A. Section Includes:

1. Mechanically fastened thermoplastic PVC/TPA roofing system on wood or metal deck, including:
2. Roof insulation cover board.
3. Walkway material.

## B. Related Sections:

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Division 06 Section " [Rough Carpentry] [Miscellaneous Rough Carpentry]" for wood nailers, curbs, and blocking.
3. Division 07 Section "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, and counterflashings.
4. Division 07 Section "Roof Accessories" for manufactured roof curbs and supports, hatches, and manufactured penetration flashings.
5. Division 07 Section "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

## 1.02 DEFINITIONS

- A. Roofing Terminology: See ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

## 1.03 SUBMITTALS

## A. Action Submittals

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

## B. Informational Submittals

1. Contractor's Product Certificate: Submit notarized certificate, indicating products intended for Work of this Section, including product names and numbers and manufacturers' names, with statement indicating that products to be provided meet the requirements of the Contract Documents.
2. Qualification Data: For Installer, Manufacturer, and Roofing Inspector.
  - a. Include letter from Manufacturer written for this Project indicating approval of Installer.
3. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.



- a. Product Compatibility: Indicate manufacturer has verified compatibility of roofing system components, including but not limited to: Roofing membrane, flashing sheets, adhesives, and sealants.

4. Warranties: Unexecuted sample copies of special warranties.

C. Closeout Submittals

1. Maintenance Data: To include in maintenance manuals.
2. Warranties: Manufacturer and contractor warranties.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and certified by manufacturer, including a full-time on-site supervisor with a minimum of five years' experience installing products comparable to those specified, able to communicate verbally with Contractor, Architect, and employees, and qualified by the manufacturer to install manufacturer's product and furnish warranty of type specified.
- B. Manufacturer Qualifications: Approved manufacturer listed in this Section, UL listed for roofing systems identical to that specified for this Project, with minimum five years' experience in manufacture of specified products in successful use in similar applications.
- C. Roofing Inspector Qualifications: A technical representative of manufacturer not engaged in the sale of products and experienced in the installation and maintenance of the specified roofing system, qualified to perform roofing observation and inspection specified in Field Quality Control Article, to determine Installer's compliance with the requirements of this Project, and approved by the manufacturer to issue warranty certification. The Roofing Inspector shall be one of the following:
  1. An authorized full-time technical employee of the manufacturer.
- D. Preinstallation Roofing Conference: Conduct conference at Project site.
  1. Meet with Owner, Architect, roofing Installer, roofing system manufacturer's representative, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
  2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
  3. 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 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 will affect roofing system.
  7. Review governing regulations and requirements for insurance and certificates if applicable.
  8. Review temporary protection requirements for roofing system during and after installation.

9. Review roof observation and repair procedures after roofing installation.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. 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.
- B. 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.
  1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. 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.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

#### 1.06 PROJECT 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. Daily Protection: Coordinate installation of roofing so insulation and other components of roofing system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.
  1. Provide tie-offs at end of each day's work to cover exposed roofing and insulation with a course of roofing sheet securely in place with joints and edges sealed.
  2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing.
  3. Remove temporary plugs from roof drains at end of each day.
  4. Remove and discard temporary seals before beginning work on adjoining roofing.

#### 1.07 WARRANTY

- A. Warranty, General: Warranties specified shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

- B. **Manufacturer's Warranty:** Manufacturer's standard or customized form, in which manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period. Failure includes roof leaks.
  - 1. Manufacturer's warranty includes roofing membrane, base flashings, fasteners, roofing membrane accessories and other components of roofing system specified in this Section.
  - 2. A single manufacturer will provide warranty for both single ply and built-up roof systems specified.
  - 3. Warranty Period: 20 years from date of Substantial Completion.
- C. **Installer's Warranty:** Submit roofing Installer's warranty, on warranty form, signed by Installer, covering the Work of this Section and related Sections indicated above, including all components of membrane roofing such as single ply roofing membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:
  - 1. Warranty Period: Two years from date of Substantial Completion.
- D. **Extended Roof System Warranty:** Warranties specified in this Section include the following components and systems specified in other sections supplied by the roofing system Manufacturer, and installed by the roofing system Installer:
  - 1. Sheet metal flashing and trim, including roof penetration flashings.
  - 2. Manufactured copings, roof edge, counterflashings, and reglets.
  - 3. Roof curbs, hatches, and penetration flashings.
  - 4. Roof and parapet expansion joint assemblies.
  - 5. Metal roof, wall, and soffit panels and trim.

## **PART 2 – PRODUCTS**

### **2.01 MANUFACTURERS**

- A. **Basis-of-Design Manufacturer/Product:** The roof system specified in this Section is based upon products of Tremco, Inc. or Equal.
- B. **Source Limitations:** Obtain components for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.

### **2.02 PERFORMANCE REQUIREMENTS**

- A. **General Performance:** Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.

1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
  2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.
- C. Flashings and Fastening: Comply with requirements of Division 07 Sections "Sheet Metal Flashing and Trim" and "Roof Specialties." Provide base flashings, perimeter flashings, detail flashings and component materials and installation techniques that comply with requirements and recommendations of the following:
1. NRCA Roofing Manual (Sixth Edition) for construction details and recommendations.
  2. SMACNA Architectural Sheet Metal Manual (Seventh Edition) for construction details.
- D. Exterior Fire-Test Exposure: ASTM E 108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.
- E. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.
- F. Energy Performance: Roofing system shall have an initial solar reflectance index of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.

## 2.03 THERMOPLASTIC MEMBRANE MATERIALS

- A. Thermoplastic PVC/TPA sheet, ASTM D4434 Type IV internally fabric reinforced, Energy Star qualified, CRRC listed, and California Title 24 Energy Code compliant. The PVC/TPA sheet is comprised of an elastomeric tri-polymer alloy that is a blend of CPE, Elvaloy, and PVC.
1. Basis of design product: Tremco, TPA Roof Membrane or Equal.
  2. Tensile Strength at 0 deg. F (-18 deg. C), minimum, ASTM D 751: 300 lbf/in.
  3. Tear Strength at 77 deg. F (25 deg. C), minimum, ASTM D 751: 100 lbf.
  4. Elongation at 0 deg. F (-18 deg. C), minimum at fabric break, ASTM D 751: 25 percent.
  5. Minimum Thickness, nominal, ASTM D 751: 60 mils.
  6. Exposed Face Color: White.
  7. Reflectance, ASTM C 1549: 86 percent.
  8. Thermal Emittance, ASTM C 1371: 0.86.
  9. Solar Reflectance Index (SRI), ASTM E 1980: 108.
  10. Recycled Content, minimum: 25 percent pre-consumer.
- B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC/TPA sheet membrane.

## 2.04 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use, and compatible with membrane roofing.
  - 1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
- B. Membrane Bonding Adhesive:
  - 1. Elastomeric solvent-based contact-type adhesive for bonding TPA single ply membranes and flashings to substrates.
    - a. TPA Single Ply Bonding Adhesive or Equal.
    - b. Density at 77 deg. F (25 deg. C), minimum, ASTM D 1475: 7.0 lb/gal.
    - c. Percent solids, minimum: 25 percent.
- C. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 mm by 3 mm) thick; with anchors.
- D. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening components to substrate, and acceptable to membrane roofing system manufacturer.
- E. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

## 2.05 ROOF INSULATION MATERIALS

- A. General: Preformed roof insulation boards manufactured or approved by roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Global-approved roof insulation.
- B. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.
- C. Roof Insulation:
  - 1. Board Insulation, Polyisocyanurate: CFC- and HCFC- free, with recycled content glass-fiber mat facer on both major surfaces, ASTM C1289 Type II Class 1.
    - a. Compressive Strength, ASTM D1621: [Grade 2: 20 psi (138 kPa)] [Grade 3: 25 psi (172 kPa)].
    - b. Conditioned Thermal Resistance at 75 deg. F (24 deg. C): 14.4 at 2.5 inches (50.8 mm) thick.
- D. Glass-mat-faced, pre-primed, gypsum panel coverboard, ASTM C 1177/C 1177M.
  - 1. Basis of design product: DensDeck or equal.
  - 2. Thickness: 1/4 inch.

## 2.06 WALKWAY MATERIALS

- A. Walkway roll, reinforced PVC/TPA membrane roll with serrated slip-resistant surface, fabricated for heat welding to compatible PVC/TPA membrane surface.
  - 1. TPA Walkway Roll or Equal.
  - 2. Roll Size: 36 inches by 60 feet.
  - 3. Thickness: 0.080 inch.
  - 4. Color: Grey.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
  - 1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.
  - 2. Wood Roof Deck: Verify that wood deck is securely fastened with no projecting fasteners.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 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. 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.
- C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

### 3.03 INSTALLATION, GENERAL

- A. Install roofing system in accordance with manufacturer's recommendations.

### 3.04 INSULATION INSTALLATION

- A. Cover Boards: Install cover boards straight lines with end joints staggered between rows. Loosely butt cover boards together and mechanically fasten to roof deck.

1. Mechanically fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.
2. Mechanically fasten cover boards, minimum 8 fasteners per 4' x 8' board.

### 3.05 MECHANICALLY FASTENED MEMBRANE ROOFING INSTALLATION

- A. Mechanically fasten membrane roofing over area to receive roofing and install according to roofing system manufacturer's written instructions.
  1. Install sheet according to ASTM D 5082.
- B. Start installation of membrane roofing in presence of roofing system manufacturer's technical personnel.
- C. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Mechanically fasten or adhere membrane roofing securely at terminations, penetrations, and perimeter of roofing.
- E. Apply membrane roofing with side laps shingled with slope of roof deck where possible.
- F. Welded Seams: Clean seam areas, overlap membrane roofing, and hot-air weld side and end laps of membrane roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.
  1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet membrane.
  2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
  3. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.
  4. Install T patches where sheets intersect.
- G. Spread sealant bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.

### 3.06 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

### 3.07 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.
- B. Walkways will not be installed over seams in single ply membrane.

### 3.08 FIELD QUALITY CONTROL

- A. Manufacturer Inspector: Manufacturer will employ technical personnel to inspect the roof while it is being installed. Roof will be inspected a minimum of 3 times per week while in progress with jobsite reports, including photos, sent to all of the project stakeholders.
- 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 membrane roofing system where inspections indicate that they do not comply with specified requirements.
- D. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### 3.09 PROTECTING AND CLEANING

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

END OF SECTION



## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

SECTION 07 60 00

FLASHING AND SHEET METAL

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. All applicable portions of Division 1, including the drawings and general provisions of the contract, the general and supplementary conditions and Division 1 specification sections which apply to work of this section as if printed herein.
- B. Section Includes:
  - 1. Flashings, counter flashings, and copings as indicated on the Drawings and specified herein.
- C. Related Sections:
  - 1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
  - 2. Section 05 50 00 - Miscellaneous Metal.
  - 3. Section 07 52 16 – SBS Modified Bituminous Membrane Roofing.
  - 4. Section 07 54 19 – Polyvinyl-Chloride Roofing.
  - 5. Section 07 71 23 – Gutters and Related Flashings.
  - 6. Section 07 90 00 – Joint Sealants.
  - 7. Refer to Division 7, for Roofing Sections, and Prefabricated roof curbs, hatches, roof deck insulation, and Division 8 component daylight systems.

**1.02 REFERENCES**

- A. Fabricate sheet metal items from sheet steel in accordance with ASTM G90.
- B. ASTM A924 / A924M-16ae1 - General Requirements for Steel Sheet, Metallic-Coated by the Hot Dip Process.
- C. FS TT-C 494B – Federal Specification for Coating Compound, Bituminous, Solvent Type, Acid Resistant.
- D. SMACNA - Architectural Sheet Metal Manual, current edition.
- E. AWS - American Welding Society.

**1.03 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.

- B. Shop Drawings: Indicate locations, configurations, jointing methods, welding methods, fastening methods, expansion joint layouts, downspout layout and installation details.
- C. Samples: Submit two samples, 12 inches long illustrating component design, finish, color, and configuration.

#### 1.04 QUALITY ASSURANCE

- A. Conform to SMACNA Manual for architectural sheet metal flashing and installation details.

### PART 2 – PRODUCTS

#### 2.01 MATERIALS

- A. Where general flashing pieces are shown on drawings, provide steel sheet metal of at least 22-gauge steel unless otherwise noted on drawings.
- B. Where sheet aluminum is shown on Drawings, provide 0.032-inch thickness (20-gauge) and in accordance with ASTM B209, 6063-T5 in color finish as selected by Architect.
- C. Extruded Aluminum: Manufacturer's standard extrusions of sizes and profiles indicated, 60063-T52, AA-C22A41 clear anodized finish; 0.080-inch minimum thickness for primary legs of extrusions.
- D. Stainless Steel: AISI Type 302/304, complying with ASTM A167, 2D annealed finish, soft, except where harder temper required for forming or performance; 0.0156-inch thick (28 gauge) except as otherwise indicated.
- E. Galvanized Steel: ASTM A924 / A924M-09a, Grade A, G90 zinc coating.

#### 2.02 ACCESSORIES

- A. Fasteners and Clips: Provide as required and appropriate for the materials being fastened. Where fasteners or clips may be exposed to outside weather conditions, provide galvanized or stainless-steel type.
  - 1. Provide fasteners such as bolts, screws, and nails hot-dip galvanized as specified in accordance with ASTM A153.
- B. Where rivets will be used, provide malleable iron type with rust-inhibitive coating.
- C. If drive pins are incorporated into work, provide Omark or other approved, cadmium plated with neoprene facing, at least 1-inch long, with neoprene washers.
- D. Solder: For use steel or copper, provide 50 – 50 tin/lead solder (ASTM B32) with rosin flux.
- E. Solder: For use with stainless steel, provide 60 – 40 tin/lead solder (ASTM B32) with acid-chloride type flux, except use rosin flux over tinned surfaces.

- F. Bituminous Coating: SSPC – Paint 12, solvent-type bituminous mastic, nominally free of sulfur, compounded for 15-mil dry film thickness per coat.
- G. Mastic Sealant: Polyisobutylene; non-hardening, non-skinning, non-drying, non-migrating sealant.
- H. Elastomeric Sealant: Generic type recommended by manufacturer of metal and fabricator of components being sealed and complying with requirements for joint sealants as specified in Section 07 90 00 Joint Sealers.
- I. Epoxy Seam Sealer: Two-part noncorrosive metal seam cementing compound, recommended by metal manufacturer for exterior/interior non-moving joints including riveted joints.
- J. Adhesives: Type recommended by flashing sheet manufacturer for waterproof/weather-resistant seaming and adhesive application of flashing sheet.
- K. Paper Slip Sheet: 5 lbs. rosin-sized building paper.
- L. Polyethylene Underlayment: Minimum 6-mil carbonated polyethylene film resistant to decay when tested in accordance with ASTM E154.
- M. Reglets: Metal or plastic units of type and profile indicated, compatible with flashing indicated, noncorrosive.
- N. Elastic Flashing Filler: Closed-cell polyethylene or other soft closed-cell material recommended by elastic flashing manufacturer as filler under flashing loops to ensure movement with minimum stress on flashing sheet.

## 2.03 FABRICATION

- A. General Metal Fabrication:
  - 1. Shop fabricate work to greatest extent possible. Comply with details shown and with applicable requirements of SMACNA "Architectural Sheet Metal Manual" and other recognized industry practices. Fabricate waterproof and weather-resistant performance with expansion provisions for running work, sufficient to permanently prevent leakage, damage, or deterioration of the work.
  - 2. Form work to fit substrates. Comply with material manufacturer instructions and recommendations for forming material. Form exposed sheet metal work without excessive oil-canning, buckling, and tool marks, true to line and levels indicated, with exposed seams with epoxy seam sealer; rivet joints for additional strength where required.
- B. Seams: Fabricate non-moving seams in sheet metal with flat-lock seams. For metal other than aluminum, in edges to be seamed, form seams and solder. Form aluminum seams with epoxy seam sealer; rivet joints for additional strength where required.

- C. Expansion Provisions: Where lapped or bayonet-type expansion provisions in work cannot be used or would not be sufficiently weather/waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- D. Sealant Joints: Where movable, non-expansion type joints are indicated or required for proper performance of work, form metal to provide for proper installation of elastomeric sealant, in compliance with SMACNA standards.
- E. Separations: Provide for separation of metal from incompatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with bituminous coating or other permanent separation as recommended by manufacturer/fabricator.
- F. Aluminum Extrusion Units: Fabricate extruded aluminum running units with formed for extruded aluminum joint covers. Fabricate mitered and welded corner units.

#### 2.04 PREFABRICATED SHEET METALS

- A. Copings: Provide factory prefabricated 22-gauge galvanized steel sheet metal continuous snap on type copings per SMACNA Chapter 3, Figure 3-1 with EIEPGE Styles. Copings shall be maximum 10-foot lengths, secured at one (1) end and free at other end and/or per SMACNA requirements. Cover plate shall extend 6-inch minimum beyond 1/2-inch space between coping lengths. Secure cover plate with screw in neoprene washer per SMACNA Figure 3-1-Detail 1 in oversized holes. Provide copings manufactured by MM Systems Corporation, Construction Specialties, Tremco, KC Metals, Fry Reglet or others, as approved by Architect.
  - 1. Pre-finish coping in Kynar 500 coating of standard color as selected by Architect.
- C. All other flashing: Provide minimum 22-gauge galvanized flashing to the sizes and shapes as detailed on the drawings. All exposed flashing shall be primed and painted per the paint specification sections. Provide minimum two (2) coats of paint.
- D. Expand-O-Flashing, for Expansion Joints at Roof Expansions and Roof/Wall Expansion Joint Conditions: Provide factory Expand-O-Flash by Johns Manville or equal. Provide 10 foot or maximum lengths possible. Fabricate Expand-O-Flash expansion joint covers as detailed on the drawings. Use Type N-Neoprene Sheet-Black, flange shall be minimum 26 ga. galvanized steel bellows width minimum 4 inches.
- E. Expansion and Seismic Covers for Expansion Joints and Seismic Joints for Floors, Ceilings, Walls and Roofs: Provide factory aluminum joint covers by Balco Inc. or equal. Provide maximum lengths possible. Fabricate expansion and seismic joints covers Model No. RDA-4 with aluminum center plate. Provide extruded aluminum sub-channel (6063-T5) standard mill finish. Movement capabilities shall be at 50 percent or as recommended by the manufacturer.
  - 1. At Rated Expansion and Seismic Joint Conditions up to 2 Hour Rated Systems: Use Balco Fire Barrier Systems as tested in accordance with ASTM E1966 and as listed with Omega Point Laboratories Inc.

2. Expansion and Seismic Joint Covers at Interior, Vertical, and Ceiling Surfaces: Use 6000 Series No. 6GOU- Aluminum snap lock cover plate with standard aluminum mill finish.
  3. Expansion and Seismic Joint Cover at Exterior Vertical and Ceiling/Soffit Surfaces: Use FCWW aluminum with standard mill finish.
- F. All Expansion and Seismic Covers that intersect at Floor to Wall, Wall to Ceiling/Soffit, Roof to Parapet, etc.: Use factory preassembled transition pieces that will meet the manufacturers' minimum requirement for a watertight intersection connection.
- G. Balconies Edge Flashing: Use Schluter-Bara-Rak powder-coated aluminum edging profile with drip lip. Extruded aluminum to ASTM B221, 6463-T5 alloy with integral trap E201-DAL-perforated anchoring leg and complete with outside/inside corners and connectors. Length 8 ½ inches long. Color from standard color. Use a thin set mortar over the trapezoid perforated anchoring leg. Apply waterproof membrane per manufacturers' requirements.

### **PART 3 – EXECUTION**

#### **3.01 PREPARATION**

- A. Inspect substrate conditions prior to installation of sheet metal items. Conditions which could be detrimental to correct and proper installation of sheet metal assemblies are to be called to the attention of the Owner for their disposition prior to sheet metal work being installed.
- B. Coordinate fabrication and installation of sheet metal items with work of others such as roofing, curtainwall and windows, sealants, mechanical and electrical.

#### **3.02 INSTALLATION**

- A. General: Except as otherwise indicated, comply with manufacturer's installation instructions and recommendations and with SMACNA "Architectural Sheet Metal Manual." Anchor units of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weatherproof.
- B. Underlayment: Where stainless steel or aluminum is to be installed directly on cementitious or wood substrates, install a slip sheet of red rosin paper and a course of polyethylene underlayment.
- C. Bed flanges of work in a thick coat of bituminous roofing cement where required for waterproof performance.
- D. Install reglets to receive counterflashing in manner and by methods indicated. Where shown in concrete, furnish reglets to trades of concrete work for installation as work of Division 3 sections. Where shown in masonry, finish reglets to trades of masonry work, for installation as work of Division 4 sections.

- E. Install counter flashings in reglets, either by snap-in seal arrangement or by welding in-place for anchorage and filling reglet with mastic or elastomeric sealant, as indicated in depending on degree of sealant exposure.
- F. Install elastic flashing in accordance with manufacturer's recommendations. Where required, provide for movement as joints by forming loops or bellows in width of flashing. Locate cover or filler strips at joints to facilitate complete drainage of water for flashing. Seam adjacent flashing sheets with adhesive, seal and anchor edges in accordance with manufacturer's recommendations.
- G. Nail flanges of expansion joint units to curb nailers, at maximum spacing of 6 inches o.c. Fabricate seams at joints between units with minimum 3-inch overlap, to form a continuous, waterproof system.
- H. Conductor Head Guards: Install "bee-hive type" strainer-guard at conductor heads, removable for cleaning downspouts.
- I. Flash around exterior openings in the building where other waterproofing methods are insufficient.
- J. Joints
  - 1. Typically, provide flat locked joints with sealant between metal surfaces, unless shown otherwise. Where standing seams are required, provide with folded corners.
  - 2. Provide minimum of 3-inch laps.
  - 3. Where concealed joints are possible, provide flat locked joints with 3-inch reinforcing behind, set-in full bed of sealant.
  - 4. Do not leave sheet metal joint unsealed. See sealant section of these specifications.

### 3.03 INSPECTION

- A. Immediately following installation of sheet metal work, touch-up areas where primer has been removed during installation operations and where soldering has occurred.
- B. Where architectural coatings are provided, touch-up marred or abraded finishes with compatible coating which can be expected to provide the same serviceability as factory applied coatings.

### 3.04 CLEANING

- A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.

### 3.06 PROTECTION

- A. Advise Contractor of required procedures for surveillance and protection of flashings and sheet metal work during construction to ensure that work will be without damage or deterioration other than natural weathering at time of Substantial Completion.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.



SECTION 07 71 23  
GUTTERS AND RELATED FLASHINGS

**PART 1 – GENERAL**

**1.01 SUMMARY**

**A. Section Includes**

1. Galvanized steel gutters.
2. Downspouts.
3. Related flashing.

**B. Related Sections**

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 05 50 00 - Metal Fabrications.
3. Section 07 60 00 - Sheet Metal Flashing and Trim.
4. Section 07 52 16 – SBS Modified Bituminous Membrane Roofing.
5. Section 07 54 19 – Polyvinyl-Chloride Roofing.
6. Refer to Division 7, for Roofing Sections, and Prefabricated roof curbs, hatches, roof deck insulation, and Division 8 component daylight systems.
7. Section 07 90 00 - Sealants.
8. Section 09 91 00 - Painting: Field painting of metal surfaces.

**1.02 REFERENCES**

- A. ASTM A924 / A924M-16ae1 – Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- B. FS TT-C-494 - Coating Compound, Bituminous, Solvent Type, Acid Resistant.
- C. SMACNA - Architectural Sheet Metal Manual, current edition.
- D. AWS - American Welding Society.

**1.04 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.
- B. Shop Drawings: Indicate locations, configurations, jointing methods, welding methods, fastening methods, expansion joint layouts, downspout layout and installation details.
- C. Samples: Submit two samples, 12 inches long illustrating component design, finish, color, and configuration.

**1.05 QUALITY ASSURANCE**

- A. Conform to SMACNA Manual for architectural sheet metal flashing and installation details.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, protect and handle products to site under provisions of Section 01 66 00.
- B. Stack pre-formed material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope to drain.
- C. Prevent contact with materials during storage which may cause discoloration, staining, or damage.

**1.07 COORDINATION**

- A. Coordinate painting portions prior to installation and the work with downspout discharge pipe inlet.

**PART 2 – PRODUCTS****2.01 MATERIALS**

- A. Galvanized Steel: ASTM A924 / A924M-09a, Grade A, G90 zinc coating.
- B. Schedule 10 galvanized pipe.

**2.02 COMPONENTS**

- A. Gutters: 18-gauge core steel. Minimum size shall be 6"x6" or as otherwise shown on drawings.
- B. Downspouts: Finished grade to bottom of gutter shall be schedule 10 galvanized pipe, round shape only, 3" minimum diameter or size as shown on drawings.

**2.03 ACCESSORIES**

- A. Anchorage Devices: SMACNA requirements.
- B. Gutter Supports: Straps.
- C. Fasteners: Galvanized steel or stainless steel and as specified in Section 05 50 00. Finish exposed fasteners same as flashing metal.
- D. Clean out Tee: Smith 4510 cleanout tee with countersunk plug and round access cover. 4", 5" or sized as required to coordinate with downspout and underground piping sizes.
- E. Touch-up Primer: Cold applied zinc-rich type.

- F. Protective Back Coating: FS TT-C-494, bituminous.
- G. Sealant: Type as specified under Section 07 90 00.
- H. Conductor-Head Guards: 20-gauge bronze or nonmagnetic stainless-steel mesh or fabricated units, with salvaged edges and noncorrosive fasteners. Select materials for compatibility with gutters and downspouts.
- I. Overflow Drain: 18 ga. galvanized sheet metal. Approximately 2 inches high by 2 inch diameter.

## 2.04 FABRICATION

- A. Form gutters of profiles and size indicated, to SMACNA requirements.
- B. Gutters shall be fascia mounted whenever possible. See drawings for additional mounting information.
- C. Fabricate with required connection pieces.
- D. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.
- E. Hem all exposed edges of metal.
- F. Welding process shall be Metallic Inert Gas (MIG).
- G. Weld all shop formed metal joints. Grind exposed joints flush with adjacent surfaces and apply touch-up primer as specified.
- H. Butt weld all field assembled gutter sections. Grind exposed joints flush with adjacent surfaces and apply touch-up primer as specified.
- I. Fabricate gutter sections with SMACNA butt type expansion joints at 40 feet maximum with a minimum of one (1) downspout in each 40 foot section. Provide additional downspouts as necessary to accommodate expansion joint locations.
- J. All joints shall be watertight per SMACNA standards.
- K. All downspouts shall have fully welded joints and be ground smooth. Provide T-shaped bracket welded to back of downspout for bolting to building. See drawings for additional information.
- L. All downspouts that spill to grade shall have a 45-degree elbow of same pipe profile fully welded to bottom of downspout.
- M. All downspouts connecting to underground storm drainage systems shall be provided with a cleanout tee at grade.

- N. At all individual gutter sections, provide an overflow drain at opposite end of gutter from downspout. Overflow drain shall be fully welded to gutter bottom. I.D. shall match the I.D. for the downspout outlet.

## 2.05 FINISHES

- A. Field paint gutters under provisions of Section 09 91 00.
- B. Apply bituminous protective backing on surfaces in contact with dissimilar materials.

## PART 3 – EXECUTION

### 3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work.

### 3.02 INSTALLATION

- A. Install gutters and downspouts as shown on drawings. Install expansion joints, additional downspouts and accessories as specified.
- B. Field assemble (weld) gutter sections at “ground level” wherever possible and lift into place as one unit.
- C. All downspout sections shall be fully welded, ground smooth, primed and painted. All downspouts shall be mechanically fastened to building at top, bottom, and maximum 6 feet on center.
- D. Install gutters level and straight in line with building. Shim horizontally and vertically as required to level. Installed gutter to have no ponding water more than ¼” deep.
- E. Water test all gutters and downspouts for leaks and ponding in presence of IOR.
- F. At all welded connections, end caps, overflows, and outlets, provide bituminous coating minimum 1 inch each side of joint.
- G. Provide 3-inch closure plate at all gutter expansion joint locations.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 2023-01-06 – Corrected wrong references to other spec sections.
- 2025-01-25 – Removed references to fire sealants. This type of material is not District defined and is project specific to be provided elsewhere by Design Team.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

SECTION 07 90 00

JOINT SEALERS

**PART 1 – GENERAL**

**1.01 SUMMARY**

**A. SECTION INCLUDE**

1. Preparing sealant substrate surfaces.
2. Concrete Joint Sealants.
3. Sealant and backing.

**B. RELATED SECTIONS**

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 00 72 13: General Conditions.
3. Section 03 30 00: Cast-In-Place Concrete.
4. Section 07 60 00: Flashing and Sheet Metal: Sealants used in conjunction with metal flashings.
5. Section 07 71 23: Gutters and Related Flashings.
6. Section 08 11 00: Metal Doors and Frames: Perimeter sealants.
7. Section 09 29 00: Gypsum Board Systems.
8. Division 22: Mechanical.
9. Division 26: Electrical.
10. Section 32 16 00: Site Concrete.

**C. REFERENCES**

1. ASTM C834 Standard Specification for Latex Sealants.
2. ASTM C920 Standard Specification for Elastomeric Joint Sealants.
3. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
4. ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials.
5. ASTM E814 Standard Test Method for Fire Tests of Penetration Firestop Systems.
6. FM (Factory Mutual) - Fire Hazard Classifications.
7. UL - Fire Hazard Classifications.
8. UL 263 – Standard for Fire Tests of Building Construction and Materials.
9. UL 723 - Test for Surface Burning Characteristics of Building Materials.
10. UL 1479 - Fire Tests of Through-Penetration Firestops.
11. FS TT S 00227 Sealing Compound: Elastomeric Type, Multi-Component.
12. FS TT S 00230 Sealing Compound: Elastomeric Type, Single Component.
13. FS TT S 001543 Sealing Compound, Silicone Rubber Base.

**1.02 SUBMITTALS**

- A. Submit manufacturer's product data under provisions of Section 01 33 00 for each product required.

- 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 standard color ranges of exposed materials for Architect selection.
- E. Submit manufacturer's installation instructions under provisions of Section 01 33 00.

1.03 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years' experience.
- B. Applicator: Company specializing in applying the work of this section with minimum three years' experience, with projects of a similar size and type.
- C. Conform to Sealant Waterproofing and Restoration Institute requirements for materials and installation.
- D. Prior to installation of joint sealants, field test adhesion to joint substrates.
  - 1. Install joint sealants in 5-foot joint lengths. Allow to cure before testing. Test adhesion by pulling sealant out of joint.
  - 2. Perform field tests for each type of elastomeric sealant and joint substrate.
  - 3. Arrange for tests to take place with joint sealant manufacturer's technical representative present.
  - 4. Report whether or not sealant in joint connected to pulled out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate.
  - 5. Sealants not evidencing adhesive failure from testing, in absence of other indications of non-compliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrate during testing.

1.04 ENVIRONMENTAL REQUIREMENTS

- A. Do not install solvent curing sealants in enclosed building spaces.
- B. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.
- C. Do not install sealants under adverse weather conditions or when temperatures are above or below manufacturer's recommended limitations for installation.

- D. Deliver materials in the unopened, original containers or unopened packages with manufacturer's name, labels, product identification, color, expiration period, curing time and mixing instructions for multi-component materials.

#### 1.05 SEQUENCING AND SCHEDULING

- A. Coordinate the work of this Section with all Sections referencing this Section.

#### 1.06 WARRANTY

- A. Provide two-year warranty for materials and workmanship under provisions of Section 01 33 00.
- B. Warranty: Include coverage of installed sealants and accessories which fail to achieve airtight and watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

### PART 2 – PRODUCTS

#### 2.01 SEALANTS

- A. Silicone Sealant: Silicone Sealant (use at concrete, masonry, or glazing applications): FS TT S 01543, Class A, low modulus type; Spectrum I as manufactured by Tremco, Inc.
- B. Interior Building Sealant: Acrylic-emulsion; one-part, non-sag, mildew-resistant. Complying with ASTM C834, formulated to be paintable; Pecora Corp. "AC-20", Sonneborn "Sonolac", Tremco Inc. "Tremco Acrylic Latex 834" or approved equal.
- C. Sanitary Sealant: One-part mildew-resistant silicone; ASTM C920 Type S; Grade NS Class 25; Uses NT, G, A and O; formulated with fungicide for sealing interior joints with nonporous substrates around ceramic tile, showers, sinks and plumbing fixtures; Dow Corning Corp. "786 Mildew Resistant", or approved equal.
- D. Acoustical Sealant for Concealed Joints: Nondrying, nonhardening, non-skinning, non-staining, gun-able, synthetic rubber sealant recommended for sealing interior concealed joints to reduce transmission of airborne sound; Pecora Corp. "BA-98", Tremco Inc. "Tremco Acoustical Sealant" or approved equal.
- E. Acoustical Sealant for Exposed Joints: Nonoxidizing, skin-able, paintable, gun-able sealant recommended for sealing interior exposed joints to reduce transmission of airborne sound; Pecora Corp. "AC-20", USG "Sheetrock Acoustical Sealant" or approved equal.
- F. Concrete Expansion Joints: Joint sealing material shall be a two-component, self-leveling, polyurethane elastomeric sealant. Product shall be Sikaflex 2cSL as manufactured Sika Corporation, or equal. Color shall be chosen from the full range of manufacturer's standard colors.
- G. Vertical Building Expansion Joints: Joint sealing material shall be a one-component, polyurethane-based non-sag elastomeric sealant. Product shall be Sikaflex Construction Sealant as manufactured



Sika Corporation, Pecora Corp. "DynaTrol II" or approved equal. Color shall be chosen from the full range of manufacturer's standard colors.

- H. Sheet Metal Flashings, Trims, Gutters, & Joints: Joint sealing material shall be a two-component, self-leveling, polyurethane elastomeric sealant. Product shall be Sikaflex 2cSL as manufactured Sika Corporation, or equal. Color shall be chosen from the full range of manufacturer's standard colors. Provide Sikaflex 260 Primer at all stainless steel and/or galvanized substrate location for proper adhesion of Sikaflex 2cSL.
- I. Substitutions: Under provisions of Section 01 33 00.
- J. Color of sealant shall be as selected by Architect.

## 2.03 ACCESSORIES

- A. Primer: Non staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Noncorrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Backing: Non-staining; compatible with sealant and primer; such as round, closed cell polyethylene foam rod; oversized 30 to 50 percent larger than joint width. Materials impregnated with oil, bitumen or similar materials shall not be used. Sealant shall not adhere to back-up material.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.
- E. Solvents: cleaning agents or other accessory materials shall be as recommended by the sealant manufacturer.

## PART 3 – EXECUTION

### 3.01 EXAMINATION

- A. Verify that surfaces and 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 surfaces.

### 3.02 PREPARATION

- A. Clean and prime joints in accordance with manufacturer's instructions.
- 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 sealant manufacturer's recommendations.

- E. Protect elements surrounding the work of this Section from damage or disfiguration.
- F. Clean concrete, masonry, unglazed surfaces of ceramic tile and similar porous surfaces, by brushing, grinding, blast cleaning, mechanical abrading, or acid washing to produce a clean, sound substrate. Remove loose particles remaining from cleaning operations by vacuuming or blowing out joints.
- G. Clean metal, glass, glazed surfaces of ceramic tile and other non-porous surfaces by chemical cleaners or other means which are not harmful to substrates or leave residues capable of interfering with adhesion of joint sealants.

### 3.03 INSTALLATION

- A. Install sealant in accordance with manufacturer's instructions.
- B. Caulk all exterior joints and openings in the building envelope that are observable sources of air infiltration.
- C. Measure joint dimensions and size materials to achieve required width/depth ratios.
- D. Install joint backing to achieve a neck dimension no greater than  $\frac{1}{3}$  the joint width. Roll the material into the joint to avoid lengthwise stretching. Do not twist or braid rod stock.
- E. Install bond breaker where joint backing is not used.
- F. Prime surfaces to receive joint sealant with primer recommended by sealant manufacturer.
- G. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges. Apply masking tape where required to protect adjacent surfaces from sealant application.
- H. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- I. Tool joints concave.
- J. At all surface-mounted light fixtures mounted on gypsum board ceilings, contractor shall caulk light fixture body to ceiling finish to eliminate gap between metal body and fixture. Coordinate locations with drawings.

### 3.04 CLEANING AND REPAIRING

- A. Clean work under provisions of Section 01 77 00.
- B. Clean adjacent soiled surfaces. Use a solvent or cleaning agent as recommended by the sealant manufacturer.
- C. Repair or replace defaced or disfigured finishes caused by work of this Section.

3.05 PROTECTION OF FINISHED WORK

- A. Protect finished installation under provisions of Section 01 66 00.
- B. Protect sealants until cured.
- C. Do not paint sealants until sealant is fully cured.
- D. Do not paint silicone sealant.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Knock down frames are okay for modernization work.
- Metal or FRP doors at exterior locations. No exterior wood doors.

## SECTION 08 11 00

## METAL DOORS AND FRAMES

**PART 1 - GENERAL**

## 1.01 SUMMARY

## A. Work Included:

1. Non-rated and fire rated rolled steel doors, panels, and frames.
2. Louvers.

## B. Referenced Sections:

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 08 14 00 - Wood Doors and Frames.
3. Section 08 16 13 - FRP Doors.
4. Section 08 43 00 - Storefronts.
5. Section 08 71 00 - Door Hardware.
6. Section 08 80 00 - Glazing.

## 1.02 REFERENCES

- A. ANSI A250 .8 – Recommended Specification for Standard Steel Doors and Frames.
- B. ANSI A250.3 - Test Procedure and Acceptance Criteria for Factory-Applied Finish Painted Steel Surfaces for Steel Doors and Frames.
- C. ANSI A250 .10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
- D. ASTM A653 - Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot- Dip Process.
- E. ASTM A924 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
- F. CEC - California Energy Commission.
- G. NFPA 80 - Fire Doors and Windows.
- H. SDI-105 - Recommended Erection Instructions for Steel Frames.
- I. DHI - Door and Hardware Institute.

- J. CBC - California Building Code, (CCR) California Code of Regulations, Title 24, Part 2 and Part 6.
- K. UL 9 - Fire Tests of Window Assemblies.
- L. UL 10C - Fire Tests of Door Assemblies.

#### 1.03 QUALITY ASSURANCE

- A. Conform to requirements of ANSI A250.8.
- B. Fire rated door, panel and frame construction to conform to UL 9 and UL 10C.
- C. Installed frame and door assembly to conform to NFPA 80 for fire rated class indicated on Drawings.
- D. Installed exterior frame and door assembly to be weather tight
- E. Manufacturer shall have both fabrication and assembly plant located within the continental United States or Canada. Products that are either fabricated or assembled outside the continental United States or Canada are not acceptable.

#### 1.04 SYSTEM REQUIREMENTS

##### A. Performance Requirements

1. Thermal Performance: Glazed exterior borrowed lite, side lite and transom lite frames shall have an overall minimum u-value of 1.19 as rated in accordance with the default table method approved by the California Energy Commission (CEC). Provide Label Certificate FC-1, Figure 3-3, from the Nonresidential Compliance Manual documenting compliance with the CBC, California Building Code, (CCR) California Code of Regulations, Title 24, Part 6, Section 116, Table 116-A.
2. Solar Heat Gain Coefficient: Glazed exterior borrowed lite, side lite and transom lite frames shall have an overall maximum solar heat gain coefficient of 0.68 as rated in accordance with default table method approved by the California Energy Commission (CEC). Provide Label Certificate FC-1, Figure 3-3, from the Nonresidential Compliance Manual documenting compliance with the CBC, California Building Code, (CCR) California Code of Regulations, Title 24, Part 6, Section 116, Table 116-B.

##### A. Regulatory Requirements

1. Conform to CBC, California Building Code, (CCR) California Code of Regulations, Title 24, Part 2 for fire rated frames and doors.
2. Conform to CBC, California Building Code, (CCR) California Code of Regulations, Title 24, Part 6, for u- value and solar heat gain coefficient.

#### 1.05 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 01 33 00.

- B. Indicate frame configuration, anchor types and spacings, location of cutouts for hardware, reinforcement, and finish.
- C. Indicate door elevations, internal reinforcement, closure method, and cut outs for glazing and louvers.
- D. Submit two (2) samples of exterior frame profile at mullion intersection.
- E. Submit Label Certificate FC-1, Figure 3-3, from the Nonresidential Compliance Manual documenting compliance with the CBC, California Building Code, (CCR) California Code of Regulations, Title 24, Part 6, Section 116, Table 116-A and 116-8.

#### 1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect, and handle products under provisions of Section 016200.
- B. Store products on site under cover.
- C. Place products on at least 4-inch wood sills to prevent rust and damage.
- D. Protect doors and frames with resilient packaging.

#### 1.08 SEQUENCING AND SCHEDULING

- A. Sequence work under the provisions of Section 01 32 13.
- B. Schedule work under the provisions of Section 01 32 13.
- C. Schedule delivery of all doors and frames so as not to delay progress of other trades.

### PART 2 - PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS

- A. Amweld Building Products, Inc., [www.amweld.com](http://www.amweld.com).
- B. Curries Mfg. Inc., [www.curries.com](http://www.curries.com).
- C. Door Components, Inc., [www.doorcomponents.com](http://www.doorcomponents.com).
- D. Fleming, [www.flemingdoor.com](http://www.flemingdoor.com).
- E. Krieger Steel Products Company, [www.kriegersteel.com](http://www.kriegersteel.com).
- F. Republic Builders Products Corporation, [www.republicdoor.com](http://www.republicdoor.com).

- G. Curries, [www.curries.com](http://www.curries.com).
- H. Ceco, [www.cecodoor.com](http://www.cecodoor.com).
- I. Substitutions: Under provisions of Section 01 25 13.

## 2.02 MATERIALS

### A. Doors, Panels and Frames

1. Steel: Commercial quality cold rolled steel conforming to ASTM A653 galvanized to A60 or G60 coating class or Type 8, A40 (ZF120) according to ASTM A924 with minimized spangle, mill phosphatized.
2. Exterior Doors: ANSI A250.8, Level 3, extra heavy-duty, Model 2, continuous welded seam, minimum 0.053-inch-thick faces (16 GA. Minimum).
3. Interior Doors: ANSI A250.8, Level 2 heavy duty, Model 1, minimum 0.042-inch-thick faces (18 GA. Minimum).
4. Exterior Frames: ANSI A250.8, Level 3, 0.067-inch-thick material (14 GA. Minimum), core thickness.
5. Interior Frames: ANSI A250.8, Level 2, 0.053-inch-thick material (16 GA. Minimum), core thickness.
6. Panels: Same materials and construction as specified for doors.

### B. Door Core

1. Exterior Core: Polystyrene insulation.
2. Interior Door Core: Impregnated cardboard honeycomb.

### C. Closer Channels

1. Close top and bottom edge of exterior door flush with inverted steel channel closure. Weld all joints watertight.

### D. Frame Anchors

1. Masonry Anchors: Adjustable T-strap, 0.053-inch-thick steel, corrugated, 2-inch x 10-inch size. Fire rated frames to have UL listed perforated strap anchor permanently anchored to frame.
2. Metal Stud Anchor: Z type anchor, welded to frame, 0.053-inch-thick steel, UL listed as required for fire rating.
3. Wood Stud Anchor: U shaped anchor, welded to frame, 1 inch wide, 0.053-inch-thick steel, with 2 pre-punched holes in nailing flange. UL listed as required for fire rating.
4. Existing Wall Anchor: 0.053-inch-thick pipe spacer with 2-inch x 0.053-inch-thick steel plate sized to accommodate a 3/8 diameter countersunk flathead expansion anchor. UL listed as required for fire rating.
5. Floor Clip: Angle anchor, full width of frame, 0.067-inch-thick steel.



## E. Protective Coatings

1. Bituminous Coating: Fibered asphalt-based corrosion proofing and sound deadener compound. Equivalent to Transcoat 101-F, [www.oilservice.com](http://www.oilservice.com).
2. Primer: Clean and treat with three stage iron phosphate process. Provide baked-on shop coat of EPA compliant gray synthetic rust - inhibitive enamel primer meeting acceptance criteria of ANSI 250.10.

## F. Hardware Reinforcement

1. Fabricate frames and doors with hardware reinforcement plates welded in place.
2. Hinge reinforcing shall be full width of frame profile.
3. Provide spacers for all thru-bolted hardware.
4. Reinforcement components shall be the following minimum thickness:
5. Hinge (door and frame)      3/16 inch
6. Mortise Lock or Deadbolt    0.093 inch
7. Bored Lock or Deadbolt      0.093 inch
8. Flush Bolt Front            0.093 inch
9. Surface Bolt                 0.093 inch
10. Surface Applied Closer      0.093 inch
11. Hold Open Arm              0.093 inch
12. Pull Plates and Bars        0.067 inch
13. Surface Exit Device         0.093 inch
14. Floor Checking Hinge       0.167 inch
15. Pivot Hinge                 0.167 inch

## 2.03 ACCESSORIES

- A. Door Louvers: 18-gauge, non-vision, inverted split "Y" louver with 12-gauge security grille two sides, prime coat finish for field painting. Provide optional galvanized attached mesh insect screen. Size as shown on Drawings.
  1. Anemostat security door louvers, model #PLSL.
  2. Air Louvers Inc., Model 1500-A.
- B. PeepHoles: Schlage 190 Degree Wide Angle Viewer. Satin nickel finish.
- C. Rubber Silencers: Resilient rubber as supplied by Section 08 71 00.
- D. Glazing Stops: Rolled steel channel shape, mitered corners; prepared for countersink style tamperproof screws at door installations, square butt at light frames.

## 2.03 FABRICATION

- A. When shipping limitations so dictate, frames for large openings shall be fabricated in sections designed for splicing.

- B. All spliced joints shall occur on the interior side of exterior frames.
- C. Fabricate frames as full profile welded units.
- D. All face, rabbet and soffit joints between abutting members shall be continuously welded and finished smooth when exposed to exterior.
- E. Corner joints shall have all contact edges closed tight, with faces mitered and continuously welded.
- F. Frames with multiple openings shall have mullion members fabricated with no visible seams or joints. All face, rabbet and soffit joints between abutted members shall be continuously welded and finished smooth when exposed to exterior.
- G. Provide 3/8-inch back bend return on frames where gypsum board wall material occurs whether on one or both sides.
- H. Mullions for Double Doors: Removable type supplied by Section 08 71 00.
- I. Dust cover boxes or mortar guards of 0.016-inch-thick steel shall be provided at all hardware mortises on frames.
- J. Reinforce frames wider than 48 inches with roll formed, 0.093-inch-thick steel channels fitted tightly and welded into frame head, inverted U-shape profile.
- K. Prepare frame for silencers except for frames which receive weatherstripping. Provide three (3) single rubber silencers for single doors on strike side, and two (2) single silencers on frame head at double doors without mullions.
- L. Provide steel spreader temporarily attached to feet of both jambs as a brace during shipping and handling. Spreader is not to be used for installation purposes.
- M. Attach fire rated label to each frame and door unit.
- O. Manufacturing Tolerances
  - 1. Manufacturing tolerance shall be maintained within the following limits:
  - 2. Frame width                   +1/16 inch -1/32 inch
  - 3. Frame height                +3/64 inch
  - 4. Frame face                  +1/32 inch
  - 5. Frame stop                  +1/32 inch
  - 6. Frame rabbet                +1/64 inch
  - 7. Frame depth                +1/32 inch
  - 8. Frame throat                +1/16 inch
  - 9. Door width and height    +3/64 inch
  - 10. Door thickness            +1/16 inch
  - 11. Hardware location        +1/32 inch
  - 12. Door flatness              +1/16 inch

## 2.4 FINISHES

- A. Primer: Baked on rust-inhibitive enamel.
- B. Finish: Site paint under provisions of Section 09 91 00.
- C. Coat inside of frame profile for frames installed in masonry construction with bituminous coating to a thickness of 1/16 inch. Coating may be factory or site applied. Do not apply coating to fire rated frames.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install frames in accordance with SDI-105.
- B. Install doors in accordance with DHI.
- C. Install fire doors and frames in accordance with NFPA 80.
- D. Installation of exterior doors and frames to be weathertight and waterproof.
- E. Seal penetration of all surface applied screws on exterior face of frames at glass stops and hardware attachments.
- F. Coordinate with wall construction and details for anchor placement. Provide anchors as follows:
- G. Frames up to 7 feet 6 inches height - 4 anchors each jamb.
- H. Frames 7 feet 6 inches to 8 feet 0-inch height - 5 anchors each jamb, plus an additional anchor for each 2 feet or fraction thereof over 8 feet 0 inch.
- I. Frames for double doors; minimum of two (2) anchors in head approximately 12 inches from each jamb.
- J. Borrowed lite frames; two (2) anchors each jamb plus 1 for each 18 inches or fraction thereof over 3 feet 0 inch. Minimum two (2) anchors in head and sill approximately 12 inches from each jamb plus 1 for each 30 inches of length or fraction thereof.
- K. Floor anchors - one (1) anchor each jamb for interior doors. Where wall construction will not allow placement of floor anchor, provide one (1) additional jamb anchor as close to floor as possible.
- L. Existing wall anchors shall be welded to provide non-removable condition. Welded bolt head to be ground, dressed and finished smooth.
- M. Frames installed in masonry walls to be fully grouted with masonry grout.

- N. Exposed field welds to be finished smooth and touched up.
- O. Primed or painted surfaces which are scratched or marred shall be touched up.
- P. Hardware to be applied in accordance with hardware manufacturer's templates and instructions.
- Q. Coordinate installation of glass and glazing.
- R. Install door louvers.
- S. Install roll formed steel reinforcement channels between two abutting frames. Anchor to structure and floor.

### 3.02 CONSTRUCTION

#### A. INSTALLATION TOLERANCES

- 1. Edge clearance for swinging doors shall not exceed the following:
  - a. Between door and frame at head and jamb: 1/8 inch.
  - b. Between edge of pair of doors: 1/8 inch.
  - c. At door sill with threshold. (From bottom of door to top of threshold): 3/8 inch.
  - d. At door sill with no threshold: 1/2 inch.
  - e. At door bottom and rigid floor covering per NFPA 80: 1/2 inch.
  - f. At door bottom and nominal floor covering per NFPA 80: 5/8 inch.
- 2. Frame installation tolerance shall not exceed the following:
  - a. Squareness  $\pm 1/16$  inch.
  - b. Alignment  $\pm 1/16$  inch.
  - c. Plumbness  $\pm 1/16$  inch.
  - d. Diagonal Distortion  $\pm 1/32$  inch.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Provide wood doors at primarily interior spaces.
- Prefer painted over stained.
- Provide stained doors at administrative spaces. Provide painted doors at all other locations.

## SECTION 08 14 00

## WOOD DOORS AND FRAMES

**PART 1 - GENERAL****1.01 SUMMARY****A. Section Includes:**

1. Flush faced wood doors and panels, fire rated, and non-rated.
3. Door louvers.

**B. Referenced Sections:**

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 08 11 00 - Metal Doors and Frames (for frame construction).
3. Section 08 71 00 - Door Hardware.
4. Section 08 80 00 - Glazing.

**1.02 REFERENCES**

- A. CBC - California Building Code, (CCR) California Code of Regulations, Title 24, Part 2.
- B. NFPA 80 – Standard for Fire Doors and Other Opening Protectives.
- C. NWWDA I.S.1 - Industry Standard for Wood Flush Doors (Includes Standards I.S.1.1 through I.S.1.7).
- D. FSC - Forest Stewardship Council.
- E. UL 10C – Standard for Positive Pressure Fire Tests of Door Assemblies.
- F. WI - Woodwork Institute: Manual of Millwork.

**1.03 QUALITY ASSURANCE**

- A. Conform to requirements of WI Manual of Millwork, Section 12 and 13, Custom Grade except where otherwise indicated.
- B. All wood doors and the installation of wood doors shall be monitored for compliance under the scope of the WI Certified Compliance Program (CCP).
- C. Issue a WI Certified Compliance Certificate prior to delivery of doors certifying that doors meet all requirements of WI Grade specified.

D. After completion issue a WI Certified Compliance Certificate for Installation.

E. Regulatory Requirements:

1. Conform to CBC - California Building Code, for fire rated doors and panels.
2. Fire Door and Panel Construction: Conform to UL 10C, Category A.
3. Installed Doors and Panels: Conform to NFPA 80 for fire rated class indicated.

#### 1.05 SUBMITTALS

- A. Submit shop drawings under provisions of Section 01 33 00. Shop drawings shall bear the WI Certified Compliance Label on the first page of each set.
- B. Indicate door elevations, stile and rail reinforcement, internal blocking for hardware attachment, and cutouts for glazing and louvers.
- C. Submit samples under provisions of Section 01 33 00.
- D. Submit two (2) samples 12 by 12 inch in size illustrating each species.
- E. Provide LEED Submittal required per Section 01814, LEED Requirements, for Credits MRc7 and EQc4.4.

#### 1.06 DELIVERY, STORAGE, AND PROTECTION

- A. Protect products under provisions of Section 01 62 00.
- B. Package, deliver, and store doors in accordance with WI requirements as set forth in Technical Bulletin 419-R.

#### 1.07 WARRANTY

- A. Provide manufacturer's standard lifetime warranty for interior doors and five (5) year warranty for exterior doors under provisions of Section 01 78 36 for solid core doors.
- B. Provide five (5) year manufacturer's warranty under provisions of Section 01 78 36 for Stile and Rail Doors.

### PART 2 – PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS

A. FLUSH FACED DOORS

1. Graham, [www.grahamdoors.com](http://www.grahamdoors.com).
2. Algoma Hardwoods, [www.algomahardwoods.com](http://www.algomahardwoods.com).

3. Buell Door Co., [www.buelldoor.com](http://www.buelldoor.com).
4. Eggers Industries, [www.eggersindustries.com](http://www.eggersindustries.com).
5. Oshkosh Door Co., [www.oshkoshdoor.com](http://www.oshkoshdoor.com).
6. Marshfield Door Systems, Inc., [www.marshfelddoors.com](http://www.marshfelddoors.com).
7. V.T. Industries, [www.vtindustries.com](http://www.vtindustries.com).
8. Substitutions: Under provisions of Section 01 25 13.

## 2.02 MATERIALS

### A. Door And Panel

1. Solid Non-Rated Core: Solid wood block, framed block glued, or solid particleboard.
2. Solid, Special Function Core: Labeled fire performance type, UL 10C, Category A. intumescent seals concealed by outer stile in matching veneer.
3. Construction: WI, custom grade, 5 ply, manufactured as an edge bonded, sanded core assembly, laminated in a one-step, hot pressed operation. Cold-press method is not acceptable.
4. Panels: WI Type 1.
5. Flush Interior Door Veneer: Birch species; plain sliced with book matched grain, for transparent stain finish. Satin sheen. Factory finish. Color as selected.
6. Wood materials shall be Forest Stewardship Council (FSC) certified.
7. Composite wood shall be free of added urea formaldehyde.

### B. Adhesives

1. Exterior Doors: WI Type I.
2. Interior Doors: WI Type I.

## 2.03 ACCESSORIES

- A. Door Louvers: 18-gauge, non-vision, inverted split "Y louver with 12-gauge security grille two sides, prime coat finish for field painting. Provide optional galvanized attached mesh insect screen. Size as shown on Drawings.

1. Anemostat security door louvers, model #PLSL.
2. Air Louvers Inc., Model 1500-A.

- B. PeepHoles: Schlage 190 Degree Wide Angle Viewer. Satin nickel finish.

- C. Rubber Silencers: Resilient rubber as supplied by Section 08 71 00.

## 2.04 FABRICATION

- A. Fabricate non-rated wood doors to requirements of WI Manual of Millwork, Section 12 or 13, in the WI Grade specified.
- B. Fabricate fire rated doors per manufacturer's standard construction, and labeling agency requirements.



- C. Pre-machine doors for finish hardware.
- D. For fire rated doors with mineral cores, provide solid wood blocks for hardware reinforcement at lock edge and at top of door for closer.
- E. For fire rated doors with mineral cores, provide solid wood blocking for thru-bolted hardware.

### **PART 3 – EXECUTION**

#### **3.01 INSTALLATION**

- A. Install doors in accordance with WI Manual of Millwork Sections 12 and 13 and WI Technical Bulletin 420-R.
- B. Conform to WI and NFPA requirements for fit tolerances.
- C. Coordinate installation of glass and glazing.
- D. Install door louvers.
- E. Adjust doors for smooth and balanced movements.
- F. Install fire doors in accordance with NFPA 80.
- G. INSTALLATION TOLERANCES

- 1. Edge clearance for swinging doors shall not exceed the following as required by WI and NFPA 80:
  - a. Between door and frame at head and jamb 1/8 inch
  - b. Between edge of pair of doors 1/8 inch
  - c. Diagonal distortion 1/8 inch
  - d. At door sill with threshold. (From bottom of door to top of threshold) 3/8 inch
  - e. At door sill with no threshold 1/2 inch
  - f. At door bottom and rigid floor covering per NFPA 80 1/2 inch
  - g. At door bottom and nominal floor covering per NFPA 80 5/8 inch

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Provide FRP doors at high abuse/high use locations including hallways, corridors, and primary building entrances.
- Suggest using continuous hinges at all FRP doors.

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

## SECTION 08 31 00

## ACCESS DOORS AND PANELS

**PART 1 – GENERAL****1.01 SUMMARY****A. Section Includes:**

1. Steel access panels, except those specified under Divisions 22 - Plumbing, 23 - HVAC, or 26 - Electrical.

**B. Related Sections:**

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 06 10 00 - Rough Carpentry.
3. Section 09 24 23 - Cement Plaster and Metal Lath.
4. Section 09 29 00 - Gypsum Board.
5. Section 09 30 00 - Ceramic Tiling.
6. Section 09 91 00 - Painting and Coating.
7. Division 22 - Plumbing.
8. Division 23 - HVAC.
9. Division 26 - Electrical.
10. Division 27 - Communications.

**1.02 SUBMITTALS****A. Shop Drawings:**

- B. Indicate sizes, materials, thickness, fabrication methods, panel door and frame reinforcement, anchorage, and installation details.
- C. Provide layout drawings, indicating dimensioned locations of proposed access panels, size of each panel, and installation details. Determine and indicate required access panels in finished surfaces, whether furnished under this section or as part of Work of Divisions 22-Plumbing, 23- HVAC, and 26-Electrical.

**1.03 QUALITY ASSURANCE**

- A. Panels shall be provided with UL listings and labels.
- B. Access panels and frames shall be products of one (1) manufacturer.
- C. Coordinate access panels with plumbing, HVAC, and electrical work.

## 1.04 DELIVERY, STORAGE AND HANDLING

- A. Panels and Frames: Provide protection as required by manufacturer to protect panels from damage during storage.

**PART 2 – PRODUCTS**

## 2.01 MATERIALS

- A. Access Panels:

| <u>Non-Rated</u>        | <u>Milcor</u> | <u>Karp</u> | <u>Nystrom</u> |
|-------------------------|---------------|-------------|----------------|
| Ceramic Tile            | MS            | DSC214M     | NT             |
| Plaster                 | K             | DSC214M     | NP             |
| Drywall, Plaster Veneer | DW            | DSC214M     | NW             |
| <br><u>Fire Rated</u>   |               |             |                |
| Ceramic Tile            | MS            | KRP150FR    | IT             |
| Plaster                 | M             | KRP150PR    | IP             |
| Drywall, Plaster Veneer | M             | KRP150FR    | IW             |

- B. Or approved equal.
- C. Unless otherwise indicated, provide brushed stainless-steel finish for panels installed in ceramic tile. Provide prime coat finish suitable for field painting for panels installed in other finishes.
- D. Access Panels shall be 18 gauge minimum with vandal-proof lock operated by Allen wrench or another special tool. Exposed fastenings shall be secured with vandal-proof screws.
- E. Ceiling Access Doors.
1. Provide exterior type single-door by Dur-Red Products, Model TCA, 30 inches by 36 inches in size.
    - a. Door Leaf: 1-inch-thick core rigid fiberglass with 20-gauge steel outer shell.
    - b. Finish: Primer grey and painted minimum two (2) coats of paint. Color to match adjacent ceiling color finish.
  2. Install ceiling access door where access to the enclosed attic spaces is required and/or as shown in the drawings. If not shown in the drawings, provide one ceiling access panel in each enclosed drywall ceiling room. Where ceiling is rated, the ceiling access door shall meet or exceed the rating of the ceiling. All ceiling access doors shall receive keyed locks.

**PART 3 – EXECUTION**

## 3.01 GENERAL

- A. Provide access panels in finish construction, where indicated on Drawings, wherever required for access to concealed mechanical and electrical equipment, and where required by codes. Panels indicated on architectural Drawings shall be furnished under this section. Required panels for access to equipment, but not indicated on architectural Drawings, shall be furnished as part of Work requiring access.

### 3.02 INSTALLATION

- C. Install panels accurately in location, perfect alignment, plumb, straight and true. Brace to prevent displacement by adjacent Work.
- B. Examine panels after installation for proper opening, closing and clearances. Replace damaged or defective panels.

### 3.03 CLEANING

- A. Remove rubbish, debris and waste materials and legally dispose of off Project site.

### 3.04 PROTECTION

- A. Protect Work of this section until Substantial Completion.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- All exterior storefront systems shall be thermally broken.
- All exterior storefront systems shall accommodate 1 inch thick glazing unit.
- All interior storefront systems shall accommodate 1/4 inch glazing unless thicker glazing panels are needed for reduction of sound transmission.
- District is okay with the use of composite infill panels (Mapes) at lower glazing panels.
- Provide laminate glazing units all around openings in storefront systems.

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 2023-01-06 – Clarified references to gate hardware.
- 2025-01-31 – Minor edits to hardware information and model numbers.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- District currently does keying schedules but wants contractor to do the actual keying on future jobs.
- All keyways shall be Primus.
- Any access control shall be "fail-secure".
- Confirm all exterior doors have columbine function.
- If power transfer hinges are needed, they shall NOT use armored whips. Only use internal power transfers.
- At exterior doors, provide a peep hole. District prefers these over a vision lite.



SECTION 08 71 00

DOOR HARDWARE

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes items known commercially as finish or door hardware that are required for swing, sliding, and folding doors, except special types of unique hardware specified in the same sections as the doors and door frames on which they are installed.
- B. This Section includes the following, but is not necessarily limited to:
  - 1. Door Hardware, including electric hardware.
  - 2. Storefront and Entrance door hardware.
  - 3. Gate Hardware.
  - 4. Digital keypad access control devices.
  - 5. Thresholds, gasketing and weather-stripping.
  - 6. Door silencers or mutes.
- C. Related Sections:
  - 1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
  - 2. Section 08 11 00 – Metal Doors and Frames.
  - 3. Section 08 14 00 – Wood Doors and Frames.
  - 4. Section 08 16 13 – FRP Doors.
  - 5. Section 08 43 00 – Storefronts.
  - 6. Section 32 31 13 – Chain Link Fences.
  - 7. Section 32 31 19 – Decorative Metal Fences and Gates (for hinge/closer units).
- D. Related Documents
  - 1. Drawings and general provisions of Contract, including General and Supplementary Conditions of Division 1 Specification Sections, apply to this Section.

1.02 REFERENCES

- A. 2022 California Building Code, CCR, Title 24.
- B. BHMA – Builders' Hardware Manufacturers Association
- C. CCR – California Code of Regulations, Title 24, Part 2, California State Accessibility Standards.

- D. DHI – Door and Hardware Institute
- E. NFPA - National Fire Protection Association.
  - 1. NFPA 80 – Standard for Fire Doors and Other Opening Protectives
  - 2. NFPA 105 – Standard for Smoke Door Assemblies and Other Opening Protectives
- F. UL - Underwriters Laboratories.
  - 1. UL 10C – Standard for Positive Pressure Fire Tests of Door Assemblies
  - 2. UL 305 – Standard for Panic Hardware
- G. WHI - Warnock Hersey Incorporated
- H. SDI - Steel Door Institute

### 1.03 SUBMITTALS & SUBSTITUTIONS

- A. General: Submit in accordance with Conditions of the Contract and Division 1 Specification sections.
- B. Submit product data (catalog cuts) including manufacturers' technical product information for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
- C. Submit six (6) copies of schedule organized vertically into “Hardware Sets” with index of doors and headings, indicating complete designations of every item required for each door or opening. Include following information:
  - 1. Include a Cover Sheet with;
    - a. Job Name, location, telephone number.
    - b. Architects name, location and telephone number.
    - c. Contractor’s name, location, telephone number and job number.
    - d. Suppliers name, location, telephone number and job number.
    - e. Hardware consultant's name, location and telephone number.
  - 2. Job Index information included;
    - a. Numerical door number index including; door number, hardware heading number and page number.
    - b. Complete keying information (referred to DHI hand-book "Keying Systems and Nomenclature"). Provision should be made in the schedule to provide keying information when available; if it is not available at the time the preliminary schedule is submitted.
    - c. Manufacturers' names and abbreviations for all materials.
    - d. Explanation of abbreviations, symbols, and codes used in the schedule.
    - e. Mounting locations for hardware.
    - f. Clarification statements or questions.
    - g. Catalog cuts and manufacturer’s technical data and instructions.

3. Vertical schedule format sample:
  - a. Single or pair with opening number and location.
  - b. Degree of opening
  - c. Hand of door(s)
  - d. Door and frame dimensions and door thickness.
  - e. Label requirements if any.
  - f. Door by frame material.
  - g. (Optional) Hardware item line #.
  - h. Keyset Symbol.
  - i. Quantity.
  - j. Product description.
  - k. Product Number.
  - l. Fastenings and other pertinent information.
  - m. Hardware finish codes per ANSI A156.18.
  - n. Manufacture abbreviation.
- D. Make substitution requests in accordance with Division 1. Substitution requests must be made prior to bid date. Include product data and indicate benefit to the project. Furnish samples of any proposed substitution.
- E. Wiring Diagrams: Provide product data and wiring and riser diagrams for all electrical products listed in the Hardware Schedule portion of this section.
- F. Keying Schedule: Submit separate detailed schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.
- G. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- H. Furnish as-built/as-installed schedule with close-out documents, including keying schedule and transcript, wiring/riser diagrams, manufacturers' installation and adjustment and maintenance information.
- I. Fire Door Assembly Testing: Submit a written record of each fire door assembly to the Owner to be made available to the Authority Having Jurisdiction (AHJ) for future building inspections.
- J. LEED Certification Points: Submit information and certifications necessary to achieve maximum points for LEED certification; coordinate and cooperate with Owner and Architect in providing information necessary for required LEED rating.

#### 1.04 QUALITY ASSURANCE

- A. Obtain each type of hardware (latch and lock sets, hinges, closers, exit devices, etc.) from a single manufacturer.

- B. Supplier Qualifications: A recognized architectural door hardware supplier, with warehousing facilities in the project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this project and that employs an experienced architectural hardware consultant (AHC) who is available to Owner, Architect, and Contractor, at reasonable times during the course of the Work, for consultation.
  - 1. Responsible for detailing, scheduling and ordering of finish hardware.
  - 2. Meet with Owner to finalize keying requirements and to obtain final instructions in writing. To maintain the integrity of patented key systems, provide a letter of authorization from the specified manufacturer indicating that supplier has authorization to purchase the key system directly from the manufacturer.
  - 3. Stock parts for products supplied and are capable of repairing and replacing hardware items found defective within warranty periods.
- C. Hardware Installer: Company specializing in the installation of commercial door hardware with five years documented experience.
- D. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and tested by UL or Warnock Hersey for given type/size opening and degree of label. Provide proper latching hardware, door closers, approved-bearing hinges and seals whether listed in the Hardware Schedule or not.
  - 1. Where emergency exit devices are required on fire-rated doors, (with supplementary marking on doors' UL labels indicating "Fire Door to be Equipped with Fire Exit Hardware") provide UL label on exit devices indicating "Fire Exit Hardware".
- E. Exit Doors: Operable from inside with single motion without the use of a key or special knowledge or effort.
- F. Product packaging to be labelled in compliance with CA Prop 65, Safe Drinking Water and Toxic Enforcement Act of 1986.
- G. Pre-Installation Conference
  - 1. Schedule a pre-installation conference at least one week prior to beginning work of this section.
  - 2. Attendance: Architect, Construction Manager, Contractor, Security Contractor, Hardware Supplier, Installer, Key Owner Personnel, and Project Inspector.
  - 3. Agenda: Review hardware schedule, products, installation procedures and coordination required with related work. Review Owner's keying standards.

#### 1.05 DELIVERY, STORAGE AND HANDLING

- A. Coordinate delivery of packaged hardware items to the appropriate locations (shop or field) for installation.

- B. Hardware items shall be individually packaged in manufacturers' original containers, complete with proper fasteners. Clearly mark packages on outside to indicate contents and locations in hardware schedule and in work.
- C. Provide locked storage area for hardware, protect from moisture, sunlight, paint, chemicals, etc.
- D. Contractor to inventory door hardware jointly with representatives of hardware supplier and hardware installer until each all are satisfied that count is correct.

#### 1.06 WARRANTY

- A. Provide warranties of respective manufacturers' regular terms of sale from day of final acceptance as follows:
  - 1. Locksets: "L" Series (3) years – "ND" Ten (10) years.
  - 2. Electronic: One (1) year.
  - 3. Closers: Thirty (30) years –1260 twenty (20) years –Concealed High Security fifteen (15) years except electronic closers shall be two (2) years.
  - 4. Exit devices: Three (3) years.
  - 5. All other hardware: Two (2) years.

#### 1.07 MAINTENANCE

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

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

| <u>Item</u>                        | <u>Manufacturer</u> | <u>Acceptable Substitutes</u> |
|------------------------------------|---------------------|-------------------------------|
| Hinges                             | Ives                | Hager, Stanley, McKinney      |
| Locks, Latches<br>& Cylinders      | Schlage             | Or Approved Equal             |
| Exit Devices                       | Von Duprin          | Or Approved Equal             |
| Closers                            | LCN                 | Or Approved Equal             |
| Push, Pulls<br>& Protection Plates | Ives                | Trimco, BBW, DCI              |
| Flush Bolts                        | Ives                | Trimco, BBW, DCI              |

|                    |               |                       |
|--------------------|---------------|-----------------------|
| Dust Proof Strikes | Ives          | Trimco, BBW, DCI      |
| Coordinators       | Ives          | Trimco, BBW, DCI      |
| Stops              | Ives          | Trimco, BBW, DCI      |
| Overhead Stops     | Glynn-Johnson | Or Approved Equal     |
| Thresholds         | Zero          | Pemko, National Guard |
| Seals & Bottoms    | Zero          | Pemko, National Guard |

## 2.02 MATERIALS

**DESIGNERS!! Hardware listed below is District standard. You are required to provide hardware groups per specific opening requirements utilizing these hardware components. Delete this statement prior to issuance.**

### A. Hinges: Ives as scheduled.

1. Ives5BB1HW x NRP (Heavy use exterior doors) 630 finish.  
Ives 5BB1HW (Interior doors) 652 finish.
2. Hinges shall be sized in accordance with the following:
  - a. Height:
    - 1) Doors up to 42" wide: 4-1/2" inches.
    - 2) Doors 43" to 48" wide: 5 inches.
  - b. Width: Sufficient to clear frame and trim when door swings 180 degrees.
  - c. Number of Hinges: Furnish 3 hinges per leaf to 7'-5" in height. Add one for each additional 2 feet in height.
3. Exterior out-swinging door butts shall be non-ferrous material and shall have stainless steel hinge pins. All doors to have non-rising pins.
4. Furnish non-removable pins (NRP) at all exterior out-swing doors and interior key lock doors with reverse bevels.

### B. Continuous Hinges: Ives as scheduled.

1. SL-224HD (Heavy use exterior doors & Remodels) 628 finish.

### C. Heavy Duty Cylindrical Locks and Latches: Schlage "ND" Series as scheduled with "Rhodes" design, fastened with through-bolts and threaded chassis hubs.

1. Bathroom (Student – multi use) ND94
2. Faculty ND94
3. Administration ND91
4. Communicating ND72VandlegardXN12-003

5. Classroom Safe School Lock ND98
  6. Bathroom (Typical) ND94
  7. Janitor / Storage room ND96
  8. Bathroom (Faculty - single compartment toilet) L9485 x 06A x L283-722
  9. Bathroom (Faculty and Student please consult)
  10. Provide cylindrical locksets exceeding the ANSI/BHMA A156.2 Grade 1 performance standards for strength, security, and durability in the categories below:
    - a. Abusive Locked Lever Torque Test – minimum 3,100 inch-pounds without gaining access
    - b. Offset lever pull – minimum 1,600-foot pounds without gaining access
    - c. Vertical lever impact – minimum 100 impacts without gaining access
  11. Cycle life - tested to minimum 16 million cycles per ANSI/BHMA A156.2 Cycle Test with no visible lever sag or use of performance aids such as set screws or spacers
  12. Cylinders: Refer to "KEYING" article, herein.
  13. Provide solid steel anti-rotation through bolts and posts to control excessive rotation of lever.
  14. Provide lockset that allows lock function to be changed to over twenty other common functions by swapping easily accessible parts.
  15. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
  16. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
  17. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
  18. Provide wired electrified options as scheduled in the hardware sets.
    - a. 12 through 24-volt DC operating capability, auto-detecting
    - b. Selectable EL (fail safe)/EU (fail secure) operating mode via switch on chassis
    - c. 0.230A (230mA) maximum current draw
    - d. 0.010A (10mA) holding current
    - e. Modular / "plug in" request to exit switch
  18. Lever Trim: Solid cast levers without plastic inserts, and wrought roses on both sides.
- D. Exit devices: Von Duprin as scheduled.
1. CD98L-AX-996L-KC (Single Door) 626 finish
  2. CD98L-AX-996L-KC x CD98DT x KR4954 Mullion x 154 (Pairs) 626 finish
  3. 98L-AX-2-F-996L (F Rated Single Door) 626 finish
  4. 98L-AX-2-F-996L x 2 KR9954 Mullion 154(F Rated Pairs) 626 finish
    - a. No vertical rods allowed.
    - b. Use -2 Function to meet AB 211.
    - c. MT54 Mullion Storage at Pairs.
    - d. Provide 154 stabilizers at all mullions.
  5. Provide certificate by independent testing laboratory that device has completed over 1,000,000 cycles and can still meet ANSI/BHMA A156.3 - 2001 standards.
  6. All internal parts shall be of cold-rolled steel with zinc dichromate coating.
  5. Non-handed basic device design with center case interchangeable with all functions.
  6. All devices shall have quiet return fluid dampeners.

7. All latch bolts shall be deadlocking with  $\frac{3}{4}$ " throw and have a self-lubricating coating to reduce friction and wear.
  8. Device shall bear UL label for fire and or panic as may be required.
  9. All surface strikes shall be roller type and utilize a plate underneath to prevent movement.
  10. Lever Trim: "Breakaway" design, forged brass or bronze escutcheon with a minimum of .130" thickness, match lockset lever design.
  11. Removable Mullions: Removable with single turn of building key. Securely reinstalled without need for key.
    - a. MT54 Mullion Storage at Pairs
  12. Furnish glass bead kits for vision lites where required.
  13. All Exit Devices to be sex-bolted to the doors.
  14. Panic Hardware shall comply with CBC Section 11B.404.2.7 and shall be mounted between 34" and 44" above the finished floor surface.
    - a. The unlatching force shall not exceed 15 lbs. applied in the direction of travel.
- OR-
- b. Provide exit devices UL certified to meet maximum 5-pound requirements according to the California Building Code section 11B-309.4, and UL listed for Panic Exterior Fire Exit Hardware.
- E. Closers: LCN as scheduled. Place closers inside building, stairs, room, etc.
1. P4041XP 689 finish
    - a. Hold open arms or cush closers are not allowed.
  2. Door closer cylinders shall be of high strength cast iron construction with double heat-treated pinion shaft to provide low wear operating capabilities of internal parts throughout the life of the installation. All door closers shall be tested to ANSI/BHMA A156.4 test requirements by a BHMA certified testing laboratory. A written certification showing successful completion of a minimum of 10,000,000 cycles must be provided.
  3. All door closers shall be fully hydraulic and have full rack and pinion action with a shaft diameter of a minimum of 11/16 inch and piston diameter of 1 inch to ensure longevity and durability under all closer applications.
  4. All parallel arm closers shall incorporate one-piece solid forged steel arms with bronze bushings. 1-9/16" steel stud shoulder bolts, shall be incorporated in regular arms, hold-open arms, arms with hold open and stop built in. All other closers to have forged steel main arms for strength, durability, and aesthetics for versatility of trim accommodation, high strength and long life.
  5. All parallel arm closers so detailed shall provide advanced backcheck for doors subject to severe abuse or extreme wind conditions. This advanced backcheck shall be located to begin cushioning the opening swing of the door at approximately 45 degrees. The intensity of the backcheck shall be fully adjustable by tamper resistant non-critical screw valve.
  6. Closers shall be installed to permit doors to swing 180 degrees.
  7. All closers shall utilize a stable fluid withstanding temperature range of 120 degrees F. to -30 degrees F. without requiring seasonal adjustment of closer speed to properly close the door.
  8. Provide the manufactures drop plates, brackets and spacers as required at narrow head rails and special frame conditions. NO wood plates or spacers will be allowed. Door frames shall be reinforced at all mounting locations.



9. Maximum effort to operate closers shall not exceed 5 lbs., such pull or push effort being applied at right angles to hinged doors. Compensating devices or automatic door operators may be utilized to meet the above standards. When fire doors are required, the maximum effort to operate the closer may be increased but shall not exceed 15 lbs. when specifically approved by fire marshal. All closers shall be adjusted to operate with the minimum amount of opening force and still close and latch the door. These forces do not apply to the force required to retract latch bolts or disengage other devices that hold the door in a closed position. Per 11B- 404.2.8.1, door shall take at least 5 seconds to move from an open position of 90 degrees to a position of 12 degrees from the latch jamb.
- F. Flush Bolts & Dust Proof Strikes: Ives as scheduled.
1. FB51 (Manual) (metal doors) (Storage & Utility rooms) 626 finish
  2. FB61P (Manual) (wood doors) (Storage & Utility rooms) 626 finish
    - a. Manual flush bolts only permitted on storage or mechanical openings as scheduled.
    - b. Provide dust proof strikes at openings using bottom bolts.
    - c. Automatic flush bolts allowed only where required by Fire Code.
- G. Door Stops: Ives as scheduled.
1. FS18S (Exterior Floor) 626 finish
  2. FS 436/438 (Interior Floor) 626 finish
  3. WS 406CVX (Wall) 626 finish
  4. WS406CCV (Inswing push-button locks) 626 finish
    - a. Allow for maximum swing of doors
    - b. Backing required at wall holders
  5. Unless otherwise noted in Hardware Sets, provide floor type with appropriate fasteners. Where wall type cannot be used, provide floor type. If neither can be used, provide overhead type.
  6. Do not install floor stops more than four (4) inches from the face of the wall or partition (CBC Section 11B-307).
  7. Overhead stops shall be made of stainless steel and non-plastic mechanisms and finished metal end caps. Field-changeable hold-open, friction and stop-only functions.
- H. Door Holders: Ives as scheduled.
1. WS452-4 Series Automatic Holder (Door) 626 finish
  2. FS40 Series Automatic Holder (Wall) 626 finish
    - a. Backing required at wall holders
    - b. Allow for maximum door swing
- I. Protection Plates: Ives as scheduled.
1. Kick Plate: 8400-10" x 2" LDW 630 finish
  2. Mop Plate: 8400-5" x 2" LDW 630 finish
  3. Push / Pull Plate: 8200 x 8302-6x 4x16 630 finish
  4. Lock Protector: LP-13, LP-12 626 finish

5. Fabricate either kick, armor, or mop plates with four beveled edges. Provide kick plates 10" high and 2" LDW. Sizes of armor and mop plates shall be listed in the Hardware Schedule. Furnish with machine or wood screws of bronze or stainless to match other hardware.
- J. Thresholds: As Scheduled and per details.
1. Thresholds shall not exceed 1/2" in height, with a beveled surface of 1:2 maximum slope.
  2. Set thresholds in a full bed of butyl-rubber or polyisobutylene mastic sealant complying with requirements in Division 7 "Thermal and Moisture Protection".
  3. Use 1/4" fasteners, red-head flat-head sleeve anchors (SS/FHSL).
  4. Thresholds shall comply with CBC Section 11B-404.2.5.
- K. Seals and Surface Applied Hardware: Zero as scheduled.
1. Smoke Seal:488S-BK Black
  2. Weather Seal: 488S-BK 628 finish
- and-
- 8780N Factory
  3. Door Sweep: 328AA 689 finish
  4. 139SS (Wood doors) (Use only where required by fire code) 630
    - a. Astragal by door manufacturer at HM door
  5. Drip Guard: 17D x 4" PDW (Exterior doors exposed to rain) 628
  6. Door Bottom: Use automatic door bottoms only if required by code.
  7. Provide silicone gasket at all rated and exterior doors.
  8. Fire-rated Doors, Resilient Seals: UL10C Classified complies with NFPA 80 & NFPA 252. Coordinate with selected door manufacturers' and selected frame manufacturers' requirements.
  9. Fire-rated Doors, Intumescent Seals: Furnished by selected door manufacturer. Furnish fire-labeled opening assembly complete and in full compliance with UL10C Classified complies with NFPA 80 & NFPA 252. Where required, intumescent seals vary in requirement by door type and door manufacture -- careful coordination required.
  10. Smoke & Draft Control Doors, Provide UL10C Classified complies with NFPA 80 & NFPA 252 for use on "S" labeled Positive Pressure door assemblies.
- L. Door Shoes & Door Top Caps: Provide door shoes at all exterior wood doors and top caps at all exterior out-swing doors.
- M. Silencers: Ives as scheduled.
1. 654A, 655A, 623A Black
  2. Furnish silencers for interior hollow metal frames, 3 for single doors, 2 for pairs of doors. Omit where sound or light seals occurs, or for fire-resistive-rated door assemblies.
- N. Keying: Schlage as scheduled.
1. Furnish a Proprietary Schlage master key system as directed by the owner or architect. Key system to be designated and combination-d by the Schlage Master Key Department even if pinned by the Authorized Key Center, Authorized Security Center or a local authorized

commercial dealer. This is to be a Schlage PrimusXP "Classic" keying system. SCUSD to verify all keyways. Provide as follows:

- |                                                          |            |
|----------------------------------------------------------|------------|
| a. 6 pin x Standard Core plug (ND Series)                | 626 finish |
| b. 6 pin x Rim type x IC Core (Exit Device)              | 626 finish |
| c. 6 pin x 1-1/4" Mortise x IC Core (KR Mullions and CD) | 626 finish |

2. A detailed keying schedule is to be prepared by the owner and/or architect in consultation with a representative of Allegion or an Authorized Key Center or Authorized Security Center. Each keyed cylinder on every keyed lock is to be listed separately showing the door #, key group (in BHMA terminology), cylinder type, finish and location on the door.
3. Establish a new master key system for this project as directed by the keying schedule.
4. Furnish all cylinders in the Schlage conventional style except the exit device and removable mullion cylinders which will be supplied in Schlage Full Size Interchangeable Core (FSIC). Pack change keys independently (PKI).
5. Furnish PrimusXP "Classic" keyway Patent Protected Schlage cylinders where noted. Furnish all other cylinders in matching conventional "Classic" keyway. Furnish Patent Protected Schlage keys for all cylinders. (e.g., Primus XP Classic Keyway for patent protected / Maximum control) (with mix of conventional "Classic" keyway)
6. Furnish construction keying for doors requiring locking during construction.
  - a. For FSIC systems provide 23-030-ICX Full Size Construction Cores
  - b. For FSIC systems provide ten 48-101-ICX Construction Keys
  - c. For FSIC systems provide two 48-056-ICX Control Keys (const.)
  - d. For FSIC systems provide two control keys for installing the permanent cores (49-056 for "Classic" keyways, 48-052-XP for "Classic Primus").

-OR-

7. Furnish construction keying for doors requiring locking during construction.
  - a. For "Split Key" Construction Cylinders (non-IC cylinders) specify "CK" for each keyed cylinder.
  - b. Provide ten Construction Keys (48-104 "Classic")
  - c. Provide two Extractor Tools (35-057)
8. Furnish all keys with visual key control.
  - a. Stamp key "Do Not Duplicate".
9. Furnish mechanical keys as follows:
  - a. Furnish 2 cut change keys for each different change key code.
  - b. Furnish 1 uncut key blank for each change key code.
  - c. Furnish 6 cut master keys for each different master key set.
  - d. Furnish 3 uncut key blanks for each master key set.
  - e. Furnish 2 cut control keys cut to the top master key for permanent I/C cylinders.
  - f. Furnish 1 cut control key cut to each SKD combination.
  - g. Furnish KS43D2200 padlock for use with non-I/C Schlage cylinders. Furnish 47-413 (conventional) or 47-743-XP (PrimusXP) with above.
  - h. Furnish KS43G3200 padlock for use with FSIC Schlage cylinders. Furnish 23-030 (Classic) or 20-740 (PrimusXP) with above.
  - i. Furnish KS41D1200 padlock for use with FSIC Schlage cylinders.

10. Furnish Schlage Padlocks and the cylinders to tie them into the master key system for gates, storage boxes, utility valve security, roof hatches and roll-up doors keyed as directed in the keying schedule.
  - a. Furnish KS43D2200 padlock for use with non-I/C Schlage cylinders. Furnish 47- 413 (conventional) or 47-743-XP (PrimusXP) with above.
  - b. Furnish KS43G3200 padlock for use with FSIC Schlage cylinders. Furnish 23-030 (Classic) or 20-740 (PrimusXP) with above.
  - c. Furnish KS41D1200 padlock for use with SFIC Schlage cylinders.

O. Fasteners

1. Screws for strikes, face plates and similar items shall be flat head, countersunk type, provide machine screws for metal and standard wood screws for wood.
2. Screws for butt hinges shall be flathead, countersunk, full-thread type.
3. Fastening of closer bases or closer shoes to doors shall be by means of sex bolts and spray painted to match closer finish.
4. Provide expansion anchors for attaching hardware items to concrete or masonry.
5. All exposed fasteners shall have a Phillips head.
6. Finish of exposed screws to match surface finish of hardware or other adjacent work.
7. All Exit Devices and Lock Protectors shall be fastened to the door by the means of sex bolts or through bolts.

2.04 FINISHES

- A. Generally, to be satin chrome US26D (626 on bronze and 652 on steel) unless otherwise noted.
- B. Furnish push plates, pull plates and kick or armor plates in satin stainless steel US32D (630) unless otherwise noted.
- C. Door closers shall be powder-coated to match other hardware, unless otherwise noted.
- D. Aluminum items to be finished anodized aluminum except thresholds which can be furnished as standard mill finish.

**PART 3 - EXECUTION**

3.01 INSPECTION

- A. Verify that doors and frames are square and plumb and ready to receive work and dimensions are as instructed by the manufacturer.
- B. Beginning of installation means acceptance of existing conditions.
- C. Fire-Rated Door Assembly Inspection: Upon completion of the installation, all fire door assemblies shall be inspected to confirm proper operation of the closing device and latching device and that only the manufacturer's furnished fasteners are used for installation and that it meets all criteria of

a fire door assembly per NFPA 80 (Standard for Fire Doors and Other Opening Protectives) A written record shall be maintained and transmitted to the Owner to be made available to the Authority Having Jurisdiction (AHJ). The inspection of the swinging fire doors shall be performed by a certified FDAI (Fire Door Assembly Inspector) with knowledge and understanding of the operating components of the type of door being subjected to the inspection. The record shall list each fire door assembly throughout the project and include each door number, an itemized list of hardware set components at each door opening, and each door location in the facility.

### 3.02 INSTALLATION

- A. Install hardware in accordance with manufacturer's instructions and requirements of DHI.
- B. Use the templates provided by hardware item manufacturer.
- C. Mounting heights for hardware shall be as recommended by the Door and Hardware Institute. Operating hardware will to be located between 34" and 44" AFF.
- D. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- E. Drill and countersink units that are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- F. Set thresholds for exterior doors in full bed of butyl-rubber sealant.
- G. If hand of door is changed during construction, make necessary changes in hardware at no additional cost.
- H. Hardware Installer shall coordinate with security contractor to route cable to connect electrified locks, panic hardware and fire exit hardware to power transfers or electric hinges at the time these items are installed so as to avoid disassembly and reinstallation of hardware.
- I. Hardware Installer shall also be present with the security contractor when the power is turned on for the testing of the electronic hardware applications. Installer shall make adjustments to solenoids, latches, vertical rods and closers to insure proper and secure operation.
- J. All wiring for electro-mechanical hardware mounted on the door shall be connected through the power transfer and terminated in the interface junction box specified for in the Electrical Section.
- K. Conductors shall be minimum 18 gage stranded, multicolored. A minimum 12 in. loop of conductors shall be coiled in the interface junction box. Each conductor shall be permanently marked with its function.
- L. If a power supply is specified in the hardware sets, all conductors shall be terminated in the power supply. Make all connections required for proper operation between the power supply and the electro-mechanical hardware. Provide the proper size conductors as specified in the manufacturer's technical documentation.

J. Hardware Locations

1. Conform to CCR, Title 24, Part 2; and ADAAG; and the drawings for access-compliant positioning requirements for the disabled.

3.03 ADJUSTING AND CLEANING

- A. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.
- B. Clean adjacent surface soiled by hardware installation.
- C. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy, return to that work area and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
- D. Instruct Owner's Personnel in proper adjustment and maintenance of hardware finishes, during the final adjustment of hardware.
- E. Continued Maintenance Service: Approximately six months after the completion of the project, the Contractor accompanied by the Architectural Hardware Consultant, shall return to the project and re-adjust every item of hardware to restore proper functions of doors and hardware. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures. Replace hardware items which have deteriorated or failed due to faulty design, materials or installation of hardware units. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the hardware.

3.05 FIELD QUALITY CONTROL

- A. Contractor is responsible for providing the services of an Architectural Hardware Consultant (AHC) or a proprietary product technician to inspect installation and certify that hardware and its installation have been furnished and installed in accordance with manufacturers' instructions and as specified herein.

3.06 SCHEDULE

- A. The items listed in the following schedule shall conform to the requirements of the foregoing specifications.
- B. While the hardware schedule is intended to cover all doors, and other movable parts of the building, and establish type and standard of quality, the contractor is responsible for examining the Plans and Specifications and furnishing proper hardware for all openings whether listed or not. If there are any omissions in hardware groups in regard to regular doors they shall be called to the attention of the

Architect prior to bid opening for instruction; otherwise, list will be considered Complete. No extras will be allowed for omissions.

C. The Door Schedule on the Drawings indicates which hardware set is used with each door.

Manufacturers Abbreviations (Mfr.)

|     |   |                           |                                                                                                          |
|-----|---|---------------------------|----------------------------------------------------------------------------------------------------------|
| GLY | = | Glynn-Johnson Corporation | Overhead Door Stops                                                                                      |
| IVE | = | Ives                      | Hinges, Pivots, Bolts, Coordinators, Dust Proof Strikes, Push Pull & Kick Plates, Door Stops & Silencers |
| LCN | = | LCN                       | Door Closers                                                                                             |
| SCE | = | Schlage Electronics       | Electronic Door Components                                                                               |
| SCH | = | Schlage Lock Company      | Locks, Latches & Cylinders                                                                               |
| VON | = | Von Duprin                | Exit Devices                                                                                             |
| ZER | = | Zero International        | Thresholds, Gasketing & Weather-stripping                                                                |

Designers!! Example group shown below is for order of hardware pieces only. Designer shall build each hardware group for each door type needed on individual projects.

HARDWARE GROUP NO. 00X – LOCATION/FUNCTION TYPE

DOOR NUMBERS – (AS REQUIRED)

| QTY |    | DESCRIPTION       | CATALOG NUMBER                | FINISH | MFR |
|-----|----|-------------------|-------------------------------|--------|-----|
| 1   | EA | CONT. HINGE       | MODEL #                       | 628    | IVE |
| 1   | EA | POWER TRANSFER    | MODEL #                       | 689    | VON |
| 1   | EA | ELEC OFFICE LOCK  | MODEL #                       | 626    | SCE |
|     |    |                   | VDC (PROVIDED BY DIVISION 28) |        |     |
| 1   | EA | PRIMUS K-I-L CYL. | AS REQUIRED                   | 626    | SCH |
| 1   | EA | CLOSER            | MODEL #                       | 689    | LCN |
| 1   | EA | LOCK GUARD        | MODEL #                       | 630    | IVE |
| 1   | EA | KICK PLATE        | MODEL #                       | 630    | IVE |
| 1   | EA | FLOOR STOP        | MODEL #                       | BLK    | IVE |
| 1   | EA | DOOR SWEEP        | MODEL #                       | AA     | ZER |
| 1   | EA | GASKETING         | MODEL #                       | BK     | ZER |
| 1   | EA | THRESHOLD         | PER DETAIL                    | AL     | ZER |

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- District prefers that all exterior glass is laminated and LOW-E coated.
- Maximum glass size is 4'-0" x 8'-0" although the District prefers smaller, more manageable pieces.
- District does not want fancy/special order films, tints, colors, etc. to be used on projects. No special order type glazing is to be used.



## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

SECTION 08 90 00

METAL WALL LOUVERS

**PART 1 – GENERAL**

1.01 SUMMARY

A. Work Included

1. Fixed Blade Metal Wall Louvers.
2. Screening.

B. Related Work

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 00 72 00: General Conditions.
3. Section 06 10 00: Rough Carpentry: Framed Openings.
4. Section 07 62 00: Sheet Metal Flashing and Trim.
5. Section 07 90 00: Joint Sealers.
6. Section 09 90 00: Painting.

1.02 REFERENCES

- A. AMCA 501 (Air Movement Council Association) Application Manual for Air Louvers.
- B. AMCA 502 (Air Movement Council Association) Damper Application Manual for Heating, Ventilating and Air Conditioning.
- C. ANSI/ASTM A653 / A653M Steel Sheet, Zinc Coated (galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the hot-dip process.

1.03 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacture of AMCA certified louvers with three years' experience.

1.04 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 00 72 00.
- B. Indicate on shop drawings layout, elevations, dimensions, and tolerances; head, jamb, and sill details; blade configuration; screening; and frames.

C. Submit manufacturer's installation instructions under provisions of Section 00 72 00.

D. Samples: Submit (2) two 6" x 6" samples of selected finish color.

#### 1.06 COORDINATION

A. Coordinate work of this Section with installation of flashings and exterior finish system.

### PART 2 – PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS - WALL LOUVERS

A. Wonder Metals Corporation, model #L-445.

B. The Airolite Company.

C. Construction Specialties, Inc.

D. Substitutions: Under provisions of Section 00 72 00.

#### 2.02 MATERIALS

A. Louver blades, head, jamb, and sill: 18 ga. galvanized steel.

B. Fasteners and Anchors: Stainless steel type or as recommended by manufacturer.

#### 2.03 ACCESSORIES

A. Flashings: Of same material as louver frame.

B. Insert screen and frame: Galvanized steel frame with 18 x 14 galvanized insect mesh, fabricated by louver manufacturer. Install on interior side of louver.

C. Sealants: specified in Section 07 90 00.

#### 2.04 FABRICATION

A. Louver Size: 4 inches deep, face measurements as indicated. Nominal free area opening of 45%.

B. Louver Type: Continuous with fixed, storm proof blades.

C. Head and Sill Members: Roll formed to required shape, one piece per location.

- D. All welded construction.
- E. Screens: Screw to louver frame.

## 2.05 FINISHES

- A. Factory primed for field paint finish.

## PART 3 – EXECUTION

### 3.01 INSPECTION

- A. Verify that prepared openings and flashings are ready to receive work and opening dimensions are as indicated on shop drawings.
- B. Beginning of installation means acceptance of existing conditions.

### 3.02 INSTALLATION

- A. Install louver assembly in accordance with manufacturer's instructions.
- B. Install louvers level and plumb.
- C. Secure louvers in opening framing with concealed fasteners.
- D. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.
- E. Install perimeter sealant in accordance with Section 07 90 00.

### 3.03 CLEANING

- A. Clean surfaces and components.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Do not use a Level 5 smooth finish for new work. Provide a Level 4 with light orange peel at all visible surfaces.
- Coordinate with installation of other finishes for minimum gypsum board finish levels.
- Interior walls/partitions shall comply with *ANSI/ASA S12.60-2010/Part 1 Performance Criteria, Design Requirements, and Guidelines for Schools, Part 1: Permanent Schools* for Minimum STC Rating requirements for assemblies between adjacent spaces (Table excerpt from guideline on following page).

TABLE 4 – Minimum STC ratings required for single or composite wall and floor-ceiling assemblies that separate a core learning space from an adjacent space.

| ADJACENT SPACE                                                                                                                                         |                                                                     |                                                                |                                                                                                                                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|----------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| Other enclosed or open-plan core learning space, therapy room, health care room and space requiring a high degree of acoustical privacy <sup>a,b</sup> | Common-use and public-use toilet room and bathing room <sup>a</sup> | Corridor, staircase, office, or conference room <sup>c,d</sup> | Music room, music performance space, auditorium, mechanical equipment room, <sup>e</sup> cafeteria, gymnasium or indoor swimming pool. |
| 50                                                                                                                                                     | 53                                                                  | 45                                                             | 60                                                                                                                                     |

a) These requirements do not apply to toilets opening only into the core learning space and used only by occupants of the core learning space.

b) A 20 cm (8") concrete masonry unit wall having a surface weight density of at least 180 kg/m<sup>2</sup> painted and

sealed on both sides, acoustically sealed at the entire perimeter and extending from the floor slab to the structural deck above, is an acceptable alternate assembly that conforms to the intent of 5.4.2.1.

c) For corridor, office, or conference room walls containing doors, the basic wall, exclusive of the door, shall have an STC rating as shown in the appropriate column in this table. The entrance door shall conform to the requirements of 5.4.2.4.

d) When acoustical privacy is required, the minimum composite STC rating, including the effects of doors, of the partitions around an office or conference room, shall be increased to 50.

e) The isolation between core learning spaces and mechanical equipment rooms shall have a STC rating of 60 or greater unless it is shown that the sound level in the mechanical equipment room combined with a lower STC rating can achieve the required sound level in the core learning space. In no case shall the design STC between such spaces be less than 45.

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- District does not want any fiberglass tiles at suspended ceilings.

SECTION 09 51 00

ACOUSTICAL CEILINGS

**PART 1 – GENERAL**

**1.01 SUMMARY**

**A. Section Includes:**

1. Lay-in acoustical ceiling systems and metal suspension system.

**B. Related Requirements:**

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 09 29 00 - Gypsum Board.
5. Division 23 - HVAC.
6. Division 26 - Electrical.

**1.02 REFERENCES**

- A. Conform to CBC requirements and UL - Tunnel Test for Fire Hazard Classification of Building Materials.
- B. Cisca: Acoustical Ceilings Use and Practice.
- C. Division of the State Architect: Comply with requirements of IR 25-2.10.
- D. ASTM A641 - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
- E. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- F. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
- G. ASTM C635 - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
- H. ASTM C636 - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
- I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.



- J. ASTM E580 – Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.
- K. ASTM E1264 - Standard Classification for Acoustical Ceiling Products.
- L. ASTM E1414 - Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum.
- M. ASTM E1477 - Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers.
- N. ASCE 7 - Minimum Design Loads for Buildings and Other Structures, as amended by CBC 1615A.1.16.
- O. CHPS Low-Emitting Materials Table: Materials submitted must be listed as low emitting on the CHPS website, [www.CHPS.net](http://www.CHPS.net).

### 1.03 SUBMITTALS

#### A. Samples:

- 1. Lay in panels of each specified type, 6-inch by 6-inch minimum size.
- 2. Suspension System: 12-inch-long samples of suspension system members, connections, moldings and wall angles, for each color specified.

#### B. Shop Drawings:

- 1. Indicate complete plan layouts and installation details.
- 2. Indicate related Work of other sections which is installed in, attached to, or penetrates ceiling areas, such as air distribution and electrical devices.

#### C. Product Data:

- 1. Suspension System for Lay-in Ceiling: Printed data for suspension system components, including load tests, indicating conformance to specified tests and standards.
- 2. Acoustical units: Printed data indicating conformance to specified tests and standards.

#### D. Maintenance Materials: Provide extra panels equal to 1 percent of the area of each typical module size of acoustical panel, but not less than eight (8) of each specified size, style and color.

### 1.04 QUALITY ASSURANCE

#### A. Ceiling systems shall consist of lay-in acoustical ceiling panels by a single manufacturer and suspension systems by a single manufacturer for the entire project.

#### B. Qualifications of Installer: Minimum five (5) years' experience in installing acoustical ceiling systems of the types specified.

C. Design Criteria:

1. Deflection of finished surface to 1/360 of span or less.
2. 1/8-inch maximum permissible variation from true plane measured from 10-foot straightedge placed on surface of finished acoustical fiber units.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the Project site in original sealed packages.
- B. Storage: Store materials in building area where they will be installed, in original package. Keep clean and free from damage due to water or deteriorating elements.
- C. Handle in a manner to prevent damage during storage and installation.

1.06 PROJECT CONDITIONS

- A. Installation of acoustical ceiling system shall not begin until the building is enclosed, permanent heating and cooling is in operation, and residual moisture from plaster and concrete work has dissipated. Building areas to receive ceilings shall be free of construction dust and debris.
- B. Environmental Requirements: Maintain temperature in space at 55 degrees F or above for 24 hours before, during, and after installation of materials.
- C. Scheduling:
  1. Before concealing Work of other sections, verify required tests and inspections have been completed.
  2. Coordinate with related Work of other sections. Coordinate location and symmetrical placement of air distribution devices, electrical devices, and penetrations with related Work section.

1.07 WARRANTY

- A. Manufacturer shall provide a 10-year material warranty.
- B. Installer shall provide a two (2) year fabrication and installation warranty.

**PART 2 - PRODUCTS**

2.01 ACCEPTABLE MANUFACTURERS

- A. USG Corporation.
- B. Armstrong World Industries.
- C. CertainTeed Ceilings Corp.

D. Or Approved Equal.

## 2.02 SUSPENSION SYSTEM

- A. Metal suspension system for acoustical lay-in tile shall be hot-dipped galvanized steel conforming to ASTM A653. Main beams and cross tees shall be double-web steel construction with exposed flange design, with factory punched cross tee slots, hanger holes and integral couplings.
- B. Metal suspension system for acoustical lay-in tile shall conform with ASTM C635, C636 and E580 and section 13.5.6 of ASCE 7, as amended by CBC Section 1615A.1.16, for installation in high seismic areas.
- C. Structural classification of suspension systems shall be heavy-duty in conformance to ASTM C635.
- D. Vertical Strut: USG Donn Compression Post, or equal, or as indicated; types and designs complying with requirements of authorities having jurisdiction and seismic Zones D, E and F requirements. Provide base attachment clip for connection of vertical strut to main beams.
- E. Wall Molding: Fabricated from galvanized steel with 2-inch horizontal leg and hemmed edges, same finish as main and cross tees.
- F. Spacer/Stabilizer Bars: Provide for tying together the ends of main runners and cross tees that are not attached to wall molding.
- G. Hanger Wire: 0.106-inch diameter (0.144-inch diameter for pendant fixtures), galvanized soft annealed mild steel wire as defined in ASTM A641, Class 1 coating.
- H. Provide attachment devices and any other required accessories for a complete suspended ceiling system installation.

## 2.03 ACOUSTICAL CEILING PANELS

- A. Acoustical ceiling panels shall be class A in accordance to ASTM E1264.
- B. Acoustical panels shall meet the following surface-burning characteristics when tested in accordance to ASTM E84 for Class A materials:
  - 1. Maximum Flame Spread: 25.
  - 2. Maximum Smoke Developed: 50.
- C. Mold and Mildew Resistance: Panels and faces shall be treated with a biocide paint additive or an antimicrobial solution to inhibit mold and mildew.

## 2.04 CEILING TYPES

- A. ACT 1 - Classrooms:

1. Acoustical Ceiling Panels:
    - a. Panel Name: Armstrong Fine Fissured High NRC 1811, USG Radar Climaplus HiNRC 22311, CertainTeed Fine Fissured HHF 497 HNRC, or equal.
    - b. Panel Size: 2-foot by 4-foot.
    - c. Panel Thickness: 3/4 inch.
    - d. Edge Detail: Lay-in.
    - e. Light Reflectance: 0.82 minimum, complying with ASTM E1477.
    - f. CAC: Minimum 40, UL Classified, complying with ASTM E1414.
    - g. NRC: Minimum 0.70, UL Classified, complying with ASTM C423.
    - h. Color: White.
    - i. Recycled Content: Minimum 37 percent.
  2. Suspension System:
    - a. Suspension System Name: Prelude XL by Armstrong, Donn DX by USG, 1200 Seismic Series by Chicago Metallic Corporation, or equal.
    - b. Color: White.
- B. ACT 2 - Administration:
1. Acoustical Ceiling Panels:
    - a. Panel Name: Armstrong Ultima 1912, USG Mars ClimaPlus 86985, CertainTeed Symphony M No. 1222BF-OVT-1, or equal.
    - b. Panel Size: 2-foot by 2-foot.
    - c. Panel Thickness: 3/4 inch.
    - d. Edge Detail: Beveled tegular.
    - e. Light Reflectance: 0.89 minimum, in accordance with ASTM E1477.
    - f. CAC: Minimum 35, UL Classified, complying with ASTM E1414.
    - g. NRC: Minimum 0.75, UL Classified, complying with ASTM C423.
    - h. Color: White.
    - i. Recycled Content: 74 percent minimum.
  2. Suspension System:
    - a. Suspension System Name: Silhouette XL by Armstrong, Fineline by USG, 4500 Ultraline Series by Chicago Metallic Corporation, or equal.
    - b. Color: White.
- C. ACT 3 - Cafeteria:
1. Acoustical Ceiling Panel:
    - a. Panel Name: Armstrong Optima Open Plan 3250PB, USG Halcyon Eco No. 97315, or equal. Formaldehyde free.
    - b. Panel Size: 2-foot by 2-foot.
    - c. Panel Thickness: 1 inch.
    - d. Edge Detail: Tegular.
    - e. Light Reflectance: 0.88 minimum, complying with ASTM E1477.
    - f. NRC: Minimum 0.95, UL Classified, complying with ASTM C423.

- g. Color: White.
- h. Recycled Content: Minimum 28 percent.

2. Suspension System:

- a. Suspension System Name: Prelude XL by Armstrong, Donn DX by USG, 1200 Seismic Series by Chicago Metallic Corporation, or equal.
- b. Color: White.

D. ACT 4 – Other areas:

1. Acoustical Ceiling Panel:

- a. Panel Name: Armstrong Fine Fissured 1729, USG Radar Climaplus 2410, CertainTeed Hytone Fine Fissured HHF 197, or equal.
- b. Panel Size: 2-foot by 4-foot.
- c. Panel Thickness: 5/8 inch.
- d. Edge Detail: Lay-in.
- e. Light Reflectance: 0.82 minimum, complying with ASTM E1477.
- f. CAC: Minimum 35, UL Classified, complying with ASTM E1414.
- g. NRC: Minimum 0.55, UL Classified; complying with ASTM C423.
- h. Color: White.
- i. Recycled Content: Minimum 37 percent.

2. Suspension System:

- a. Suspension System Name: Prelude XL by Armstrong, Donn DX by USG, 1200 Seismic Series by Chicago Metallic Corporation, or equal.
- b. Color: White.

### **PART 3 - EXECUTION**

#### **3.01 PREPARATION**

- A. Furnish layouts for inserts, clips or other supports and struts required to be installed by the Work of other trades that depend on the suspended ceiling system for support.
- B. Coordinate related Work to ensure completion prior to installation of clips or fasteners.
- C. Compare layouts with construction conditions. Tile shall be spaced symmetrically about the centerlines of the room or space, and shall start with a tile or joint line as required to avoid narrow tiles at the finish edges unless indicated otherwise. Joints shall be tight with joint lines straight and aligned with the walls. Ceiling moldings shall be provided where tile abuts wall with matching caulking to eliminate any space.

#### **3.02 INSTALLATION**

- A. Suspension Systems

1. Install suspension system in accordance with ASTM C636 and ASTM E580.
2. System shall be complete; with joints neatly and tightly joined and securely fastened; suspension members shall be installed in a true, flat, level plane.
3. Hanger Wires: 0.106-inch diameter minimum; larger sizes as indicated or required.
  - a. Fasten wires to panel points and structure above per most stringent requirements of fabricator and CBC and as indicated on Drawings.
  - b. Wires exceeding 1:6 out-of-plumb shall be braced with counter-sloping wires.
  - c. Maintain wires at least 6 inches from non-braced ducts, pipes, conduits, and other items.
  - d. Install wire along main runners at 4 feet on center. Terminal ends of each main runner and cross tee must be supported within 8 inches of each wall with a perimeter wire or within 1/4 of the length of the end tee, whichever is least, for the perimeter of the ceiling area.
  - e. Where obstructions prevent direct suspension, provide trapezes or equivalent devices; 1 1/2-inch minimum cold rolled channels back-to-back may be installed for spans to 6 feet maximum.
  - f. Wire shall be straight, without extraneous kinks or bend. Hanger wire connections must be capable of carrying a 200 - pound pull without stretching or shifting the suspension clip.
4. Bracing Wires to Resist Seismic Forces: 0.106-inch diameter minimum, larger sizes as indicated or required.
  - a. System for Bracing Ceilings: Lay-in Ceiling Systems: Install one (1) 4 wire set of sway bracing wires and a vertical strut for each 144 square feet maximum of ceiling area. Locate wire sets and struts at 12 feet maximum on center. At ceiling perimeters, wire-sets shall be installed within 6 feet of walls.
  - b. Install 4-wire sets and struts within 2 inches of cross-runner intersection with main runner; space wires 90 degrees from each other.
  - c. Do not install sway bracing wires at an angle greater than 45 degrees with the ceiling plane.
  - d. Wires shall be tight, without causing ceiling to lift.
  - e. Fasten struts in accordance with CBC requirements.
  - f. Maintain wires at least 6 inches from non-braced ducts, pipes, conduit, and other items.
5. Provide additional wires, 0.106-inch diameter minimum, necessary to properly support suspension at electrical devices, air distribution devices, vertical soffits, and other concentrated loads.
6. Suspension:
  - a. Suspension members shall be fastened to two (2) adjacent walls per ASTM 580; but shall be at least 3/4 inches minimum clear of other walls.
  - b. Any suspension members not fastened to walls shall be interconnected to prevent spreading, near their free end, with a horizontal metal strut or stabilizer bar or 0.064-inch diameter taut tie wire.
  - c. Provide additional tees or sub tees to frame openings for lights, air distribution devices, electrical devices, and other items penetrating through ceiling, which do not have an integral flange to support and conceal cut edges of acoustic panels. Provide cross bracing necessary to securely support any surface mounted fixtures or other items.
7. Attachment of Wires:
  - a. To Metal Deck or Steel Framing Members: Install as required by current code.
  - b. To Suspension Members: Insert through holes in members or supporting clips.
  - c. Wires shall be fastened with three (3) tight turns minimum for hanger wires and four (4) tight turns minimum bracing wires. Turns shall be made in a 1 1/2-inch maximum distance.

**B. Suspension System for 2-foot by 4-foot Lay-in Acoustical Ceilings:**

1. Main Runners: Install main runners 48 inches apart; 0.106-inch diameter hanger wires space 48 inches on center maximum along runners, and within 8 inches of ends.
2. Install wall moldings with fasteners to studs. Install corner caps at molding intersections.
3. Cross Tees: Install between main runners in a repetitive pattern of 2-foot spacings.
4. Sub-Tees: Install at edges of penetrations.

**C. Acoustical Panels**

1. Install panels into suspension system. Partial panels shall be neatly cut and fitted to suspension and around penetrations and/or obstructions. Duplicate tegular edges at partial panels; cuts to be straight. Repaint cut tiles to match color or as directed by manufacturer for mylar facing at visually exposed conditions or as required by the Architect.
2. Penetrations through the ceilings for sprinkler heads and other similar devices that are not integrally tied to the ceiling system in the lateral direction shall have a 2-inch oversized ring, sleeve or adapter through the ceiling tile to allow free movement of 1 inch in horizontal directions. Alternatively, per ASTM E580, a flexible sprinkler hose fitting that can accommodate 1 inch of ceiling movement shall be permitted to be used in lieu of the oversized ring, sleeve or adapter.

**D. Air Distribution Devices**

1. Refer to and coordinate with Division 23 - HVAC.
2. Install air distribution grilles and other devices into suspension system. Install 4 taut wires, each 0.106-inch diameter minimum, to each device within 3 inches of device corners, to support their weight independent of the suspension system.

**E. Light Fixtures**

1. Refer to and coordinate with Division 26 - Electrical.
2. Fixtures weighing less than 56 pounds: Install fixtures into suspension systems and fasten earthquake clips to suspension members. Install minimum 2 slack safety wires, each 0.106 inch diameter minimum, to each fixture at diagonally opposite corners, to support their weight independent of the system.
3. Fixtures weighing 56 pounds or more: Install fixtures into suspension system and fasten earthquake clips to suspension system members as required by the Drawings and/or code. Install not less than 4 taut 0.106-inch diameter wires capable of supporting four (4) times the fixture load.
4. Support pendant-mounted light fixtures directly from the structure above with hanger wires or cables passing through each pendant hanger and capable of supporting two (2) times the weight of the fixture. Brace the pendant-mounted light fixtures by either a bracing assembly at the ceiling penetration or below the ceiling to the walls, as indicated in the drawings.

**3.03 CLEANING**

- A. General: After installation of acoustical material has been completed, clean surfaces of the material, removing any dirt or discolorations. Replace panels as required.
- B. Acoustical Panels: Minor abraded spots and cut edges shall be touched up with the same paint as was used for factory applied finish of the lay-in panels.
- C. Remove and replace work that cannot be successfully cleaned and repaired to eliminate evidence of damage.
- D. Remove rubbish, debris, and waste materials and legally dispose of off of the Project site.

#### 3.04 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION



## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 2023-02-10 - Section revised to correct actual products.
- 2025-01-31 – Added District Design Standard item. Added reference to 07 26 00 for floor testing. Added ASTM references.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- No VCT tiles in Multi-Purpose Rooms.

SECTION 09 65 00

RESILIENT FLOORING - TILE

**PART 1 – GENERAL**

**1.01 SUMMARY**

**A. Section Includes:**

1. Flooring and accessories as shown on the drawings and schedules and as indicated by the requirements of this section.
2. Subfloor testing and preparation.

**B. Related Sections:**

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 03 31 00 – Cast-In-Place Concrete.
3. Section 07 26 00 – Vapor Retarder.
3. Section 09 29 00 – Gypsum Board.

**C. References:**

1. ANSI/ASTM E648-15e1 - Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.
2. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
2. ASTM F1869 – Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
3. ASTM F2170 – Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

**1.03 QUALITY ASSURANCE AND REGULATORY REQUIREMENTS**

- A. Installation Qualification:** Contractors for floor covering installation should be experienced in managing commercial flooring projects and provide professional installers, qualified to install the various flooring materials specified. An installer is “qualified” if trained, or a certified by Tarkett or a certified INSTALL (International Standards & Training Alliance) resilient floor covering installer.
- B. Mockups:** Provide resilient products with mockups specified in other Sections.
- C.** If required, provide types of flooring and accessories supplied by one (1) manufacturer, including leveling and patching compounds, and adhesives. To avoid disruptions in delivery and execution, manufacturer should maintain production facilities within 400 miles of jobsite.

**1.04 SUBMITTALS:**

- A. Submit shop drawings, seaming plan, coving details, and manufacturer's technical data, installation and maintenance instructions for flooring and accessories.
- B. Submit the manufacturer's standard samples showing the required colors for flooring and applicable accessories.
- C. If required, submit the manufacturer's certification that the flooring has been tested by an independent laboratory and complies with the required fire tests.

**1.05 PROJECT CONDITIONS**

- A. Deliver materials in good condition to the jobsite in the manufacturer's original unopened containers that bear the name and brand of the manufacturer, project identification, and shipping and handling instructions.
- B. Store materials in a clean, dry, enclosed space off the ground, and protected from the weather and from extremes of heat and cold. Protect adhesives from freezing. Store flooring, adhesives and accessories in the spaces where they will be installed for at least 48 hours before beginning installation.
- C. Maintain a minimum temperature in the spaces to receive the flooring and accessories of 65 degrees F (18 degrees C) and a maximum temperature of 100 degrees F (38 degrees C) for at least 48 hours before, during, and for not less than 48 hours after installation. Thereafter, maintain a minimum temperature of 55 degrees F (13 degrees C) in areas where work is completed. Protect all materials from the direct flow of heat from hot-air registers, radiators, or other heating fixtures and appliances.
- D. Install flooring and accessories after the other finishing operations, including painting, have been completed. Close spaces to traffic during the installation of the flooring. Do not install flooring over concrete slabs until they are sufficiently dry to achieve a bond with the adhesive, in accordance with the manufacturer's recommended bond and moisture tests.

**PART 2 – PRODUCTS****2.01 MATERIALS**

- A. Resilient Tile Flooring
  - 1. Provide tile flooring, in [color selected from the range currently available], having a nominal total thickness of 1/8 inch, 12 inches by 12 inches, composed of polyvinyl chloride resin binder, plasticizers, fillers, and pigments with colors and texture dispersed uniformly throughout its thickness. The pattern shall consist of a tone-on-tone grained visual with a textured, multidimensional look. Vinyl composition tile shall conform to the requirements of ASTM F 1066, Class 2 – through pattern such that pattern AND color extends through product to back.

2. Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
    - a. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
    - b. Maximum Specific Optical Density: 450 or less.
  2. Acceptable Manufacturer's:
    - a. Armstrong Excelon.
    - b. Tarkett VCT II.
    - c. Or approved equal.
- B. Wall Base
1. Provide 1/8 inch thick, [4 inch or 6 inch] high wall base with a matte finish, conforming to ASTM F 1861, [Type TV-Vinyl, Thermoplastic] [Type TP – Rubber, Thermoplastic], Group 2 – Layered, [Style A – Straight] [Style B – Cove].
  2. Acceptable Manufacturer's:
    - a. Burke Industries, Type TP.
    - b. Roppe Rubber Corporation, Vinyl Wall Base Series.
    - c. Or approved equal.
- C. Adhesives
1. For conventional full spread system: Provide [asphalt cut-back] [water-based asphalt/rubber] [water-based rubber resin] [water-based/latex-resin] adhesive under the tile and latex wall base adhesive at the wall base as recommended by the flooring manufacturer.
  2. For installation over existing resilient flooring: Provide [water-based rubber-resin] [water-based/latex-resin] adhesive under the tile over smooth, completely bonded existing resilient flooring and latex wall base adhesive at the wall base as recommended by the flooring manufacturer.
  3. Acceptable Products:
    - a. Armstrong: S-525 BBT Bio-Flooring Adhesive High Moisture.
    - b. Tarkett: 100 Clear Thin Spread Adhesive.
    - c. Or approved equal high moisture / high pH adhesive.

## 2.04 ACCESSORIES

- A. For patching, smoothing, and leveling monolithic subfloors (concrete, terrazzo, quarry tile, ceramic tile, and certain metals), provide Portland cement-based latex underlayment or patch and skim coat as recommended by the resilient flooring manufacturer.
- B. For sealing joints between the top of wall base or integral cove cap and irregular wall surfaces such as masonry, provide plastic filler applied according to the manufacturer's recommendations.

- C. Provide transition/reducing strips tapered to meet abutting materials.
- D. Provide threshold of thickness and width as shown on the drawings.
- E. Provide resilient edge strips of width shown on the drawings, of equal gauge to the flooring, homogeneous vinyl or rubber composition, tapered or bullnose edge, with color to match or contrast with the flooring, or as selected by the Architect from standard colors available.
- F. Provide metal edge strips of width shown on the drawings and of required thickness to protect exposed edges of the flooring. Provide units of maximum available length to minimize the number of joints. Use butt-type metal edge strips for concealed anchorage, or overlap-type metal edge strips for exposed anchorage. Unless otherwise shown, provide strips made of extruded aluminum with a mill finish.

### **PART 3 – EXECUTION**

#### **3.01 EXAMINATION**

- A. Examine subfloors prior to installation to determine that surfaces are smooth and free from cracks, holes, ridges, and other defects that might prevent adhesive bond or impair durability or appearance of the flooring material.
- B. Inspect subfloors prior to installation to determine that surfaces are free from curing, sealing, parting and hardening compounds; residual adhesives; adhesive removers; and other foreign materials that might prevent adhesive bond. Visually inspect for evidence of moisture, alkaline salts, carbonation, dusting, mold, or mildew.
- C. Report conditions contrary to contract requirements that would prevent a proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.
- D. Failure to call attention to defects or imperfections will be construed as acceptance and approval of the subfloor. Installation indicates acceptance of substrates with regard to conditions existing at the time of installation.

#### **3.02 PREPARATION**

- A. Smooth concrete surfaces, removing rough areas, projections, ridges, and bumps, and filling low spots, control or construction joints, and other defects with Portland cement-based latex underlayment or patch and skim coat as recommended by the flooring manufacture.
- B. Remove paint, varnish, oils, release agents, sealers, and waxes. Remove residual adhesives as recommended by the flooring manufacturer. Remove curing and hardening compounds not compatible with the adhesives used, as indicated by a bond test or by the compound manufacturer's recommendations for flooring. Avoid organic solvents.

- C. Perform subfloor Calcium Chloride Tests, RH Tests, and Bond Tests recommended by the resilient flooring manufacturer to determine if surfaces are dry; free of curing and hardening compounds, old adhesive, and other coatings; and ready to receive flooring.
- D. Vacuum or broom-clean surfaces to be covered immediately before the application of flooring. Make subfloor free from dust, dirt, grease, and all foreign materials.

### 3.03 INSTALLATION

#### A. Tile

1. Install flooring in strict accordance with the manufacturer's written instructions.
2. Install flooring wall to wall before the installation of floor-set cabinets, casework, furniture, equipment, movable partitions, etc. Extend flooring into toe spaces, door recesses, closets, and similar openings as shown on the drawings.
3. If required, install flooring on pan-type floor access covers. Maintain continuity of color and pattern within pieces of flooring installed on these covers. Adhere flooring to the subfloor around covers and to covers.
4. Scribe, cut, and fit to permanent fixtures, columns, walls, partitions, pipes, outlets, and built-in furniture and cabinets.
5. Install flooring with adhesives, tools, and procedures in strict accordance with the manufacturer's written instructions. Observe the recommended adhesive trowel notching, open times, and working times.

#### B. Accessories

1. Apply top set wall base to walls, columns, casework, and other permanent fixtures in areas where top-set base is required. Install base in lengths as long as practical, with inside corners fabricated from base materials that are mitered or coped. Tightly bond base to vertical substrate with continuous contact at horizontal and vertical surfaces.
2. Fill voids with plastic filler along the top edge of the resilient wall base or integral cove cap on masonry surfaces or other similar irregular substrates.
3. Place resilient edge strips tightly butted to flooring, and secure with adhesive recommended by the edge strip manufacturer. Install edge strips at edges of flooring that would otherwise be exposed.
4. Apply [butt-type] [overlap] metal edge strips where shown on the drawings, [before] [after] flooring installation. Secure units to the substrate, complying with the edge strip manufacturer's recommendations.

### 3.05 CLEANING AND PROTECTION

- A. Perform initial maintenance according to the flooring manufacturer's instructions.
- B. Protect installed flooring as recommended by the flooring manufacturer against damage from rolling loads, other trades, or the placement of fixtures and furnishings.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 2025-01-31 – Updated entire spec to cover more specific information.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

SECTION 09 65 16

RESILIENT FLOORING – SHEET VINYL

**PART 1 – GENERAL**

**1.01 SUMMARY**

**A. Section Includes:**

1. Flooring and accessories as shown on the drawings and schedules and as indicated by the requirements of this section.

**B. Related Sections:**

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 03 31 00 - Cast-in-Place Concrete.
3. Section 09 29 00 – Gypsum Board.

**1.02 REFERENCES**

**A. Manufacturer's flooring technical manuals.**

**B. ASTM International:**

1. ASTM E 648 Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
2. ASTM E 662 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
3. ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
4. ASTM F 1482, Standard Guide to Wood Underlayment Products Available for Use Under Resilient Flooring
5. ASTM F 1861 Standard Specification for Resilient Wall Base
6. ASTM F 1869 Standard Test Method for Measuring Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
7. ASTM F 1913 Standard Specification for Vinyl Sheet Floor Covering Without Backing
8. ASTM F 2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
9. ASTM D2047 Standard for Slip-resistance: Minimum coefficient of friction 0.6

**C. National Fire Protection Association (NFPA):**

1. NFPA 253 Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source



2. NFPA 258 Standard Test Method for Measuring the Smoke Generated by Solid Materials

D. Standards Council of Canada

1. CAN/ULC-S102.2 Standard Test Method for Surface Burning Characteristics of Flooring, Floor Covering and Miscellaneous Materials and Assemblies

1.03 SYSTEM DESCRIPTION

- A. Performance Requirements: Provide flooring which has been manufactured, fabricated, and installed to performance criteria certified by manufacturer without defects, damage, or failure.
- B. Administrative Requirements
  1. Pre-installation Meeting: Conduct an on-site pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements. Comply with Division 1 Project Management and Coordination (Project Meetings) Section.
  2. Pre-installation Testing: Conduct pre-installation testing as follows: [Specify testing (i.e., moisture tests, bond test, pH test, etc.)]

1.04 SUBMITTALS

- A. Submit shop drawings, seaming plan, coving details, and manufacturer's technical data, installation, and maintenance instructions for flooring and accessories.
- B. Submit the manufacturer's standard samples showing the required colors for flooring, welding rods, and applicable accessories.
- C. Submit Safety Data Sheets (SDS) available for adhesives, weld rod, moisture mitigation systems, primers, patching/leveling compounds, floor finishes (polishes) and cleaning agents and Material Information Sheets for flooring products.
- D. If required, submit the manufacturer's certification that the flooring has been tested by an independent laboratory and complies with the required fire tests.
- E. Closeout Submittals: Submit the following:
  1. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section. Include methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.
  2. Warranty: Warranty documents specified herein

1.04 QUALITY ASSURANCE

- A. Qualifications of Installer: Minimum five (5) years' experience in successfully installing the specified products or similar flooring materials.
- B. Comply with the following as a minimum requirement:
  - 1. Materials shall be compliant with requirements of CBC Chapter 11B and ADAAG.
  - 2. ASTM E84: Class A Flame Spread Rating of 25 or less.
  - 3. Fire Test Data: ASTM E648, NFPA 253, ASTM E662, NFPA 258.
  - 4. Moisture Testing: ASTM F1869.
  - 5. ASTM E 662 (Smoke Generation) Maximum Specific Optical Density of 450 or less
  - 6. CAN/ULC-S102.2 – Flame Spread Rating and Smoke Developed – Results as tested.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Comply with Division 1 Product Requirements Sections
- B. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- C. Deliver materials in good condition to the jobsite in the manufacturer's original unopened containers that bear the name and brand of the manufacturer, project identification, and shipping and handling instructions.
- D. Store materials in a clean, dry, enclosed space off the ground, protected from harmful weather conditions and at temperature and humidity conditions recommended by the manufacturer. Protect adhesives from freezing. Store flooring, adhesives, and accessories in the spaces where they will be installed for at least 48 hours before beginning installation.

1.06 PROJECT CONDITIONS

- A. Ventilation and Temperature: Verify areas that are to receive new flooring are ventilated to remove fumes from installation materials, and areas are within temperature range recommended by the various material manufactures for project site installation conditions, through completion of project.
- B. Install resilient products after other finishing operations, including painting, have been completed.

1.07 WARRANTY

- A. Manufacturer shall provide ten (10) year material warranty, minimum.
- B. Installer shall provide a two (2) year fabrication and installation warranty.

1.08 MAINTENANCE

- A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials from same production run as products installed. Packaged with protective covering for storage and identified with appropriate labels.
  - 1. Quantity: Furnish quantity of flooring units equal to 5% of amount installed
  - 2. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage, and protection of extra material.

**PART 2 – PRODUCTS**

2.01 ACCEPTABLE MANUFACTURERS

- A, Armstrong Flooring.
- B. Tarkett Commercial.
- C. Or Approved Equal.

2.02 MATERIALS

- A. Heterogeneous Sheet Vinyl Flooring:
  - 1. Description: An inlaid sheet flooring consisting of an embossed wear layer of vinyl chips/granules consolidated on a flexible fibrous backing. Protected by a UV-cured polyurethane finish, the colors and pattern detail are dispersed uniformly throughout the wear layer of the product. Color pigments are insoluble in water and resistant to cleaning agents and light.
  - 2. Inlaid vinyl sheet flooring shall conform to the requirements of ASTM F1303 Standard Specification for Sheet Vinyl Floor Covering with Backing, Type II, Grade 1, with Class A backing.
  - 3. Pattern and Color: pattern/color selected from the range currently available from manufacturer.
  - 4. Width: Per manufacturer.
  - 5. Length: Per manufacturer.
  - 6. Thickness: 0.080 in. (2.0 mm)
  - 7. ASTM F 1515 Resistance to Light – Max. Avg.  $\Delta E \leq 8$
  - 8. Product shall be heat weldable
- B. Homogeneous Sheet Flooring
  - 1. Description: An unbacked, nonlayered, homogeneous sheet vinyl flooring. Protected by a diamond-infused UV-cured polyurethane finish, the colors and pattern detail are dispersed uniformly throughout the thickness of the product. Color pigments are insoluble in water and resistant to cleaning agents and light.
  - 2. Homogeneous sheet flooring shall conform to the requirements of ASTM F1913 Standard Specification for Sheet Floor Covering Without Backing
  - 3. Pattern and Color: pattern/color selected from the range currently available from manufacturer.

4. Width: Per manufacturer.
5. Length: Per manufacturer.
6. Thickness: 0.080 in. (2.0 mm)

C. Weld Rod:

1. Provide solid color vinyl weld rod as produced by manufacturer and intended for heat welding of seams. Color shall be compatible with field color of flooring or as selected by Architect to contrast with field color of flooring. Color selected from the range currently available from manufacturer.

D. Seam Adhesive:

1. Provide Seam Adhesive at seams as recommended by the resilient flooring manufacturer.

E. Integral Flash Cove Base:

1. Provide integral flash cove wall base by extending sheet flooring (New Construction, non-toilet room or food service - 4 in. high, Modernization-type projects, new cafeteria spaces, and toilet rooms -6 in. high) up the wall using adhesive, welding rod, and accessories recommended and approved by the flooring manufacturer.

F. Rubber Wall Base:

1. Cove style, conforming to ASTM F 1861 or FS-SS-W-40, Type 1. New Construction - 4" high and 1/8-inch (3.2mm) gauge. Modernization-type projects and new construction cafeteria spaces - 6" high and 1/8-inch (3.2mm) gauge. No manufactured corners.
  - a. Armstrong Flooring.
  - b. Tarkett Commercial.
  - c. Burke Industries.
  - d. Roppe Rubber Corp.
  - e. Approved equal.

G. Resilient Edge and Adapter/Transition Strips: 1/8-inch-thick, tapered or bullnose, minimum of 1 inch wide.

1. Roppe
2. Johnsonite
3. Flexco Floors
4. Approved equal.

H. Leveling and Patching Compounds:

1. Portland cement-based patch recommended by carpet manufacturer. Install as recommended by manufacturer for specific application.

- I. Concrete Primer: Non-staining type recommended by manufacturer of resilient sheet vinyl flooring.
- J. Trim: Stainless steel or extruded aluminum top trim and  $\frac{3}{4}$  inch radius plastic fillets with integral cove base.
- K. Floor Sealer: Install as recommended by manufacturer for specific application.

### **PART 3 - EXECUTION**

#### **3.01 COORDINATION**

- A. Coordinate with related Work to assure level, smooth, and clean finish surfaces to receive floor tile.

#### **3.02 COMPLIANCE**

- A. Comply with manufacturer's product data, including technical bulletins, product catalog, installation instructions, and product carton instructions for installation and maintenance procedures as needed.

#### **3.02 EXAMINATION**

- A. Site Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer's instructions (i.e., moisture tests, bond test, pH test).
- B. Visually inspect flooring materials, adhesives, and accessories prior to installation. Flooring material with visual defects shall not be installed and shall not be considered as a legitimate claim.
- C. Examine subfloors prior to installation to determine that surfaces are smooth and free from cracks, holes, ridges, and other defects that might prevent adhesive bond or impair durability or appearance of the flooring material.
- D. Inspect subfloors prior to installation to determine that surfaces are free from curing, sealing, parting and hardening compounds; residual adhesives; adhesive removers; and other foreign materials that might prevent adhesive bond. Visually inspect for evidence of moisture, alkaline salts, carbonation, dusting, mold, or mildew.
- E. Report conditions contrary to contract requirements that would prevent a proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.
- F. Failure to call attention to defects or imperfections will be construed as acceptance and approval of the subfloor. Installation indicates acceptance of substrates regarding conditions existing at the time of installation.

### 3.03 PREPARATION

- A. Smooth concrete surfaces, removing rough areas, projections, ridges, and bumps, and filling low spots, control or construction joints, and other defects with leveling compound as recommended by the flooring manufacturer. Refer to the product installation recommendations and ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring for additional information on subfloor preparation.
- B. Subfloor Preparation Moisture Mitigation: Smooth concrete surfaces, removing rough areas, projections, ridges, and bumps, and filling low spots, control or construction joints, mitigate moisture and other defects as recommended by the flooring manufacturer. Refer to the product installation recommendations and ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring for additional information on subfloor preparation.
- C. Subfloor Cleaning: The surface shall be free of dust, solvents, varnish, paint, wax, oil, grease, sealers, release agents, curing compounds, residual adhesive, adhesive removers, and other foreign materials that might affect the adhesion of resilient flooring to the concrete or cause a discoloration of the flooring from below. Remove residual adhesives as recommended by the flooring manufacturer. Remove curing and hardening compounds not compatible with the adhesives used, as indicated by a bond test or by the compound manufacturer's recommendations for flooring. Avoid organic solvents. Spray paints, permanent markers and other indelible ink markers must not be used to write on the back of the flooring material or used to mark the concrete slab as they could bleed through, telegraphing up to the surface and permanently staining the flooring material. If these contaminants are present on the substrate, they must be mechanically removed prior to the installation of the flooring material. Refer to the product installation recommendations and ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring for additional information on subfloor preparation.
- D. When using certain adhesives, perform subfloor moisture testing in accordance with ASTM F 2170, "Standard Test Method for Determining Relative Humidity in Concrete Slabs Using in-situ Probes" and Bond Tests as described by manufacturer to determine if surfaces are dry; free of curing and hardening compounds, old adhesive, and other coatings; and ready to receive flooring. The internal relative humidity of the concrete shall not exceed 95%. On installations where both the Percent Relative Humidity and the Moisture Vapor Emission Rate tests are conducted, results for both tests shall comply with the allowable limits listed above. Do not proceed with flooring installation until the results of moisture tests are acceptable. All test results shall be documented and retained.
- E. Concrete pH Testing: Perform pH tests on concrete floors regardless of their age or grade level. All test results shall be documented and retained.

### 3.04 INSTALLATION OF FLOORING

- A. Install flooring in strict accordance with the latest edition of the flooring installation recommendations. Failure to comply may result in voiding the manufacturer's warranty listed in Section 1.08.

- B. Install flooring wall to wall before the installation of floor-set cabinets, casework, furniture, equipment, movable partitions, etc. Extend flooring into toe spaces, door recesses, closets, and similar openings as shown on the drawings.
- C. If required, install flooring on pan-type floor access covers. Maintain continuity of color and pattern within pieces of flooring installed on these covers. Adhere flooring to the subfloor around covers and to covers.
- D. Scribe, cut, and fit or flash cove to permanent fixtures, columns, walls, partitions, pipes, outlets, and built-in furniture and cabinets.
- E. Adhere flooring to the subfloor without cracks, voids, raising and puckering at the seams. Roll with a 100-pound (45.36 kilogram) roller in the field areas. Hand-roll flooring at the perimeter and the seams to assure adhesion. Refer to specific rolling instructions of the flooring manufacturer.
- F. Lay flooring to provide a minimum number of seams. Avoid cross seams, filler pieces, and strips. Match edges for color shading and pattern at the seams in compliance with the manufacturer's recommendations.
- G. Install flooring with adhesives, tools, and procedures in strict accordance with the manufacturer's written instructions. Observe the recommended adhesive trowel notching, open times, and working times.
- H. Prepare heat-welded seams with methods and sequence of work in conformance with written instructions of the flooring manufacturer. Finish all seams flush and free from voids, recesses, and raised areas.
- I. Provide integral flash cove wall base where shown on the drawings, including cove fillet support strip and top edge cap trim. Construct flash cove base in accordance with the flooring manufacturer's instructions. Heat-weld seams or use seam adhesive as specified for those on the floor.

### 3.05 INSTALLATION OF ACCESSORIES

- A. Apply top set wall base to walls, columns, casework, and other permanent fixtures in areas where top-set base is required. Install base in lengths if practical, with inside corners fabricated from base materials that are mitered or coped. Tightly bond base to vertical substrate with continuous contact at horizontal and vertical surfaces.
- B. Fill voids with plastic filler along the top edge of the resilient wall base or integral cove cap on masonry surfaces or other similar irregular substrates.
- C. Place resilient edge strips tightly butted to flooring, and secure with adhesive recommended by the edge strip manufacturer. Install edge strips at edges of flooring that would otherwise be exposed.
- D. Apply metal edge strips where shown on the drawings, during flooring installation. Secure units to the substrate, complying with the edge strip manufacturer's recommendations.

3.06 CLEANING

- A. Perform initial and on-going maintenance according to the latest edition of the maintenance recommendations from manufacturer.

3.07 PROTECTION

- A. Protect installed flooring as recommended by the flooring manufacturer against damage from rolling loads, other trades, or the placement of fixtures and furnishings.

END OF SECTION



## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

### Cf List

- 2.01 and 2.02 need fixing. Information is a bit jumbled.

SECTION 09 67 23

FLUID-APPLIED FLOORING - EPOXY

**PART 1 – GENERAL**

1.01 1.1 SUMMARY

A. Section Includes

1. Trowel applied monolithic epoxy {urethane} flooring [for kitchen and food processing use].
2. Perimeter edging and integral 1/2-inch coved base.

A. Related Sections

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 09 05 61 - Common Work Results for Flooring Preparation.
3. Section 09 06 00 - Schedules for Finishes.
4. Section 09 65 15 - Cove Caps, Reducers, and Transitional Moldings.

1.02 REFERENCES

- A. ASTM D2240 – Standard Test Method for Rubber Property - Durometer Hardness.
- B. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials
- C. ASTM E648 - Critical Radiant Flux of Floor Covering Systems
- D. ADA Standards – ADA Title [II] [III] Regulations and the ADA Standards for Accessible Design.
- E. CBC-8 - CBC Chapter 8, Interior Finishes
- F. CBC-11B - CBC Chapter 11B, Access to Public Buildings, Public Accommodations, Commercial Facilities and Publicly Funded Housing
- G. California Fire Code (CFC)
- H. NFPA 101 - Life Safety Code
- I. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source
- J. SMAQMD – Sacramento Metropolitan Air Quality Management District Regulations.

### 1.03 SUBMITTALS

#### A. Action Submittals

1. Product Data for each system component and accessory item
2. Certified Copies of Field Quality Assurance Test Reports
3. [Shop Drawings showing traffic areas that will receive non-slip finish and equipment and fixture layout that will receive standard smooth finish]

#### B. Information Submittals

1. Manufacturer's Installation Instructions
2. Certificates of Compliance regarding specified performance requirements

#### C. Closeout Submittals

1. Manufacturer's Maintenance Instructions

### 1.04 QUALITY ASSURANCE

A. Flooring system components shall be compliance with VOC content limits in SMAQMD [APCD-67.0].

B. [Installed flooring system shall have ASTM C1028, Coefficient of Friction, as follows.

1. Dry/Level Surfaces: 0.6, minimum.
2. Wet/Sloped Surfaces: 0.8, minimum.

C. Installed flooring system shall be CBC-8, Section 803.1, Class A interior finish with the following surface burning characteristics.

1. ASTM E84 Flame Spread: 25, maximum.
2. ASTM E84 Smoke Developed: 450, maximum.
3. ASTM E648, Critical Radiant Flux: NFPA 253, Class II, minimum 0.22 watts per square centimeter.

D. Manufacturer: company with minimum [10] [15] –years' experience manufacturing poured epoxy flooring for commercial projects similar in scale and complexity to those required for this Project.

E. Installer: company with minimum five (5) years' experience installing poured epoxy flooring for commercial [DSA inspected,] Projects similar in scale and complexity to those required for this Project.

1. Installer: approved by the materials manufacturer.
2. Installer shall have completed at least five (5) comparable projects that are more than two (2) years old; submit list with names and telephone numbers of knowledgeable client contacts.

- F. Field Sample. For each color and finish of fluid applied flooring, install a Field Sample with one corner as an exploded view showing each step in the process of surface preparation and installation.
1. Size: minimum 4- by 5-feet.
  2. Location: acceptable to Architect.
  3. Modify materials and methods of installation for each Field Sample as required to obtain Architect's approval.
  4. Document materials and methods used to obtain Architect's approval of each Field Sample. Maintain at least one copy of these documents in a readily accessible location on Site while this work is in progress.
  5. Maintain access to and protect Field Sample from damage while this work is in progress.
  6. [Upon acceptance of related work, Field Sample that remains in acceptable condition may remain as part of the work.]
  7. [Upon acceptance of related work, remove Field Sample from Site and correct occupied space to indicated conditions.]

#### 1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in un-opened containers, factory mixed and packaged.
- B. Store materials in a dry, secure area.

#### 1.06 PROJECT REQUIREMENTS

- A. Do not install flooring when temperature is below 60 degrees F or above 90 degrees F.
- B. Maintain this temperature range, 24 hours before, during and 72 hours after installation of flooring.
- C. Restrict traffic from area where flooring is being installed or is curing.

#### 1.07 WARRANTY [-EXTENDED]

- A. Manufacturer shall warrant installed flooring to be and to remain free from defect for a period of one (1) year [at least 3-years] from Date of Substantial Completion. Upon written notice from Owner, manufacturer shall promptly, without cost, and with least practicable inconvenience to Owner correct such defects.
- B. Evidence of defect in material, installation or both shall be delamination from substrate or degradation of surface finish individually or in combination.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

A. Products of the following manufacturers form the basis of design and quality intended for this Project.

1. Crossfield Products Corp., Compton, CA. Product: Dex-O-Tex
2. [Stonhard, Inc., Maple Shade, NJ]
3. Tnemec Company, Kansas City, MO
4. [[Tera-Lite, Inc./Revolan Systems, San Jose, CA.]]
5. {Sherwin Williams - General Polymers, Cincinnati, OH}
6. Prime Coat Coating Systems, Waukegan IL.
7. BASF, Product: MasterTop 1245 CLAD (formerly Selby 425)
8. Or equal, approved in accordance with Division 01 requirements for substitutions.

B. Resinous Flooring: Dex-O-Tex, Cheminert K {Tek-Crete SL (self-leveling), urethane mortar} {Tek-Crete SL B (self-leveling) urethane mortar, Broadcast aggregate} {{Tek-Crete TT, troweled Urethane Mortar}}, meet or exceed the following physical properties when tested in accordance with the cited referenced standard test method.

1. Thickness: ¼ inch [1/8 inch]
2. Compressive Strength (ASTM C579): 11,000 [[11,500]] {8,100} {{8,400}} psi.
3. Tensile Strength (ASTM C307): 1,643 [[2,500]] {1,000} {{1,080}} psi.
4. Flexural Modulus of Elasticity (ASTM C580): 4,300 [[4,500]] {2,000} {{2,000}} psi.
5. Water Absorption (MIL D3134): 0.30 [[0.25]] {0.64} {{0.64}} percent max.
6. Surface Hardness (ASTM D2240): 85.5 Durometer Shore "D" [[Durometer Shore D – 83]] {Durometer Shore D 85-90} {{Durometer Shore D85-90}}
7. Abrasion Resistance (ASTM D1044): 0.0 gr. [[1000 cycles, wt. loss]]
8. Impact Resistance (MIL-D-3134, Para 4.7.3): 0.024-inch max.
9. Adhesion Impact Resistance (Gardner Impact Tester): No chipping, cracking, or delamination and not more than 0.014-inch indentation Adhesion (A.C.I. Comm. No. 503.1): 400 psi (100 percent failure in concrete)
10. Electrical Conductivity (NFPA 56A): Di-electric
11. Flammability-Critical Radiant Flux (ASTM E648): Greater than 1.07 watts/cm<sup>2</sup>
12. Colors:
  - a. Solid colors: [As scheduled in Section 090600] [413 gray] [431 gray] [402 gray] [304 Beige] [211 green] [607 red] [blue] [as selected by Architect from manufacturer's full range of available colors.
  - b. [Grouted with selected variegated aggregates, top coated with clear finish coat.]
13. [Skid Resistant Epoxy Coating with aluminum Oxide: Posi-Tred O, skid-resistant. Profile: Medium Profile, 23 mils [Fine Profile, 12 mils] [Coarse Profile, 50 mils]. Color as selected by Architect.]
14. [Color quartz Topcoat: Terracolor aggregate.]
15. {Tek-Crete SL B: Aggregate; natural mineral aggregate.}
16. {Tek-Crete SL B: Top Coat; pigmented sealer; Dex-O-Tex Quik-Glaze}
17. Dex-O-Tex Cheminert SC Membrane under flooring system.
18. Antimicrobial Additive: anti-microbial biocide.
19. Integral Cove Base and Top Coat: Tek-Crete VRT
20. Vapor Control System: where moisture readings exceed 3 lbs/1000sq ft./24 hour period; Dex-O-Tex VaporControl Primer 200 [Specified in Section 072500].

C. Resinous Flooring: Tera-Lite, Tera-Gem III Industrial Flooring System (IFS) {Tera-Gem III Chemical Resistant Flooring System (CRS)} {{Tera-Gem III Decorative Quality Troweled Flooring System (DQ)}}, epoxy flooring, meet or exceed the following physical properties when tested in accordance with the cited referenced standard test method.

1. Thickness: ¼ inch [1/8 inch]
2. Compressive Strength (ASTM C579): 11,500 {{10,500}} psi.
3. Tensile Strength (ASTM C307): 6,000 {{5,000}} psi.
4. Flexural Modulus of Elasticity (ASTM C580): 4,500 {{4,700}} psi.
5. Water Absorption (MIL D3134): 0.25 percent max.
6. Surface Hardness (ASTM D2240): Shore D – 83 {{82}}
7. Abrasion Resistance (ASTM D1044): 1000 cycles, wt. loss
8. Impact Resistance (MIL-D-3134, Para 4.7.3) no cracking or delamination at: 16 ft. lbs.
9. Adhesion Impact Resistance (Gardner Impact Tester): No chipping, cracking, or delamination and not more than 0.014-inch indentation Adhesion (A.C.I. Comm. No. 503.1): 400 psi (100 percent failure in concrete)
10. Electrical Conductivity (NFPA 56A): Di-electric
11. Flammability, ASTM E635: self-extinguishing
12. Colors:
  - a. Solid colors: [As scheduled in Section 099100] [gray] [tan] [green] [red] [blue] [as selected by Architect from manufacturer's full range of available colors.]
  - b. [Grouted with selected variegated aggregates, top coated with clear finish coat.]
13. Primer: Two-component epoxy primer, liquid components, mix 2 parts of A to 1 part of B by volume. Stir with a mechanical agitator for 1-2 minutes. Distribute mixed material evenly over the floor surface using rollers, squeegees or spray. Spread rate will vary from 70 to 150 sq. ft. per gallon. Do not apply over standing water or let primer set before applying next coat.
14. Basecoat: Three-component, troweled polymer composite epoxy resin, curing agent, organic pigment and silica aggregate {{color quartz}} for Tera-Gem III IFS {CRS} {{Tera-Gem III for DQ}}. Liquid components at a ratio of 2 parts A to 1 part B by volume. To one weight equivalents of mixed liquid components add approximately 7-weight equivalent of aggregate. Mix all components using an electrical drill motor agitator or a plaster mixer. Mix all components for 2-3 minutes or until uniformly wetted, trowel to a thickness of ¼ inch.
15. Sealer: Liquid components with inorganic pigments {{DQ Clear liquid components}}, apply two (2) pigmented seal coats using the base coat liquid components, application rate approximately 125 sq. ft. per gallon.
16. [Anti-skid: No. 70 mesh silica sand or Flintshot. Applied to second seal coat.]
17. {{Quartz decorative finish: SpectraQuartz for Tera-Gem III DQ, color or blend as selected by Architect}}:

D. Flooring: Terracolor

1. Physical Properties: Provide flooring system that meet or exceed the listed minimum physical property requirements when tested according to the referenced standard test method in parentheses.
  - a. Thickness: ¼ inch

- b. Compressive Strength (ASTM C 579): 10,716 psi
- c. Tensile Strength (ASTM C 307): 1,843 psi
- d. Surface Hardness (ASTM D-2240): Durometer "D" 81
- e. Abrasion Resistance (ASTM D 1044): 0.0 gr.
- f. Indentation (MIL-D-3134): <1.0 percent
- g. Impact Resistance (Gardner Impact Tester): No chipping, cracking, or delamination
- h. Adhesion (A.G.I. Comm. No. 503.1): >400 psi (100 percent failure in concrete)
- i. Electrical Conductivity (NFPA 56A): Di-electric
- j. Flammability (ASTM E-648/NFPA 253/FTMS 372): Greater than 1.07 watts/cm<sup>2</sup> (Class I)]

**E. Flooring: DEX-O-TEX Decor-Flor**

1. Provide flooring system that meet or exceed the listed minimum typical physical properties at 75oF (24oC) tested according to referenced standard test method:

- a. Compressive Strength ASTM C579 10,500 psi
- b. (Resin, Hardener & Aggregate) (738 kg/cm<sup>2</sup>)
- c. Tensile Strength ASTM C307 1,800 psi
- d. (Resin, Hardener & Aggregate) (127 kg/cm<sup>2</sup>)
- e. Flexural Strength ASTM C580 4,000 psi (281 kg/cm<sup>2</sup>)
- f. Surface Hardness ASTM D2240 Shore D 80-85
- g. Indentation Characteristics
  - 1) (Steadily Applied Load) MIL-D-3134, 0.005 inch
  - 2) Para. 4.7.4.2.1, 2000 lbs. on 1 inch steel ram imposed for 30 minutes over concrete substrate, indented, (0.127 mm)
- h. Indentation Characteristics MIL-D-3134, Para. 4.7.3
  - 1) (Impact Load) 0.011 inch
  - 2) (2 lb. 0.908 kg.) Indent from steel ball dropped twice from 8 ft. height, (0.28 mm)
- i. Adhesion ASTM D4541 > 400 psi
  - 1) (100 percent failure in concrete) (28.1 kg/cm<sup>2</sup>)
- j. Water Absorption MIL-D-3134 < 1.0%
- k. Abrasion Resistance ASTM D4060
  - 1) (CS17, 1000gr load, 1000 cycles) 0.04 gr
- l. Flammability ASTM D635 Self-Extinguishing  
Bonded to Concrete
- m. Skid Resistance Varies depending  
upon surface  
texture selected.

- F. <Stonclad GS as manufactured by Stonhard, Inc., Maple Shade, NJ, nominal 1/4-inch-thick system comprised of two-component moisture tolerant, penetrating epoxy primer, three-component troweled mortar consisting of epoxy resin, curing agent and selected, graded aggregates blended with inorganic pigments. Aggregate broadcast and a high performance, two-component, clear epoxy sealer.

G. Stonblend GSI is a nominal 3/16 in./5 mm flooring system. It combines decorative looks with excellent chemical and wear resistance and cleanability. Its surface provides a moderate degree of slip resistance while remaining resistant to staining, marring, and yellowing. It is comprised of:

1. Stonblend Primer: two-component, penetrating, UV resistant epoxy rimer
2. Stonblend GSI Base: three-component, troweled mortar consisting of epoxy resin, curing agent and colored quartz silica aggregate
3. Stonblend Grout Coat: two-component, clear, UV resistant epoxy sealer
4. Stonshield Sealer: two-component, clear UV resistant, leveling epoxy sealer
5. Stonseal GS7 Clear Flat: two-component, non-reflective, waterborne, aliphatic polyurethane coating>

H. [Resinous Flooring: Stonhard STONRES RTZ, three component resilient urethane flooring system, 3/16-inch nominal thickness, with rubber aggregates mortar; two-component grout coat and two-component clear coat. Meet or exceed the following physical properties when tested in accordance with the cited referenced standard test method. \*\*Not Epoxy\*\*

1. Tensile Strength (ASTM C307): 1200 psi.
2. Surface Hardness (ASTM D2240, Shore A): 85
3. Percent elongation (ASTM D638): 150 percent
4. Impact Resistance (ASTM D2794): greater than 60 inch/pounds
5. Static Load Limit (ASTM F970, 125-pound load): 0.002 inch
6. Residual Indentation (ASTM F1914): Less than 1 percent
7. Abrasion Restance (ASTM D4060): 0.3 gm
8. Flammability-Critical Radiant Flux (ASTM E648): Class 1
9. Slip resistance (ASTM F1679): 0.6 Dry
10. Color: as selected by Architect from manufacturer's full range of available colors.]

## 2.02 MATERIALS

A. {AquArmor Ceramic Carpet Decorative Flooring System as manufactured by Sherwin Williams - General Polymers., Cincinnati, OH, is a nominal 1-8 inch - 3/16-inch-thick system which produces a chemical resistant, tough, cleanable finish for floors.

### B. Flooring System

1. Primer:
  - a. 3460 plus 20 percent potable 250 sq. ft./gal water (6-8 Mils WFT)
2. Slurry at 1/8 inch:
  - a. 3460 1:4 100 sq. ft/2.5 gal.
  - b. 5150 27-30 lbs/2.5 gal.
  - c. 5900F To Excess 0.6 lbs/sq.ft.
3. Bonding/Broadcast:
  - a. 3561 4:1 65-70 sq. ft./gal



b. 5900F To Excess 0.4 lbs/sq.ft.

4. Grout

a. 3745 2:1 100 sq. ft./gal  
Premeasured unit

5. Topcoat

a. 3745 2:1 200 sq. ft./gal  
Premeasured units}}

## 2.03 ACCESSORIES

A. Waterproofing Membrane: Type recommended or produced by manufacturer for flooring system, for type of service and floor condition indicated. Fluid-Applied, Dex-O-Tex Cheminert SC Membrane or equal. [[not needed for Tera-Lite III]]

1. Primer: manufacturer's standard.

2. [Option: Fabric reinforcement place in wet membrane and top coated.]

B. Anti-Microbial Additive: Incorporate antimicrobial chemical additive to prevent growth of most bacteria, fungi, algae and actinomycetes.

C. Vapor Control System: per Section 09 05 61 Common Work Results for Flooring Preparation [Tera-Lite III; Aquafin Vaportight Coat-SG3, epoxy-based].

D. Primer: manufacturer's bond coat.

E. Floor transitions: Saw cut concrete and chamfer (Key in edge) to match level of existing flooring [Specified in Section 096513.36].

## PART 3 – EXECUTION

### 3.01 EXAMINATION

- A. Verify Site conditions are ready for the work of this Section. Notify Architect and Inspector of Record at least 48-hours prior to installation of testing and at conclusion of tests.
  1. Concrete shall be cured minimum 28 days prior to application of sealer.
  2. Conduct ASTM F1869 calcium chloride dome tests to verify that concrete floors are dry within moisture vapor emissions limits of flooring system manufacturer. Set one test for each 1,000 sf. of floor area but at least in four (4) in each different areas or location.
  3. Conduct ASTM F710 alkalinity testing of concrete substrate; pH levels shall not exceed the recommendations of the floor coating manufacturer, the adhesive manufacturer, or both.
  4. Conduct Relative Humidity Test Method in accordance with ASTM F 2170 with a Wagner Rapid RH probe to verify relative humidity and surface pH, ASTM F710, of concrete floor slabs, the method

- a. Requires drilling holes at diameter not to exceed outside diameter of probe by more than 0.04 inch to depth equal to 40 percent of slab's thickness (elevated structural slab shall be tested at depth equal to 20 percent of slab thickness).
  - b. Place probe to full depth of test hole, place cap over probe.
  - c. Permit test site to acclimate, or equilibrate, for 72 hours prior to taking relative humidity readings.
  - d. Remove cap and press button on the probe to obtain reading.
  - e. Relative humidity readings for substrates receiving non-permeable flooring are 75 percent or lower.
  - f. Testing shall require three (3) tests in first 1,000 square feet, with one additional test per each additional 1,000 square feet of concrete slab surface.
  - g. Alkalinity testing: follow procedures per ASTM F710, ranges shall not exceed those recommended by the flooring manufacturer.
- B. Do not begin installation until unsatisfactory conditions are corrected. Beginning installation means acceptance of existing conditions and preparatory work of others.

### 3.02 PREPARATION:

- A. Install Vapor Emission Treatment Systems per Section 090561.13 where tests reveal presence of more than acceptable moisture level in accordance with Test Method ASTM F 1869 and ASTM F 2170.
- B. Clean substrate; remove dirt, oil, grease, construction markings, and foreign matter that could adversely affect floor coating appearance or performance.
1. Surface shall be free of soil, dust, base material, oil, grease, paint, curing compounds and other foreign matter.
  2. Surface shall be cleaned and allowed to dry thoroughly. Cleanse dirty or contaminated floors with approved cleaner as per manufacturer's instructions. Rinse thoroughly with clean water.
  3. Contaminated Concrete Surfaces: clean concrete surfaces by sandblasting, steel shot-blasted, scarified, water blasted, or other approved technique by the flooring manufacturer.
- C. Repair minor defects. The substrate was prepared under Section [03 01 30.71] [03 01 30.72] [03 30 00]; remove ridges, fill depressions and repair cracks as required by floor coating manufacturer to execute specified warranty.
1. Apply, trowel and float filler to leave a smooth, flat, hard surface, free of bumps or depressions of any size.
  2. Prohibit traffic from area until filler is cured.
- D. Vacuum clean substrate.
- E. Apply primer as recommended by the materials manufacturer.
- F. [Install waterproof membrane per manufacturer's recommendations.]

### 3.03 INSTALLATION

- A. Mix components according to manufacturer's recommendations.
- B. Apply primer (bonding coat) per manufacturer's recommendation.
- C. Trowel apply ¼ inch [1/4 inch for Terracolor] thick body coat. Build up in minimum of two (2) coats.
- D. {Body Coat: Over prepared surface, screed mortar mix at nominal ¼ inch thickness. Allow material flow out and being to settle. Back roll with a spike roller or looped roller to distribute material smooth even finish.}
- E. [Slip Resistant Finish:
  - 1. Broadcast slip resistant finish into wet coating at rate recommended by manufacturer to achieve specified coefficient of friction. Backroll to encapsulate and distribute aggregate.
  - 2. Remove Excess Aggregate: Remove all loose or unsound aggregate from the cured surface. Vacuum up all dust and fine particles from the surface, remove any ridge lines and detail all imperfection in the textured surface.
  - 3. [In kitchen and food service areas, scheduled for this flooring, apply slip resistant finish only in traffic areas of floor. Do not apply slip resistant finish in locations that will be under equipment, furnishings or fixtures and similar difficult to clean locations.]
  - 4. [Power sand to remove trowel marks.
- F. [[Sealer: apply two (2) seal coats using the base coat liquid components. Sand between coats. Apply the first seal coat. Let the surface set. Mix and place the second seal coat similarly to the first coat, application rate approximately 125 sq. ft. per gallon. During second seal coat broadcast a graded silica aggregate for anti-skid and backroll.]] \*\*\*\*No sealer required for Tek-Crete SL\*\*\*\*
- G. {Pigmented Sealer for Tek-Crete SL B: Dex-O-Tex Quik-Glaze, apply over slurry mortar.}
- H. Integral Base Application: Apply vertical areas with same materials or base material specified. Height of integral base application: 6 inches, including ½ inch coved radius, unless otherwise indicated. Mask off base to provide a straight, neat, level top edge.
- I. Apply clear sealer, or pigmented where scheduled, top coat per manufacturer's instructions.

### 3.04 PROTECTION

- A. Protect finished installation from traffic until curing is complete.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

## SECTION 09 67 24

## URETHANE SLURRY FLOORING SYSTEM (KITCHENS)

**PART 1 – GENERAL****1.01 SUMMARY**

- A. This Section includes:
  - 1. High-performance resinous flooring systems.
- B. Related Sections:
  - 1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
  - 2. Section 09 05 61 - Common Work Results for Flooring Preparation.
  - 3. Section 09 06 00 - Schedules for Finishes.
  - 4. Section 09 65 15 - Cove Caps, Reducers, and Transitional Moldings.

**1.02 REFERENCES****1.03 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Installer Certificates for Qualification: Signed by manufacturer certifying that installers comply with specified requirements.
- C. Material Certificates: For each resinous flooring component, from manufacturer.
- D. Material Test Reports: For each resinous flooring system.
- E. Maintenance Data: For maintenance manuals.
- F. Samples: Submit one sample of coating, indicating coating applied on horizontal surfaces. Sample shall illustrate transition from Resinous Flooring system. Provide sample which is a true representation of proposed field applied finish; not laboratory applied finish. Provide minimum 12 feet by 4 feet field sample color and texture for owner approval as a mock up at location designated by General Contractor for review and written approval prior to installation of any other areas.
- G. Product Schedule: For resinous flooring.

**1.04 QUALITY ASSURANCE**

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of flooring systems required for this Project.

1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.
  2. Installer Letter of Certification: Installer to provide letter stating that they have been in business for at least 10 years and listing 5 projects in the last 2 years of similar scope. For each project provide: project name, location, date of installation, contact information, size of project, and manufacturer of materials with system information.
- B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.
- C. Pre-installation Conference: Conduct conference at Project site before work and mockups begin.
- D. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution. Do not cover up mockup area.
1. Apply full-thickness mockups on 16 square foot floor area selected by Architect.
  2. Simulate finished lighting conditions for Architect's review of mockups.
  3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
  4. Mockup shall demonstrate desired slip resistance for review and approval by General Contractor prior to installing project areas.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.
1. Maintain containers in clean condition, free of foreign materials and residue.
  2. Remove rags and waste from storage areas daily.

#### 1.06 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application unless manufacturer recommends a longer period.

**PART 2 – PRODUCTS****2.01 MANUFACTURERS**

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

1. The Sherwin-Williams Company

**2.02 MATERIALS**

- A. Fastop™ Topfloor SL57, with cove, as manufactured by Sherwin-Williams, consists of FasTop™ 4040 (Cove pr), FasTop™ 4060, 5055 Aggregate (Cove), FasTop™ 4050, with 5050 Aggregate as slurry, 5310-8 Dry Silica Sand (20-40 Mesh) for broadcast and Elladur™ 4850 as a seal coat at a ¼" nominal.
- B. VOC Content of Resinous Flooring: Provide resinous flooring systems, for use inside the weatherproofing system, that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24)].
1. Resinous Flooring: 100 g/L.
  2. High-Performance Resinous Flooring
    - a. Resinous Flooring: Abrasion-, impact- and chemical-resistant, high-performance, resin-based, monolithic floor surfacing designed to produce a seamless floor.
    - b. System Characteristics:
      - 1) Color and Pattern: As indicated from manufacturers listed above.
      - 2) Slip Resistance: Provide slip resistant finish.

**PART 3 – EXECUTION****3.01 EXAMINATION**

A. Environmental Conditions

1. All applicators and all other personnel in the area of the RF installation shall take all required and necessary safety precautions. All manufacturers' installation instructions shall be implicitly followed.
2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
3. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
4. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
5. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

6. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.

### 3.02 PREPARATION

- A. Inspection: Prior to commencing Work, thoroughly examine all underlying and adjoining work, surfaces and conditions upon which Work is in any way dependent for perfect results. Report all conditions which affect Work. No "waiver of responsibility" for incomplete, inadequate or defective underlaying and adjoining work, surfaces and conditions will be considered, unless notice of such unsatisfactory conditions has been filed and agreed to in writing before Work begins. Commencement of Work constitutes acceptance of surfaces. Test and report for moisture level in substrate to verify compliance with manufacturer's requirements. Do not proceed unless acceptable test results are achieved.
- B. Only installers approved by the manufacturer in writing shall perform installation of the material.
- C. Surface Preparation: Remove all surface contamination, loose or weakly adherent particles, laitance, grease, oil, curing compounds, paint, dust and debris by blast track method or approved mechanical means (acid etch not allowed). If surface is questionable try a test patch. Create a minimum surface profile for the system specified in accordance with the methods described in ICRI No. 03732 to achieve profile numbers as follows:
  1. Thin film, to 10 mils CSP-1 to CSP-3
  2. Thin and medium films, 10 to 40 mils CSP-3 to CSP-5
  3. Self-leveling mortars, to 3/16" CSP-4 to CSP-6
  4. Mortars and laminates, to 1/4" or more CSP-5 to CSP-9

### 3.03 APPLICATION

- A. Install resinous floor over properly prepared concrete surface in strict accordance with the manufacturer's directions.
  1. Install the primer and/or base coats over thoroughly cleaned and prepared concrete.
  2. Install topcoat over flooring after excess aggregate has been removed.
  3. Maintain a slab temperature of 60°F to 80°F for 24 hours minimum before applying floor topping.
- B. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
  1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum inter-coat adhesion.
  2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.



3. At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
- C. Sealant: Saw cut resinous floor topping at expansion joints in concrete slab. Fill saw cuts with sealant prior to final seal coat application. Follow manufacturer's written recommendations.
  1. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
  2. Slip Resistant Finish: Provide grit for slip resistance.
  3. Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer.

#### 3.04 CLEANING AND PROTECTION

- A. Cleaning: Upon completion of the Work, clean up and remove from the premises surplus materials, tools, appliances, empty cans, cartons and rubbish resulting from the Work. Clean off all splatterings and drippings, and all resulting stains.
- B. Protection: Protect Work in accordance with manufacturer's directions from damage and wear during the remainder of the construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.
- C. Contractor shall insure that coating is protected from any traffic until it is fully cured to the satisfaction of the coating manufacturer.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 2025-01-31 – Section revised for current product information.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- District typically wants broadloom carpet in student spaces including classrooms. Modular tiles can be used in administrative spaces and at other locations as accepted by District.

SECTION 09 68 00

CARPET

**PART 1 – GENERAL**

**1.01 SUMMARY**

**A. Section Includes:**

1. Broadloom and carpet tile.
2. Integrated walk-off mats
3. Base finish and accessories
4. Subfloor testing and preparation.
5. Installation of vapor retarder.

**B. RELATED SECTIONS**

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 00 72 00: Exhibit C: Abatement of Hazardous Materials.
3. Section 03 31 00: Structural Concrete (for floor flatness and floor levelness).
4. Section 07 26 00: Vapor Retarders
5. Section 09 21 16: Gypsum Board Systems: Wall materials to receive base.
6. Section 09 65 00: Resilient Flooring.

**1.02 REFERENCES**

- A. ANSI/ASTM E648-15e1 - Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.
- B. ASTM F1869 – Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

**1.03 QUALITY ASSURANCE**

**A. Manufacturer, Contractor, and Installer Qualifications:**

1. Manufacturer: Company specializing in contract flooring with ten years minimum experience.
2. Flooring Contractor: Company with five years' minimum documented experience, approved by manufacturer for the installation of the specified products and shall have access to all manufacturers required technical, maintenance, specifications and related documents.
3. Installer:
  - a. Floor covering installer must be factory trained and certified for the installation of the specific products being installed.

- b. Installer to provide project inspector proof of certification prior to starting work.
    - c. Certified installer must be present on job site while work is in progress.
  - 4. Testing Laboratory:
    - a. Certified, bonded, qualified and experienced agency to perform pH and Relative Humidity (RH) emission tests.
- B. Pre-Floor Covering Installation Meeting:
- 1. Contactor to notify Construction Manager with a minimum of 5-days' notice when anticipated to be ready for pre-floor covering installation meeting. (After subfloor preparation is complete and ready for floor covering installation.)
  - 2. Contractor, installer, and manufacturer representative are required to attend pre-floor covering meeting. Contractor is responsible for coordinating and scheduling their attendance.
  - 3. Construction Manager will schedule meeting with Contractor team, Project Inspector, and Architect.
  - 4. Purpose of Meeting: To review subfloor preparation, verification of readiness for floor covering installation and use of correct products, verification of the acclamation of correct finish materials and review installation requirements.
- C. Manufacturer's Field Services:
- 1. Manufacturer representative to attend the "Pre-Flooring" meeting.
  - 2. Upon Owner or Architect's request, and with at least 72-hour notice, provide manufacturer's representative site visit(s) for inspection of product installation.
  - 3. At the Owner's request, manufacturer representative to attend operation and maintenance training meeting for Owner's custodial staff prior to acceptance of floor covering installation.

#### 1.04 SUBMITTALS

- A. Provide a complete submittal package with all components required within this section. Submit per Section 01 33 00.
- 1. Product Data: Provide product data describing physical and performance characteristics, sizes, patterns, colors, material safety data sheets, and method of seaming and manufacture's installation instructions for all proposed products.
  - 2. Shop Drawings:
    - a. Provide a floor plan indicating all proposed seam locations and integrated walk-off mats. Indicate method of joining seams, and direction of carpet.
  - 3. Samples:
    - a. Submit samples for color selection illustrating color and pattern for floor material with samples of matching walk-off mats, rubber base and transition material proposed for installation.
    - b. Submit sample of solvent welded seam.

4. Maintenance Data: Submit manufacturers recommend cleaning and maintenance data. Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
5. Recycled Content Percentage Submittals
6. Submit a statement signed by the manufacturer's Executive Officer or independent certification third-party that the provided carpet materials have the specified recycled material percentage.
7. Submit documentation of manufacturer's take-back program for carpet. Including:
  - a. Confirmation that the new carpet being installed will be accepted (at the point of future replacement) through a manufacturer's operated program for recycling or reuse;
  - b. Written description of such a process for the recycling and/or recovery of used/worn products;
  - c. Contact information for the take-back program.
8. Existing Carpet Recycling Plan and Recycling Certification. Submit documentation describing the reclamation plan for existing carpet. Include appropriate contact information, overview of procedures, and limitations and conditions applicable to the project Carpet recycling options consist of:
  1. Repurposing - reusing the product in another application such as facilitating the donation of used carpeting to charities and other nonprofit organizations.
  2. Closed Loop Recycling - turning waste materials into new materials of the same value, such as vinyl backing into vinyl backing and nylon yarn into nylon carpet yarn.
  3. Open Loop Recycling – creating other product types from reclaimed carpet. For example, turning nylon face fiber into automotive parts or carpet padding, including nylon face fiber in recycled backings
  4. Waste-to-Energy - using carpet for waste-to-energy. In the case of waste-to-energy, manufacturer shall justify why carpet cannot be recycled as this method should be a last resort.
  5. Landfill or incineration – are not approved disposal methods
  6. At the completion of the project, a certificate shall be furnished verifying the reclamation of the carpet and the pounds of material diverted from the landfill.

#### 1.05 OPERATION AND MAINTENANCE DATA

- A. Submit cleaning and maintenance data under provisions of Section 01 33 00.
- B. Include maintenance procedures, recommended maintenance materials, and suggested schedule and products for cleaning.
- C. Provide in-service training with Owner's custodial staff prior to acceptance of flooring for proper care and maintenance of carpet. Also review and provide recommended type of furniture casters and glides.

#### 1.06 DELIVERY, STORAGE AND HANDLING

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

- B. Storage and Protection: Store materials protected for exposure to harmful weather conditions and at a temperature and humidity conditions recommended by manufacturer. Materials should be stored in areas that are fully enclosed, weather tight with the permanent HVAC system set at a uniform temperature of at least 68 degrees F (20 degrees C) for 72 hours prior to, during and after installation.

#### 1.07 ENVIRONMENTAL REQUIREMENTS

- A. Store materials for three days prior to installation in area of installation to achieve temperature stability.
- B. Maintain minimum 70 F ambient temperature at floor level three days prior to, during, and 24 hours after installation of materials.
- C. Prior to testing for moisture vapor emission rate, space shall be enclosed, fully weather-tight, wet-work in space shall be completed and nominally dry, work above ceilings finished. The test site should be at the same temperature and humidity expected during normal use.
- D. Maintain lighting at a minimum uniform level of 50 or more-foot candles in areas where the floor system is being installed.
- E. Comply with CRI's "CRI Carpet Installation Standard" for temperature, humidity, and ventilation limitations.
- F. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weather tight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants.
- G. Floor temperature should be 60 °F minimum for proper adhesive curing and performance.
- H. If subfloor is contaminated with an oily residue either from removal of "cutback" during asbestos abatement or from a previous end use such as metal fabrication, this residue MUST be totally removed or covered prior to applying modular adhesive and carpet.

#### 1.08 CONCRETE SUBFLOOR TESTING

- A. Testing for internal relative humidity of concrete slabs must be conducted in accordance with the current version of ASTM F2170, not to exceed manufacturer's requirements (ASTM F2170 – Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In-Situ Probes).
- B. The Flooring Contractor shall verify in writing to the Owner, a minimum of thirty (30) days prior to scheduled carpet installation, the following substrate conditions:
  - 1. Moisture: Initial emission rate, as tested with in-situ probes, per ASTM F 2170.

2. Alkalinity: pH level. Testing the pH at the surface of a concrete slab must be conducted in accordance with the current version of ASTM F710, not to exceed manufacturer's requirements (ASTM F710 – Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.)
- C. High Moisture and /or Alkalinity Readings:
1. New Construction (New Concrete Slab)
    - a. If the Contractor's test results indicate that the slab relative humidity (RH) readings are below those of flooring manufacturer's requirement, then the Owner's representative will initiate independent testing to confirm results and will initiate additional testing using petrographic analysis to determine if the Water Cement Ratio and sufficient hydration has taken place.
      - 1) If it is determined that the Specifications were followed in their entirety, water/cement ratio (as specified), and or the concrete surface has been adequately hydrated; then the Contractor shall initiate a credit to the Owner for the cost of installation of the Vapor Retarders as specified in section 07 26 00 that were not installed.
  2. Modernization Construction (Existing Concrete Slab)
    - a. If the Contractor's test results indicate that the slab relative humidity (RH) readings are below those of flooring manufacturer's requirement, then the Owner's representative will initiate independent testing to confirm results.
      - 1) If the independent test results do not substantiate the Contractor's findings, then the Contractor will be directed to proceed with the Vapor Retarder installation and the retesting cost will be back charged to the contractor.
      - 2) If the independent test results confirm the Contractor's findings, then the Contractor shall initiate a credit to the Owner for the cost of installation of the Vapor Retarders as specified in section 07 26 00 that were not installed.
- D. Comply with manufacturer's written requisites for field conditions including but not limited to testing for moisture, confirmation of vapor retarder, floor prep, bond test, photo documentation, etc.

#### 1.09 EXTRA MATERIALS

- A. Provide a minimum of 4 square yards of each color installed. In addition, provide all usable scraps one sq. yd. or larger in size. Remnants shall be packaged, identified and delivered to the Owners' Representative, who will retain any he chooses for future repairs before they are removed from the job site.
- B. Provide a minimum of 10 lineal feet of base and transition pieces of each material and color specified or 2 % whichever is greater.

#### 1.10 WARRANTY

- A. Manufacturer's Warranty: Twenty (20) year minimum manufacturer warranty commencing on recordation date of the Notice of Completion.

1. Should carpet, tend to creep, bulge, be defective in manufacturing, or show a substantial amount of wear - carpet shall be replaced with new carpeting at no cost to the Owner. Manufacturer to submit written warranty covering the following:
  - a. 20 Year minimum, non-prorated Guarantee shall also include:
    - 1) No resiliency loss of backing.
    - 2) No zippering.
    - 3) Static protection (will not lose static property—will not give static discharge above 3.5KV).
    - 4) No edge ravel or zippering.
    - 5) Delamination.
    - 6) Surface wear (maintains at least 90% surface pile weight).
    - 7) No staining.
    - 8) Dimensional Stability.
    - 9) Moisture Resistance.

## PART 2 – PRODUCTS

### 2.01 MATERIALS

**DESIGNERS!! Carpet selection shall be per project. Coordinate with District.**

- A. Carpet (Vinyl Cushioned Tufted Textile) and integrated walk-off mats: Color as selected by Owner Representative from Manufacturer's standard range. No other substitutions will be allowed.
  1. Tarkett Commercial – Hybrid resilient sheet flooring
    - a. "Aftermath II" Series, 6'-0" roll, glue down. Powerbond cushion RS vinyl backing system and seam sealer.
    - b. Or Equal.
  2. Milliken Commercial – Broadloom Roll
    - a. "Formwork", 13'-6" roll, glue down. Endura-Loc backing system.
  3. Tarkett Commercial – Carpet Tiles
    - a. "Aftermath II" Series, 24"x24" tile, glue down. Flex Aire cushion backing system.
    - b. Or Equal.
  4. Milliken Commercial – Carpet Tiles
    - a. "Journal Line By Line", 50cm x 50cm, glue down. PVC-Free WellBac Comfort Cushion.
  5. Tarkett Commercial – Walk-off System to match carpet backing at specified locations
    - a. "Abrasive Action II" walk-off system Powerbond Cushion RS or 24"x24" Flex Aire cushion tile, at all exterior doors in carpeted rooms. Color to be coordinated with carpet color selection.
  6. Milliken Commercial – Entrance Flooring
    - a. "OBEX Tiles" carpet entryway system at all exterior doors in carpeted rooms. Color to be coordinated with carpet color selection.



- B. Rubber Wall Base: Cove style, conforming to ASTM F 1861 or FS-SS-W-40, Type 1. New Construction - 4" high and 1/8-inch (3.2mm) gauge. Modernization-type projects and new construction cafeteria spaces - 6" high and 1/8-inch (3.2mm) gauge. No manufactured corners.
  - 1. Burke Industries.
  - 2. Armstrong.
  - 3. Musson Rubber Co.
  - 4. Roppe Rubber Corp.
  - 5. Approved equal.
- C. Resilient Edge and Adapter/Transition Strips: 1/8-inch-thick, tapered or bullnose, minimum of 1 inch wide.
  - 1. Roppe
  - 2. Johnsonite
  - 3. Flexco Floors
  - 4. Approved equal.
- D. Leveling and Patching Compounds:
  - 1. Portland cement-based patch recommended by carpet manufacturer. Install as recommended by manufacturer for specific application.
- E. Primer:
  - 1. Tarkett Commercial: C-36E primer.
  - 2. Milliken: None required.
- F. Adhesives: Low VOC, waterproof, and as recommended by product manufacturer.
  - 1. Tarkett "RS" pre applied microencapsulated tackifier.
  - 2. Tarkett Commercial: C-16E Powerbond Adhesive.
  - 3. Milliken: Mosaic Moisture XT Spray.

### **PART 3 – EXECUTION**

#### **3.01 EXAMINATION**

- A. New Construction (New Concrete Slab)
  - 1. Installer must examine areas and conditions under which resilient flooring and accessories are to be installed and must notify General Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Owner and Architect.
  - 2. Testing for internal relative humidity of concrete slabs must be conducted in accordance with the current version of ASTM F2170, not to exceed manufacturer's requirements (ASTM F2170 –

Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In-Situ Probes).

3. Verify that new surfaces are smooth and flat with maximum variation as specified in 03 31 00-Structural Concrete and are ready to receive work.
4. Beginning of installation on new substrates means acceptance of substrate. The existing substrates will require as much preparation as necessary to provide proper installation of new materials.

B. Modernization Construction (Existing Concrete Slab)

1. If existing flooring was determined to be asbestos containing and required abatement, verify that the abatement work has been accepted by the Owner's representative prior to commencing work.
2. Testing for internal relative humidity of concrete slabs must be conducted in accordance with the current version of ASTM F2170, not to exceed manufacturer's requirements (ASTM F2170 – Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In-Situ Probes).

3.02 PREPARATION

A. New Construction (New Concrete Slab)

1. Install underlayment where flooring is being installed on a wooden subfloor per the manufacturer's instructions.
2. Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with manufacturer recommended subfloor filler.
3. Apply, trowel, and float filler to leave a smooth, flat, hard surface.
4. Prohibit traffic from area until filler is cured.
5. Prepare floor substrate to be smooth, rigid, flat, level, permanently dry, clean and free of foreign materials such as dirt, paint, grease, oils, solvent, curing and hardening compounds, sealers, asphalt and old adhesive residue. Vacuum clean substrate.
6. Apply primer to concrete surfaces.

B. Modernization Construction (Existing Concrete Slab)

1. Remove existing finishes, adhesives, and other materials as necessary to properly prepare existing substrates. (Refer to asbestos abatement procedures.)
2. Install underlayment where flooring is being installed on a wooden subfloor per the manufacturer's instructions.
3. Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with subfloor filler.
4. Fill low spots, cracks, joints, holes and other defects with filler prior to flooring installation.
5. Apply, trowel, and float filler to leave a smooth, flat, hard surface.
6. Prohibit traffic from area until filler is cured.
7. Prepare floor substrate to be smooth, rigid, flat, level, permanently dry, clean and free of foreign materials such as dirt, paint, grease, oils, solvent, curing and hardening compounds, sealers, asphalt and old adhesive residue. Vacuum clean substrate.

8. Apply primer to concrete surfaces.

### 3.03 CARPET INSTALLATION

- A. Install in accordance with manufacturers' instructions and recommendations with fully welded seams.
- B. Install flooring square with room axis and in accordance with approved shop drawing.
- C. Layout roll-goods in a manner to minimize seams and avoid seams in traffic areas. End butt joints shall be kept to a minimum, shall be staggered, and shall occur where approved on detail plan layout. Use the largest sections possible to minimize seams. Avoid cross seams, filler pieces and strips. Match edges for color shading and pattern at the seams in compliance with the manufacturer recommendations.
- D. Terminate flooring at centerline of door openings where adjacent floor finish is dissimilar.
- E. Scribe, cut, fit flooring to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture, including pipes, outlets, edgings, thresholds, nosing and cabinets.
- F. Install edge strips at unprotected or exposed edges, and where flooring terminates.
- G. Install flooring on covers for telephone and electrical ducts, and similar items occurring within finish floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed on these covers.
- H. Adhere carpet to prepared substrate without producing open cracks, voids, raising and puckering at joints, telegraphing to adhesive spreader marks, or other surface imperfections in completed installation.
- I. Fully solvent weld all seams. Seams shall be unnoticeable in finished installation.
- J. Verify carpet match before cutting to ensure minimal variation between dye lots.
- K. Double cut carpet, to allow intended seam and pattern match. Make cuts straight, true, and unfrayed.
- L. Lay carpet on floors with run of pile in same direction as anticipated traffic.
- M. Do not change run of pile in any room where carpet is continuous through a wall opening into another room. Locate change of color or pattern between rooms under door centerline.
- N. Complete installation shall conform to the Carpet Installation Standard of Carpet and Rug Institute (CRI).

### 3.03 INTEGRATED WALK-OFF MAT INSTALLATION

- A. Install in accordance with manufacturers' instructions and recommendations.
- B. Install modular tile like any “dry-back” modular with a full-spread wet adhesive.
- C. Installation instructions for Tarkett Commercial’s Powerbond Non-RS (dry-back) Modules can be used as “reference only.”
- D. Adhesives below are offered to install modular tile product based upon application and intended use:
  - 1. C-EX - Pressure Sensitive Releasable Adhesive as required by manufacturer
  - 2. Milliken Mosaic XT.
- E. Modular tile should be securely attached to the sub-floor in compliance with ADA Accessibility Guidelines, latest edition, for Building & Facilities, Section 4.5.3.
- F. Provide integrated walk-off mats at all exterior door location where carpet is indicated to be installed. The walk-off mats shall extend a minimum of the door width plus six inches (6”) and six feet (6’-0”) in the direction of travel or as indicated on the drawings.

### 3.04 INSTALLATION - BASE MATERIAL

- A. Install resilient wall base on entire wall perimeter including toe spaces and open ends of cabinets. Set all bases in adhesive as recommended by the manufacturer. All joints in bases shall be plumb, flush, tight and inconspicuous. Seat top edge and back of base firmly against the wall. Wrap base around all outside corners and no seams within 12” of corners. Interior corners shall be mitered and tightly fitted.

### 3.05 PROTECTION

- A. Prohibit traffic from carpet areas for 24 hours after installation.
- B. Protect flooring from damages by other trades prior to owner occupancy.

### 3.06 FINAL CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage. Remove and dispose of all small scraps, cartons, and rubbish upon completion of the work. Remove all loose threads with sharp scissors.
- B. Clean carpet of all spots with proper spot remover, and vacuum carpet surfaces.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 2023-01-06 – Removed some left over editor marks. Corrected incorrect spec references.
- 2025-01-31 – Edits included from Eric Patricio.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Do not paint galvanized materials i.e. handrails.
- Try to limit number of colors used on a project to reduce attic stock. All colors and product material to be used are to be APPROVED by the SCUSD paint shop Supervisor before application NO EXCEPTIONS.
- Murals require an anti-graffiti coating on a case by case basis. Provide as needed.

SECTION 09 91 00

PAINTING

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Surface preparation and field painting of exposed interior items and surfaces, including mechanical and electrical equipment that do not have a factory-applied finish.

1.2 RELATED SECTIONS

- A. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.

B. Section 05 50 00 - Metal Fabrications: Shop priming ferrous metal.

C. Section 08 11 00 - Steel Doors and Frames: Factory priming steel doors and frames.

D. Section 09 29 00.10 - Gypsum Board Assemblies: Surface preparation of gypsum board.

E. Division 23: Mechanical.

F. Division 26: Electrical.

1.3 REFERENCES

- A. ASTM International (ASTM): ASTM D 16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications.
- B. Steel Structures Painting Council (SSPC) SP6 - Commercial Blast Cleaning Procedures.
- C. Steel Structures Painting Council (SSPC) SP10 - Near White Blast Cleaning Procedure.

1.4 DEFINITIONS

- A. General: Standard coating terms defined within Masters Painters Institute (MPI) manual.
  - 1. Gloss level 1 - Flat with a gloss range below 5 when measured at a 60-degree meter and 10 when measured at an 85-degree meter.
  - 2. Gloss level 2 - Low Sheen with a gloss range of 5 to 10 when measured at a 60 degree meter and 10 to 35 when measured at an 85 degree meter.
  - 3. Gloss level 3 - Eggshell with a gloss range between 10 and 15 when measured at a 60-degree meter and 10 to 35 when measured at an 85-degree meter.
  - 4. Gloss level 4 - Satin with a gloss range between 25 to 35 when measured with a 60 degree meter.
  - 5. Gloss level 5 - Semi-Gloss with a gloss range between 50 and 55 when measured at a 60 degree meter.

6. Gloss level 6 - Gloss with a gloss range more than 70 when measured at a 60 degree meter.

## 1.5 SUBMITTALS

- A. General: Submit in accordance with Conditions of the Contract and Division 1 Specification sections.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
  2. Preparation instructions and recommendations.
  3. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
- C. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- D. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.
- C. Paint Exposed Surfaces: If an item or a surface is not specifically mentioned, paint the item, or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
- D. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
- E. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
  1. Finish areas designated by Architect.
  2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
  3. Refinish mock-up area as required to produce acceptable work.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label:

- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain storage containers in a clean condition, free of foreign materials and residue.
- C. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- D. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F (10 and 32 deg C), unless manufacturer's instructions specifically states.
- E. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F (7 and 35 deg C).
- F. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
  - 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

**1.8 EXTRA MATERIALS**

- A. Furnish extra paint materials from the same production run as the materials applied and, in the quantities, described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.
- B. Quantity: Furnish Owner with an additional three percent, but not less than 1 gal (3.8 l) or 1 case, as appropriate, of each material and color applied.

**PART 2 PRODUCTS**

**2.1 MANUFACTURERS**

- A. Acceptable Manufacturer: Dunn Edwards Paints.
- B. Requests for substitutions will be considered in accordance with provisions of Section 01600.

**2.2 PAINT MATERIALS – GENERAL**

- A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. VOC Classification: Provide materials, including primers, undercoats, and finish-coat materials, which meet local air quality management district regulations.
- C. Color: Refer to Finish Schedule and Paint Legend for paint colors.



- D. Application Rate: Coating thickness for primer, intermediate, barrier and finish coats shall be measured as Dry Film Thickness (DFT) and comply with manufacturer's published recommendations.

## 2.3 Interior Paint Systems

- A. Gypsum and Plaster Walls:
1. Prime Coat: DE Ultra – Grip Acrylic Premium Primer
  2. 2<sup>nd</sup> Coat: DE Spartawall Acrylic Low VOC Eggshell Enamel
  3. 3<sup>rd</sup> Coat: DE Spartawall Acrylic Low VOC Eggshell Enamel
- B. Suspended and Surface applied Ceilings:
1. Prime Coat: DE Ultra – Grip Acrylic Premium Primer
  2. 2<sup>nd</sup> Coat: DE Ceiling Paint Flat Finish
  3. 3<sup>rd</sup> Coat: DE Ceiling Paint Flat Finish
- C. Wood Doors & Frames (Painted Finish):
1. Prime Coat: DE Ultra-Grip Acrylic Premium Primer
  2. 2<sup>nd</sup> Coat: DE Aristoshield Water Based Urethane Alkyd Semi-Gloss Enamel
  3. 3<sup>rd</sup> Coat: DE Aristoshield Water Based Urethane Alkyd Semi-Gloss Enamel
- D. Previously Painted Wood:
1. Prime Coat: DE Ultra-Grip Acrylic Premium Primer
  2. 2<sup>nd</sup> Coat: DE Aristoshield Water Based Urethane Alkyd Semi-Gloss Enamel
  3. 3<sup>rd</sup> Coat: DE Aristoshield Water Based Urethane Alkyd Semi-Gloss Enamel
- E. Wood Previously Stained to be Painted:
1. Prime Coat: DE Ultra – Grip Acrylic Premium Primer
  2. 2<sup>nd</sup> Coat: DE Aristoshield Water Based Urethane Alkyd Semi-Gloss Enamel
  3. 3<sup>rd</sup> Coat: DE Aristoshield Water Based Urethane Alkyd Semi-Gloss Enamel
- F. Wood to be re-finished and sealed:
1. 2 Coats: Old Masters Master Armor Satin Finish
- G. Metal Doors and Frames:
1. Prime Coat: DE Ultra-Grip Acrylic Premium Primer
  2. 2<sup>nd</sup> Coat: DE Aristoshield Water Based Urethane Alkyd Semi-Gloss Enamel
  3. 3<sup>rd</sup> Coat: DE Aristoshield Water Based Urethane Alkyd Semi-Gloss Enamel
- H. Vinyl Tackable wall Panels:
1. Prime Coat: Zinsser B-I-N Shellac Base Primer
  2. 2<sup>nd</sup> Coat: DE Spartawall Acrylic Low VOC Eggshell Enamel
  3. 3<sup>rd</sup> Coat: DE Spartawall Acrylic Low VOC Eggshell Enamel

## 2.4 Exterior Paint Systems

- A. Concrete Substrates, Masonry, Stucco, Non-Traffic Surfaces:

1. Prime Coat: DE Ultra-Grip Acrylic Premium Primer
  2. 2<sup>nd</sup> Coat: DE Spartashield 100% Acrylic Exterior Eggshell Finish
  3. 3<sup>rd</sup> Coat: DE Spartashield 100% Acrylic Exterior Eggshell Finish
- B. Wood Siding:
1. Prime Coat: DE Ultra-Grip Acrylic Premium Primer
  2. 2<sup>nd</sup> Coat: DE Spartashield 100% Acrylic Exterior Eggshell Finish
  3. 3<sup>rd</sup> Coat: DE Spartashield 100% Acrylic Exterior Eggshell Finish
- C. Wood Fascia:
1. Prime Coat: DE Ultra-Grip Acrylic Premium Primer
  2. 2<sup>nd</sup> Coat: DE Spartashield 100% Acrylic Exterior Semi-Gloss Finish
  3. 3<sup>rd</sup> Coat: DE Spartashield 100% Acrylic Exterior Semi-Gloss Finish
- D. Wood Benches:
1. Prime Coat: DE Ultra-Grip Acrylic Premium Primer
  2. 2<sup>nd</sup> Coat: DE Aristoshield Water Based Urethane Alkyd Semi-Gloss Enamel
  3. 3<sup>rd</sup> Coat: DE Aristoshield Water Based Urethane Alkyd Semi-Gloss Enamel
- E. Interior & Exterior Surfaces of Exterior Doors:
1. Prime Coat: DE Ultra-Grip Acrylic Premium Primer
  2. 2<sup>nd</sup> Coat: DE Aristoshield Water Based Urethane Alkyd Semi-Gloss Enamel
  3. 3<sup>rd</sup> Coat: DE Aristoshield Water Based Urethane Alkyd Semi-Gloss Enamel
- F. Door Mullions at Pair Doors:
1. Prime Coat: DE Ultra-Grip Acrylic Premium Primer
  2. 2<sup>nd</sup> Coat: DE Aristoshield Water Based Urethane Alkyd Semi-Gloss Enamel
  3. 3<sup>rd</sup> Coat: DE Aristoshield Water Based Urethane Alkyd Semi-Gloss Enamel
- G. Painted Infill Panels at window Locations:
1. Prime Coat: DE Ultra-Grip Acrylic Premium Primer
  2. 2<sup>nd</sup> Coat: DE Aristoshield Water Based Urethane Alkyd Semi-Gloss Enamel
  3. 3<sup>rd</sup> Coat: DE Aristoshield Water Based Urethane Alkyd Semi-Gloss Enamel
- H. Ferrous Metal Substrates:
1. Prime Coat: DE Enduraprime High Performance Acrylic Metal Primer
  2. 2<sup>nd</sup> Coat: DE Aristoshield Water Based Urethane Alkyd Semi-Gloss Enamel
  3. 3<sup>rd</sup> Coat: DE Aristoshield Water Based Urethane Alkyd Semi-Gloss Enamel
- I. Metal Handrails, Guardrails, Barricade Rails & Fencing:
1. Prime Coat: For Ferrous Metal- DE Enduraprime High Performance Acrylic Metal Primer and for Galvanized Metal – DE Ultra-Shield Galvanized Metal Primer
  2. 2<sup>nd</sup> Coat: DE Aristoshield Water Based Urethane Alkyd Semi-Gloss Enamel
  3. 3<sup>rd</sup> Coat: DE Aristoshield Water Based Urethane Alkyd Semi-Gloss Enamel
- J. Metal Panels Fascia:
1. Prime Coat: DE Surfaco Chalk Binding Primer
  2. 2<sup>nd</sup> Coat: DE Spartashield 100% Acrylic Exterior Semi-Gloss Finish
  3. 3<sup>rd</sup> Coat: DE Spartashield 100% Acrylic Exterior Semi-Gloss Finish

- K. Metal Gates:
  - 1. Primer Coat: DE Enduraprime High Performance Acrylic Metal Primer
  - 2. 2<sup>nd</sup> Coat: DE Aristoshield Water Based Urethane Alkyd Semi-Gloss Finish
  - 3. 3<sup>rd</sup> Coat: DE Aristoshield Water Based Urethane Alkyd Semi-Gloss Finish
- L. Gutters, downspouts, Cap & Edge Flashings.
  - 1. Prime Coat: DE Ultra-Grip Acrylic Premium Primer
  - 2. 2<sup>nd</sup> Coat: DE Spartashield 100% Acrylic Semi-Gloss Finish
  - 3. 3<sup>rd</sup> Coat: DE Spartashield 100% Acrylic Semi-Gloss Finish
- M. Canopies Including Undersides:
  - 1. Prime Coat: For Ferrous Metal- DE Enduraprime High Performance Acrylic Metal Primer or for Galvanized Metal DE Ultrashield Galvanized Primer
  - 2. 2<sup>nd</sup> Coat: DE Enduracoat High Performance Semi-Gloss Finish
  - 3. 3<sup>rd</sup> Coat: DE Enduracoat High Performance Semi-Gloss Finish
- N. Extended Roof Overhangs and Covered Walks Including Undersides:
  - 1. Prime Coat: DE Ultra-Grip Acrylic Premium Primer
  - 2. 2<sup>nd</sup> Coat: DE Spartashield 100% Acrylic Exterior Eggshell Finish
  - 3. 3<sup>rd</sup> Coat: DE Spartashield 100% Acrylic Exterior Eggshell Finish
- O. Flag Poles:
  - 1. Prime Coat: DE Enduraprime High Performance Acrylic Metal Primer or for Galvanized Metal DE Ultrashield Galvanized Primer
  - 2. 2<sup>nd</sup> Coat: DE Enduracoat High Performance Semi-Gloss Finish
  - 3. 3<sup>rd</sup> Coat: DE Enduracoat High Performance Semi-Gloss Finish
- P. Relocatable Classroom Buildings and Skirts:
  - 1. Prime Coat: DE Ultra-Grip Acrylic Premium Primer
  - 2. 2<sup>nd</sup> Coat: DE Spartashield 100% Acrylic Exterior Eggshell Finish
  - 3. 3<sup>rd</sup> Coat: DE Spartashield 100% Acrylic Exterior Eggshell Finish
- Q. Relocatable Building Ramp Skirts & Handrails:
  - 1. Prime Coat: DE Ultra-Grip Acrylic Premium Primer
  - 2. 2<sup>nd</sup> Coat: DE Spartashield 100% Acrylic Exterior Eggshell Finish
  - 3. 3<sup>rd</sup> Coat: DE Spartashield 100% Acrylic Exterior Eggshell Finish
  - 4. Handrails: 2 Coats: DE Aristoshield Water Based Urethane Alkyd Semi-Gloss

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on

characteristics of finish materials to ensure use of compatible primers.

1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.
2. If a potential incompatibility of primers applied by others exists, obtain the following from the primer Applicator before proceeding:
  - a. Confirmation of primer's suitability for expected service conditions.
  - b. Confirmation of primer's ability to be top coated with materials specified.

### 3.2 PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.
  1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.
  1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
  1. Provide barrier coats over incompatible primers or remove and reprime.
  2. Provide barrier coats over incompatible primers or remove primers and reprime substrate.
  3. Cementitious Substrates: Prepare concrete, brick, concrete masonry block, and cement plaster surfaces to be coated. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to dull surfaces. If hardeners or sealers have been used to improve curing, use mechanical methods to prepare surfaces.
    - a. Use abrasive blast-cleaning methods if recommended by coating manufacturer.
    - b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not coat surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
  4. Wood Substrates: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Smoothly sand surfaces exposed to view and dust off.
    - a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer, before applying primer.
    - b. Immediately on delivery, prime edges, ends, faces, undersides, and backsides of wood to be coated.
    - c. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
    - d. Determine moisture content of surfaces by performing a moisture test. Do not coat if moisture content exceeds 15 percent.

5. Ferrous-Metal Substrates: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC recommendations.
    - a. Blast-clean steel surfaces as recommended by coating manufacturer and according to SSPC-SP 10.
    - b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
    - c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire brush, solvent clean, and touch up with same primer as the shop coat.
  6. Nonferrous-Metal Substrates: Clean nonferrous and galvanized surfaces according to manufacturer's written instructions for the type of service, metal substrate, and application required.
    - a. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- D. Material Preparation: Carefully mix and prepare coating materials according to manufacturer's written instructions.
1. Maintain containers used in mixing and applying coatings in a clean condition, free of foreign materials and residue.
  2. Stir materials before applying to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into the material. Remove film and, if necessary, strain coating material before using.
  3. Use only the type of thinners approved by manufacturer and only within recommended limits.
  4. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat but provide sufficient differences in shade of undercoats to distinguish each separate coat.

### 3.3 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
- B. General: Apply high-performance coatings according to manufacturer's written instructions.
1. Use applicators and techniques best suited for the material being applied.
  2. Do not apply high-performance coatings over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to forming a durable coating film.
  3. Coating surface treatments, and finishes are indicated in the coating system descriptions.
  4. Provide finish coats compatible with primers used.
  5. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convactor covers, grilles, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.

- C. Application Procedures: Apply coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
  - 1. The number of coats and film thickness required is the same regardless of application method.
  - 2. Completed Work: Match approved Samples for color, texture, and coverage. Remove, refinish, or recoat work that does not comply with specified requirements.

#### 3.4 FIELD QUALITY CONTROL

- A. Owner reserves the right to invoke the following test procedure at any time and as often as Owner deems necessary during the period when paint is being applied:
  - 1. Owner will engage a qualified independent testing agency to sample paint material being used. Samples of material delivered to Project will be taken, identified, sealed, and certified in the presence of Contractor.
  - 2. Owner may direct Contractor to stop painting if test results show material being used does not comply with specified requirements. Contractor shall remove non-complying paint from Project site, pay for testing, and repaint surfaces previously coated with the non-complying paint. If necessary, Contractor may be required to remove non-complying paint from previously painted surfaces if, on repainting with specified paint, the two coatings are incompatible.

#### 3.5 CLEANING

- A. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

#### 3.6 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing, or replacing, and repainting, as approved by Architect.
- B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.
- C. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 2023-01-06 – Corrected signage material.
- 2025-01-31 – Corrected references. Revised language for Gravotech-type signs.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- District requires that all room identification signs are made using the Gravotac material. Please do not stray from this.
- There are numerous other materials that should be used for site signage. Designer shall modify these materials and options to fit specific projects.

SECTION 10 14 00

SIGNAGE

**PART 1 – GENERAL**

**1.01 SUMMARY**

**A. Section Includes:**

1. Plastic signs at building entrances, classrooms, restrooms, and as identified on drawings.

**B. Related Sections:**

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 08 11 00 – Metal Doors.
3. Section 08 14 00 – Wood Doors.
4. Section 09 29 00 – Gypsum Board.

**1.02 REFERENCES**

**A. Accessible signs shall conform with the following requirements as indicated:**

1. California Building Code (CBC) Title 24, 2022 Edition.
2. ADA Accessibility Guidelines (ADAAG, latest adopted edition).
3. Contracted Grade 2 Braille shall be used whenever Braille symbols are specifically required (CBC Section 11B-703.3 Braille).
4. Means of Egress Identification: CBC 11B-216.1 & 11B-703.1.
5. Tactile Exit Signs: CBC 1013.4.
6. Restroom Identification Symbols: CBC 11B-216.8 & 11B-703.7.2.6.
7. Signs and Identification: CBC 11B-216.1 & 11B-703.1.
8. International Symbol of Accessibility: CBC 11B-703.7.2.1.
9. Direction and Information Signs: CBC 11B-703.1.
10. Symbols of Accessibility: CBC 11B-703.7.
11. Finish and Contrast: CBC 11B-703.5.1.
12. Character Proportions: CBC 11B-703.2.4.
13. Character Height: CBC 11B-703.2.5.
14. Raised Characters and Pictorial Symbol Signs: CBC 11B-703.2 & 11B-703.6.
15. Braille: CBC 11B-703.3.
16. Mounting Height and Location: CBC 11B-703.4.1 & 11B-703.4.2.
17. Symbols of Accessibility: CBC 11B-703.7.2.
18. Color of Symbol: CBC 11B-703.7.2.1.
19. Entrance Signs: CBC 11B-216.6.



- B. ASTM D4802 - Standard Specification for Poly(Methyl Methacrylate) Acrylic Plastic Sheet.
- C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- E. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless-Steel Sheet, Strip, Plate, and Flat Bar.

#### 1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Shop drawings listing sign styles, lettering and locations and overall dimensions of each sign.
- B. Two (2) samples illustrating full size sample sign with tactile characters, Braille and subsurface text or pictogram to demonstrate fabrication technique and Braille measurements which shall be used on proposed project.
- C. Letters samples: 1-inch-high letters for proportions required in REGULATORY REQUIREMENTS.
- D. Submit manufacturer's technical data and installation for each type of sign required.
- E. Submit samples of background colors, character colors, and one-inch high print outs of "I," "O" and "X" from proposed type styles. Indicate which type styles shall be used for required tactile characters and for required visual characters.
- F. Submit proposed sign schedule to comply with scoping requirements above.
- G. All signage shall be designed and constructed to comply with signage specifications and drawings.

#### 1.04 QUALITY ASSURANCE

- A. Pre-installation Meeting
  - 1. Notify Architect when signs are ready for installation. Arrange for conference at job site. Do not proceed with installation until Architect's approval of specific locations and methods of attachment has been obtained.

#### 1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site and protect from damage. Store until immediately prior to Notice of Completion.
- B. Manufacturers shall submit 3 references showing products for projects completed within the last 6 years. Both tactile and non-tactile signage shall be included in the work.

- C. Manufacture's Two-Year Warranties.
- D. Contractor shall provide labor and materials to repair or replace defective signs as directed by Owner. Defects shall include:
  - 1. Tactile characters and/or Braille dots which come off or are removed.
  - 2. Discoloration, wear and scratching off of the surface color.
  - 3. All signs and sign components, except for damage by mishandling by Owner, including installation by Owner, or vandalism.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Products of following manufacturers form basis for design and quality intended.
  - 1. Gravotech. [www.gravotech.com](http://www.gravotech.com)
  - 2. Or approved equal with direct compatibility with District-owned Gravotech engraving equipment and surplus engraving materials for sign types specified as "Modular".

### 2.02 MATERIALS

- A. Modular Acrylic Framed Signs:
  - 1. Modular sign panels mounted in permanently fixed frames with sign panels capable of being removed and replaced.
  - 2. ADA Tactile and Braille Signs: Sand-Carved signs; thermosetting high-pressure laminate using Graphic Process Sand-Carved signs, exterior-grade, graphics, Braille and tactile copy required. Square corners, square cut edges, matt finish using **Gravotac** sheet engraving materials as manufactured by Gravotech.
    - a. Frame: Single-piece, square-edge modular plastic frames with concealed screw mounting by Gravotech. Color as selected by Architect at time of submittal.
    - b. ADA TactManufacturer's standard process for producing copy complying with CBC and ADA Accessibility Guidelines. Text shall be accompanied by California Grade 2 Braille. Produce precisely formed characters with square cut edges free from burrs and cut marks, permanently fused to substrate.
    - c. Raised-Copy Thickness: Not less than 1/32 inch.
- B. Non-Tactile, Non-Modular Signs:
  - 1. Cast Acrylic Plastic Sheet; ASTM D4802 Category A-1, ¼ inch overall thickness, laminated acrylic plastic sheets, sub-surface screened process graphics and symbols, exterior-grade at exterior locations, square 3/8-inch radius corners, square cut edge, drilled holes for countersunk screws, polished edges.
    - a. Unframed Signs
  - 2. Apply UV inhibitor overcoat for exterior signs.

C. Restroom Signage

1. Male Restroom Signage:

- a. Doorways leading to male restrooms shall be identified by equilateral triangle 1/4 inch thick matte finished colored acrylic polymer material, with edges 12 inches long, with vertex pointing upward in contrasting color from door color. Sign shall be mounted in center of door 60 inches from finish floor to center of sign.
- b. Room shall be further identified by rectangular room identification sign 1/4 inch thick matte finished colored acrylic polymer material, 8 inch height by 6 inch length minimum unless indicated on Drawings upon which appears a male pictogram 6 inches high, and the word "MEN" immediately below on the same sign in contrasting color. Letters: 5/8 inches minimum and 2 inches maximum high in contrasting color, raised minimum 1/32 inch fully tactile, accompanied by the California Contracted Grade 2 Braille indicator immediately below. Sign shall be located on wall on latch side of door, 60 inches from finish floor to center of sign, centered horizontally within 18-inch space adjacent to latch side of door or on nearest adjacent wall.
- c. Conform to all CBC requirements, CBC 11B.703.1 and 11B-703.7.2.6.1.

5. Female Restroom Signage:

- a. Doorways leading to female restrooms shall be identified by circle 1/4 inch thick matte finished colored acrylic polymer material, 12 inches in diameter circle in contrasting color from door color. Sign shall be mounted in center of door, 60 inches from finish floor to center of sign.
- b. Room shall be further identified by rectangular room identification sign 1/4 inch thick matte finished colored acrylic polymer material, 8-inch Height by 6-inch Length minimum unless indicated on Drawings upon which appears a female pictogram 6 inches high, and the word "WOMEN" immediately below on the same sign in contrasting color. Letters: 5/8 inches minimum and 2 inches maximum high in contrasting color, raised minimum 1/32 inch fully tactile, accompanied by the California Contracted Grade 2 Braille indicator immediately below. Sign shall be located on wall on latch side of door, 60 inches from finish floor to center of sign, centered horizontally within 18-inch space adjacent to latch side of door or on nearest adjacent wall.
- c. Conform to all CBC requirements, CBC 11B.703.1 and 11B-703.7.2.6.2.

6. Gender Neutral Restroom:

- a. Doorways leading to unisex restrooms shall be identified by circle 1/4 inch thick matte finished colored acrylic polymer material, 12 inches in diameter with 1/4-inch-thick triangle superimposed on circle and within 12-inch diameter, total 1/2 inch thick in contrasting color from door color. Sign shall be mounted in center of door 60 inches from finish floor to center of sign. Color of triangle shall have 70 percent minimum contrast with color of circle.
- b. Room shall be further identified by rectangular room identification sign 1/4 inch thick matte finished colored acrylic polymer material, 8-inch Height by 6-inch Length minimum unless indicated on Drawings upon which appear as male and female pictograms and the word "RESTROOM" immediately below on the same sign in contrasting color. Letters: 5/8 inches minimum and 2 inches maximum high in contrasting color, raised minimum 1/32 inch fully tactile, accompanied by California Contracted Grade 2 Braille indicator immediately below, on same sign. The sign shall be located on wall on latch side of door, 60 inches from finish

floor to center of sign, centered horizontally within 18-inch space adjacent to latch side of door or on nearest adjacent wall.

c. Conform to all CBC requirement, CBC 11B.703.1 and 11B-703.7.2.6.3.

7. Restroom signs – Non-Wheelchair Accessible:

- a. Provide restroom signs with similar font, size and fabrication as accessible signs without the ISA (International Symbol of Accessible) and without tactile construction.
- b. Next to the Non-Wheelchair Accessible sign provide an additional sign same construction, with the wording: "WHEELCHAIR ACCESSIBLE RESTROOM LOCATED" with ARROW below the wording directing to the nearest location.

8. [Substitute "BOYS" or "GIRLS" where appropriate.]

D. Aluminum Signs (as needed)

1. Aluminum Sheet for Anodic Finish: Alloy 5005-H32 per ASTM B209 in 0.102-inch thickness.
2. Framing Members and Posts: Special extrusions Alloy 6063-T5 per ASTM B221.
3. Aluminum sheet with die-raised copy, anodic finish applied before fabrication. Background finish enamel applied after fabrication. Color as selected by Architect from manufacturer's standard range of colors.
4. Fabrication: Raised copy, Tactile and Braille.

E. Stainless Steel Signs (as needed)

1. Stainless-Steel Plate, Sheet, and Strip: Provide stainless-steel plate, sheet, and strip, Type 302 or Type 304, complying with ASTM A 666.
2. Fabrication: Raised copy, Tactile and Braille.

F. Chemically Deep-etched Zinc Signs (as needed)

1. Solid metal plate: 0.125 [0.40] [0.064] [0.153] [0.250] inch thick.
2. Fabrication: Raised copy, Tactile and Braille.
3. Finish: matte [semigloss] [gloss] [exterior gloss] sheen.
4. Background: swirl-brushed [sandblast] [painted] [plated] zinc background finish.
5. Factory applied color finishes, minimum two (2) colors. Colors: As selected by Architect.
6. For Sizes and Dimensions verify with Architect.
7. [Rounded corners, 7/16-inch radius.]
8. Square edges.
9. Etch depth: 0.08 inch
10. Concealed Mounting: welded studs [drilled and tapped holes]
11. [Mounting Holes: Drilled and countersunk]>>>

## 2.03 FABRICATION

### A. Regulatory Requirements

1. Tactile Character Type: Tactile characters on signs shall be raised 1/32-inch (0.794 mm) minimum, and shall be sans serif uppercase characters accompanied by Contracted (Grade 2) Braille. Helvetica Regular, uppercase letters only, refer to REGULATORY REQUIREMENTS for letter-proportion compliance. Italic, oblique script, highly decorative or unusual style forms not permitted. CBC Section 11B-703.2. Fabricate sign so that raised letter cannot be peeled off.
2. Character Proportions: Raised characters on signs shall be selected from fonts where the width of the uppercase letter "O" is 60 percent minimum and 110 percent maximum of the height of the uppercase letter "I".
3. Tactile Character Height: Raised characters shall be a minimum of 5/8 inch (15.9 mm) and a maximum of 2 inches (51 mm) high. CBC Section 11B-703.2.5.
4. Stroke thickness of the uppercase letter "I" shall be 15 percent maximum of the height of the character. CBC Section 11B-703.2.6.
5. Character spacing measured between the two closest points of adjacent raised characters within a message. Where characters have rectangular cross sections, spacing shall be 1/8 inch minimum and four (4) times the stroke width, maximum. Where characters have other cross sections, spacing between individual raised characters shall be 1/16 inch minimum and four (4) times the stroke width maximum at the base of the cross sections, and 1/8 inch minimum and four (4) times the stroke width maximum at the top of the cross sections. Characters shall be separated from raised borders and decorative elements 3/8 inch minimum.
6. Line Spacing: Spacing between the baselines of separate lines of raised characters within a message shall be 135 percent minimum and 170 percent maximum of the raised character height.
7. Finish and Contrast: Characters and their background shall have a non-glare finish. Characters shall contrast with their background. Provide white characters on Navy Blue background to match District standard.
8. Braille: California (Contracted) Grade 2 Braille. Dot base diameter shall be 0.059 inch (1.5 mm) to 0.063 inch (1.6 mm). Dots shall be 0.100-inch (2.5 mm) on center in each cell with 0.300-inch (7.6 mm) space between corresponding dots in adjacent cells. Distance between corresponding dots from one cell directly below, 0.395 to 0.400 inch. Dots shall be raised 0.025 to 0.037 inch above the background. Braille dots shall be domed or rounded.
9. Polish all edges.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that surfaces are ready to receive Work.
- B. Beginning of installation means installer accepts existing surfaces.

#### **3.02 INSTALLATION**

- A. Install signs only after surfaces are finished, in all restrooms, in center of door, or on wall adjacent to latch side as specified herein.
- B. Mounting

1. Mounting Height and Location: Signs with raised characters and Braille shall be located 48 inches minimum to the baseline of the lowest line of Braille cells and 60 inches maximum to the baseline of the highest line of raised characters above the finish floor or ground surfaces. Mounting location shall be located so that a clear space of 18 inch minimum by minimum by 18 inch minimum, centered on the tactile characters, is provided beyond the arc of any door swing between the closed position and 45-degree open position. CBC Section 11B-703.4.
  2. Tactile Plastic Signs: Stainless steel screws (not just adhesive), pin torx, vandal-proof screw appropriate for substrate.
  3. Non-tactile Plastic Signs:
    - a. Install with four (4) stainless steel countersunk flathead screws, pin torx, vandal-proof. Pre-drill holes to prevent breaking plastic, use countersunk drill bits to flush screw head with sign surface.
    - b. [Install with clear silicone adhesive meeting ASTM C834, with zero clearance between plastic and face of substrate. Double face adhesive tape not permitted].
    - c. Metal Signs: Install with four (4) flathead countersunk No. 8 stainless steel vandal-proof screws at pre-drilled holes, top of screw heads shall flush with sign surface, concealed mounting.
- C. Fasteners: Stainless steel screws, flat head, pin-in-head torx screws for vandal-proof and clear silicone adhesive.
- D. Clean and polish.

### 3.03 FIELD QUALITY CONTROL

- A. DSA Inspections: Signs and identifications or other information shall be field inspected after installation and approved by Division of the State Architect prior to the issuance of a final certificate of occupancy, or final approval where no certificate of occupancy is issued. The inspection shall include, but not limited to, verification that Braille dots and cells are properly spaced and the size, proportion and type of raised characters are in compliance with CBC, Section 11B-703.1.1.2.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Urinal screens are not generally required by District at student toilet rooms.

## SECTION 10 21 13

## TOILET COMPARTMENTS AND CUBICLES

**PART 1 – GENERAL****1.01 SUMMARY****A. Section Includes:**

1. Toilet Compartments.
2. Urinal Screens.
3. Shower Dividers.
4. Dressing Compartments.

**B. Related Sections**

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 06 10 00 – Rough Carpentry.
3. Section 03 30 00 – Cast-In-Place Concrete.
4. Section 05 50 00 – Metal Fabrications
5. Section 10 28 00 - Washroom Accessories.

**1.02 REFERENCES**

- A. National Fire Protection Association 101 Life Safety Code, Chapters 5, 6, 8-30.
- B. ANSI A117.1: Accessible and Usable Buildings And Facilities.
- C. Title 24, California Code of Regulations, Parts 2, 3, and 5.
- D. ADA, Accessibility Guidelines for Buildings and Facilities, Federal Register Volume 56, Number 144, Rules and Regulations.
- E. US Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED) Program.
- F. American Society for Testing and Materials Standards:
  1. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
  2. ASTM D2794 Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
  3. ASTM D2197 Standard Test Method for Adhesion of Organic Coatings by Scrape Adhesion.
  4. ASTM D6578 Standard Practice for Determination of Graffiti Resistance.

**1.03 SYSTEM DESCRIPTION**



#### A. Performance Requirements

1. Graffiti Resistance: Partition material shall have the following graffiti removal characteristics when tested in accordance with ASTM D6578-00 Standard Practice for Determination of Graffiti Resistance in accordance with Section 9, "Graffiti Removal Procedure Using Manual Solvent Rubs":
  - a. Cleanability: Five (5) required staining agents shall be cleaned off material.
2. Scratch Resistance: Partition material shall have the following characteristics when tested in accordance with ASTM D2197-98(2002) Standard Test Method for Adhesion of Organic Coating by Scrape Adhesion, using Gardner Stock #PA-2197/ST pointed stylus attachment on scrape tester:
  - a. Scratch Resistance: Maximum Load Value shall exceed 10 kilograms.
3. Impact Resistance: Partition material shall have the following characteristics when tested in accordance with ASTM D2794-93(1999)e1 Standard Test Method for Resistance of Organic Coating to the Effects of Rapid Deformation (Impact), using .625" hemispherical indenter with 2-lb impact weight:
  - a. Impact Resistance: Maximum Impact Force value shall exceed 30 inch-lbs.
4. Fire Resistance: Partition material shall comply with the following requirements, when tested in accordance with ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials:
  - a. Smoke Developed Index: Not to exceed 450.
  - b. Flame Spread Index: Not to exceed 75.
  - c. Material Fire Ratings:
    - 1) National Fire Protection Association (NFPA): Class B.
    - 2) International Code Council (ICC): Class B.

#### 1.04 SUBMITTALS

##### A. Comply with requirements of Section 01 33 00.

##### B. Manufacturer's Data.

1. Provide required number copies of:
  - a. Product data sheets.
  - b. Installation instructions.
  - c. Cleaning and maintenance instructions.
  - d. Replacement parts information.

##### C. Shop Drawings.

1. Provide required number of copies of all shop drawings.
2. Show fabrication and erection of compartment assemblies, to extent not fully described by manufacturer's data sheets.
3. Show anchorage, accessory items and finishes.

4. Provide location drawings for bolt hole locations in supporting members for attachment of compartments.

D. Samples.

1. Furnish scale model of compartments, including stile, shoe, door, door hardware, divider panel, and mounting brackets.
2. Furnish sections showing stile anchoring and leveling devices, concealed threaded inserts, panel, stile, and edge construction.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver items in manufacturer's original unopened protective packaging.
- B. Store materials in original protective packaging to prevent physical damage or wetting.
- C. Handle so as to prevent damage to finished surfaces.

1.07 WARRANTY

- A. Furnish ten-year limited warranty for panels, doors, and stiles against breakage, corrosion, delamination, and defects in factory workmanship.
- B. Furnish one-year guarantee against defects in material and workmanship for stainless steel door hardware and mounting brackets.

1.08 ATTIC STOCK

- A. Provide two additional latches and associated hardware per toilet room included in scope of work.
- B. Provide one additional 12-inch-wide stile per toilet room included in scope of work.
- C. Provide one additional 36-inch-wide stall door per toilet room included in scope of work.

**PART 2 - PRODUCTS**

2.01 MANUFACTURER (DISTRICT STANDARD)

- A. Model numbers for toilet partitions manufactured by Bobrick Washroom Equipment, Inc., represented by R. E. Edwards & Associates (925-829-2942), are listed to establish a standard of quality for design, function, materials, workmanship, and appearance. Other manufacturers may be submitted for evaluation by the architect by following the conditions of the substitutions clause. Unless approval is obtained ten days prior to the bid date, all bids shall be based on the standard of quality. The architect shall be the sole judge as to the acceptability of all products submitted for substitution.

- B. Toilet partitions shall be the product(s) of a single manufacturer.

## 2.02 MOUNTING CONFIGURATIONS

- A. Toilet Partitions/Shower Dividers/Dressing Compartments shall be:

- 1. Overhead-Braced (1092.67 Sierra™ Series)

- B. Urinal Screens shall be:

- 1. Floor-Anchored (1091 Sierra Series):
    - or -
    - Post-to-Ceiling (1093 Sierra Series)
    - or -
    - Wall-Hung (1095 Sierra Series)

## 2.03 COMPONENTS/MATERIALS

- A. Stiles, Panels, Doors, and Screens shall be all be manufactured from Solid Color Reinforced Composite material.

- B. Toilet Partition Material

- 1. Toilet partitions shall be constructed of Solid Color Reinforced Composite material, which is composed of dyes, organic fibrous material, and polycarbonate/phenolic resins. Material shall have a non-ghosting, graffiti-resistant surface integrally bonded to core through a series of manufacturing steps requiring thermal and mechanical pressure. Edges of material shall be the same color as the surface.
  - 2. Subject to compliance with the material performance requirements, toilet partitions manufactured by others may be constructed from Solid Surface materials including, but not limited to:
    - a. Dupont Corian Privacy Plus Partitions.
    - b. WilsonArt Solid Surface.
  - 3. Toilet partitions constructed of High-Density Polyethylene (HDPE) or High-Density Polypropylene will not be acceptable.

- C. Finish Thickness

- 1. Stiles and doors shall be 3/4" (19 mm).
  - 2. Panels and benches shall be 1/2" (13 mm).

- D. Hardware

- 1. All hardware shall be Bobrick "1092.67DS Optional Institutional Hardware". Where Specifications and/or Drawings conflict with Bobrick "1092.67 Optional Institutional Hardware" requirements, the Bobrick "1092.67 Optional Institutional Hardware" requirements shall prevail.

2. Provide optional Door Plate Bobrick Part No. 1002510 at top and bottom of each partition door.
3. All hardware to be 18-8, type-304 stainless steel with satin finish.
4. Hardware of chrome-plated "Zamak", aluminum, or plastic is unacceptable.

E. Latch

1. Sliding door latch shall be 14 gauge (2 mm) and shall slide on nylon track.
2. Sliding door latch shall require less than 5-lb force to operate. Twisting latch operation will not be acceptable.
3. Latch track shall be attached to door by machine screws into factory-installed threaded brass inserts.
4. Threaded brass inserts shall be factory installed for door hinge and latch connections and shall withstand a direct pull exceeding 1,500 lbs. per insert.
5. Through bolted, stainless steel, pin-in-head Torx sex bolt fasteners shall be used at latch keeper-to-stile connections and shall withstand direct pull force exceeding 1,500 lbs. per fastener.

F. Hinges

1. Hinge shall be 16-gauge (1.6-mm) continuous piano hinge.
2. All doors shall be equipped with self-closing hinge.
3. Continuous piano hinge shall be attached to door and stile by theft-resistant, pin-in-head Torx stainless steel machine screws into factory-installed, threaded brass inserts
4. Fasteners secured directly into the core are not acceptable.
5. Door shall be furnished with two 11-gauge (3-mm) stainless steel door stop plates with attached rubber bumpers to resist door from being kicked in/out beyond stile.
6. Door stops and hinges shall be secured with stainless steel, pin-in-head Torx machine screws into threaded brass inserts.
7. Threaded brass inserts shall withstand a direct pull force exceeding 1,500 lbs per insert.

G. Mounting Bracket

1. Mounting brackets shall be 18-gauge (1.2- mm) stainless steel and extend full height of panel.
2. U-channels shall be furnished to secure panels to stiles.
3. Angle brackets shall be furnished to secure stiles to walls and panels to walls.
4. Fasteners at locations connecting panels-to-stiles shall utilize through bolted, stainless steel, pin-in-head Torx sex bolt fasteners. Through-bolted fasteners shall withstand direct pull force exceeding 1,500 lbs. per fastener.
5. Wall mounted urinal screen brackets shall be 11 gauge (3 mm) double thickness.

H. Leveling Device shall be 7-gauge, 3/16" (5-mm) hot rolled steel bar; chromate-treated and zinc-plated; through-bolted to base of solid color reinforced composite stile.

I. Stile Shoe shall be one-piece, 4" (102-mm) high, type-304, 22-gauge (0.8-mm) stainless steel with satin finish. Top shall have 90° return to stile. Shoe will be composed of one-piece of stainless steel and capable of being fastened (by clip) to stiles starting at wall line.

- J. Headrail (Overhead Braced) shall be satin finish, extruded anodized aluminum (.125" / 3-mm thick) with anti-grip profile.
- K. Full-Height Post: At all partition panels over 5'-0" in unsupported length, provide a full-height 1-1/4"x1-1/4" stainless-steel post, Bobrick Part No. 1000070 and Anchor Package Part No. 1002703. Provide floor and ceiling saddles. Fasteners into concrete floor shall be stainless steel. The panel shall be anchored to post to help eliminate side to side flex of the panel. At locations where post is taller than 8'-0" and/or is in a high vandalism area, provide custom stainless steel post with slip-joint as detailed on drawings.
- L. Grab Bar Anchors for Toilet Partitions: At all locations as shown on drawings where grab bars are mounted on partition system, provide Bobrick 2586 Series stainless steel backing plate.
- G. Coat Hook
  - 1. Coat Hook shall Bobrick Model B-233 and be constructed of stainless steel and shall project no more than 1-1/8" (29 mm) from face of door.
  - 2. Coat hook shall be secured by to door by through-bolted, theft-resistant, pin-in-head Torx stainless steel screws. Through-bolted fasteners shall withstand a direct pull force exceeding 1,500 lbs. per fastener.
  - 3. Coat Hook shall act as door bumper on in-swing doors.
  - 4. Mounting height = 48" maximum above finished floor.
- H. Door Pull: Accessible stall door shall have a compliant loop or U-shaped door pull on inside and outside of door immediately below latch.
- I. Door Bumpers: Provide wall door bumper for all doors where partition door will impact wall finish. Wall bumper shall be equal to Trimco, Model No. 1270CVPV. Mount on wall at height to match partition door handle.

## 2.04 FABRICATION

- A. Vandal-Resistant Hardware Option: for Institutional Hardware option add suffix .67 to 1092 Series.

## PART 3 – EXECUTION

### 3.01 EXAMINATION

- A. Check areas scheduled to receive compartments for correct dimensions, plumbness of walls, and soundness of surfaces that would affect installation of mounting brackets.
- B. Verify spacing of plumbing fixtures to assure compatibility with installation of compartments.
- C. Do not begin installation of compartments until conditions are satisfactory.

### 3.02 ERECTION

- A. Install compartments rigidly, straight, plumb, and level and in accordance with manufacturer's installation instructions.
- B. Installation methods shall conform to manufacturer's recommendation for backing and proper support.
- C. Conceal evidence of drilling, cutting, and fitting to room finish.
- D. Maintain uniform clearance at vertical edge of doors.
- F. Attach panel brackets securely to walls using anchor devices. All anchors shall be into solid wood blocking. No plastic expansion sleeves will be accepted.
- G. Attach panels and pilasters to bracket with through-sleeve tamperproof bolts and nuts.
- H. Anchor urinal screen panels to walls with continuous panel brackets. At free end, provide full-height post as noted in Paragraph 2.03-K.
- I. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster. Conceal floor fastenings with pilaster shoes.
- J. Equip each door with one hinge, one door latch, and one coat hook and bumper.
- K. Install door strike and keeper with door bumper on each pilaster in alignment with door latch.
- L. Adjust hinges to locate doors in partial opening position when unlatched. Return outswing doors to close position.
- M. Contractor shall install backing/blocking as required for secure attachment.
- N. Confirm all locations of full-height post and provide blocking in ceiling space. Contractor shall open ceiling as required to install 4x4 blocking for attachment of post.
- O. At locations of grab bars mounted on partition system, Contractor shall carefully measure and drill panels for grab bar anchors.
- P. Where full-height stainless steel brackets extend above ceramic tile wainscot, provide plywood shim between wall and bracket to act as spacer. Shim shall be narrower than brackets to allow for sealant joint. After shim installation, provide sealant joint between wall and bracket to completely enclose edge of plywood.

### 3.03 ADJUSTMENT AND CLEANING

- A. Adjust hardware for proper operation after installation.
- B. Set hinge cam on in-swinging doors to hold doors open when unlatched.

- C. Set hinge cam on out-swinging doors to hold unlatched doors in closed position.
- D. Clean exposed surfaces of compartments, hardware, and fittings.
- E. Remove protective maskings. Clean surfaces.
- F. Field touch-up of scratches or damaged enamel finish will not be permitted.
- G. Replace damaged or scratched materials with new materials.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 2022-12-18 – Revised the make and model of the hand dryer.
- 2025-01-31 – Minor edits to code references.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.



## SECTION 10 28 00

## TOILET, BATH, AND WASHROOM ACCESSORIES

**PART 1 – GENERAL****1.01 SUMMARY****A. Section Includes:**

1. Toilet and bath, shower, and washroom accessories.
2. Framed mirror units.
3. Concealed anchor devices and backing plate reinforcements furnished to other Sections.
4. Attachment hardware.

**B. Related Sections:**

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 09 29 00: Gypsum Board.
3. Section 10 21 13: Toilet Compartments and Cubicles.

**1.02 REFERENCES**

- A. ADAAG - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities.
- B. CBC - California Building Code, (CCR) California Code of Regulations, Title 24, Part 2, California State Accessibility Standards.
- C. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- D. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
- E. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

**1.03 SUBMITTALS**

- A. Submit product data under provisions of Section 01 33 00. Provide product data on accessories describing size, finish, details of function, attachment methods.
- C. Submit manufacturer's installation instructions under provisions of Section 01 33 00.

**1.04 QUALITY ASSURANCE**

**A. Regulatory Requirements**

1. Conform to CBC, California Building Code, (CCR) Title 24, Part 2, and ADAAG or accessibility requirements.
2. Structural strength of grab bars, shower seats, fasteners and mounting devices shall conform to requirements of the CBC, California Building Code, (CCR) Title 24, Part 2, Section 1115B.8.3 and shall withstand the application of a 250 lb. point load.

**B. Coordination**

1. Coordinate the work of this Section under provisions of Section 01 31 00.
2. Coordinate the work of this Section with the placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

**PART 2 – PRODUCTS****2.01 MANUFACTURERS**

- A. Bobrick Washroom Equipment, Inc., [www.bobrick.com](http://www.bobrick.com). (District standard)
- B. American Specialties, Inc. (ASI), [www.americanspecialties.com](http://www.americanspecialties.com).
- C. Bradley Corporation, [www.bradleycorp.com](http://www.bradleycorp.com).
- D. Deb.
- E. EXCEL Dryer.
- F. TORK.
- G. Substitutions: Under provisions of Section 01 33 00.

**2.02 MATERIALS**

- A. Sheet Steel.
- B. Stainless Steel Sheet: Type 304.
- C. Tubing: ASTM A269, stainless steel, Type 304.
- D. Adhesive: Two component epoxy type waterproof.
- E. Fasteners, Screws, and Bolts: Hot dip galvanized, tamperproof.

- F. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

## 2.03 FABRICATION

- A. Weld and grind smooth joints of fabricated components.
- B. Form exposed surfaces from single sheet of stock, free of joints.
- C. Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.
- D. Back paint components where contact is made with building finishes to prevent electrolysis.
- E. Shop assemble components and package complete with anchors and fittings.
- F. Provide steel anchor plates, adapters, and anchor components for installation:
- G. Hot dip galvanize exposed and painted ferrous metal and fastening devices.
- H. Toilet tissue dispensers located in accessible toilet rooms or stalls shall not have their flow restricted and shall be capable of continuous flow.

## 2.04 FINISHES

- A. Galvanizing: ASTM A123 to 1.25 oz/sq yd.
- B. Shop Primed Ferrous Metals: Pretreat and clean, spray apply one coat primer and bake.
- C. Enamel: Pretreat to clean condition, apply one coat primer and minimum two coats electrostatic baked enamel.
- D. Chrome/Nickel Plating: ASTM B456, Type SC 2 satin finish.
- E. Stainless Steel: No. 4 satin luster finish.
- F. Mirror Glass: FS DD-G-451 Type I, Class 1, Quality of 2, 1/4 inch thick with silver coating, copper protective coating and non-metallic paint coating complying with FS DD-M-411.
- G. Stainless Steel Mirror: Type 430, 20 gage, bright annealed stainless steel.

## PART 3 – EXECUTION

### 3.01 EXAMINATION

- A. Verify that site conditions are ready to receive work and dimensions are as instructed by the manufacturer.

- B. Beginning of installation means acceptance of existing conditions.

### 3.02 PREPARATION

- A. Deliver inserts and rough-in frames to site at appropriate time for building-in.
- B. Provide templates and rough-in measurements as required.
- C. Verify exact location of accessories for installation.

### 3.03 INSTALLATION

- A. Install fixtures, accessories and items in accordance with manufacturers' instructions.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Accessories required to be accessible shall be mounted at heights according to CBC Section 11B-603 and as indicated on the drawings.
- D. Toilet paper dispensers and feminine napkin dispensers located on the grab bar side of an accessible toilet room or stall shall not project more than 3 inches from the finished surface of the wall nor be located closer than 1-1/2 inches clear of the tangent point of the grab bar.
- E. Contractor shall install all necessary blocking, backing, and recessed openings for all toilet accessories.
- F. At locations where grab bars are mounted to toilet partition material, provide optional anchor device, Bobrick #2586 at each flange.
- G. Toilet Seat Cover Dispensers: Provide at staff toilet rooms or stalls, and at gender neutral toilet rooms only. Do not provide at student toilet rooms or stalls.
- H. Sanitary Napkin Disposal: Provide at staff toilet rooms or stalls, at gender neutral toilet rooms, high school girls toilet rooms, and middle school girls toilet rooms.
- I. Hand Dryers: Extend power to location of hand dryer and provide necessary backbox for connection. Provide in-wall blocking for unit support.
- J. Keying Accessories
  - 1. Supply two keys for each accessory to Owner.
  - 2. Master key all accessories.

### 3.04 SCHEDULE

(Designers! Modify schedule below as required for your specific project. For other equipment not shown below, select from same product line.)

|                                |          |                                                     |
|--------------------------------|----------|-----------------------------------------------------|
| A. Grab bars                   | B-6808   | Length as required                                  |
| B. Toilet Paper Dispenser      | B-2888   | Surface mount                                       |
| C. Toilet Paper Dispenser      | B-3888   | Semi-recessed                                       |
| D. Feminine Napkin Disposal    | B-270    | Surface mount                                       |
| E. Feminine Napkin Dispenser   | B-2706   | Surface Mount for modernization projects            |
| F. Feminine Napkin Dispenser   | B-3706   | Semi-Recessed for new construction projects         |
| G. Soap Dispenser              | #91628   | Black Proline Curve Dispenser Green Tip             |
| H. Soap Dispenser Foam Soap    | #32084   | SC Johnson Professional Stoko Refresh 800ml Refill  |
| I. Electric Hand Dryer         | #XL-W    | XLERATOR, 120V. Provide at multi-use toilet rooms   |
| J. Hand Dryer Recess Kit       | #40502   | ADA-Compliant Recess Kit                            |
| K. Hand Dryer Wall Guard       | #89S     | Stainless Steel                                     |
| J. Paper Towel Dispenser       | #5510282 | Tork Matic. Provide at staff toilets & clsrn. sinks |
| K. Mirror(non-tilt)            | B-290    | Minimum size 18 inches x 36 inches                  |
| L. Toilet Seat Cover Dispenser | B-221    | Provide at staff toilet rooms                       |

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

## SECTION 11 68 16

## PLAY STRUCTURES

**PART 1 – GENERAL****1.01 SUMMARY****A. Scope Of Work:**

1. The conditions of the Contract and requirements of Division 1, General Requirements, are part of this Section and apply to work of this Section as fully as if herein repeated.
2. The work includes, but is not necessarily limited to, the following:
  - a. Installation of playground equipment.
  - b. Additional items that may be specified or shown on the Drawings.
3. Furnish and install any incidental work not shown or specified but which can reasonably be inferred as required and necessary to provide complete and workable systems.

**B. Related Sections:**

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 31 23 00: Trenching, Backfilling & Compaction.
2. Section 32 13 00: Portland Cement Concrete Paving.
3. Section 32 18 16.13: Playground Protective Surfaces.

**C. Fees, Permits, And Utility Services**

1. Obtain and pay for permits and service charges required in installation of Work. Arrange for required inspections and secure approvals for authorities having jurisdiction.

**1.02 REFERENCES****1.03 SUBMITTALS**

- A. Refer to Section 01 33 00.

**1.04 QUALITY ASSURANCE**

- A. Installer Qualifications: Engage an experienced Installer or applicator who has a minimum 5 years of experience in installing play equipment types similar to that required for this Project and who is acceptable to manufacturer of primary materials.

- B. Single Source Responsibility: Obtain urethane cement composition flooring materials, including primers, resins, hardening agents, and finish or sealing coats, from a single manufacturer.
- C. Qualified Materials: Request for material approvals for any products other than the specified products must be submitted to the architect two weeks prior to the bid, including complete application specification, physical characteristics, and chemical resistance data. Any request after this date will not be accepted. Failure of performance requires immediate removal and replacement of unapproved substituted material with those originally specified at no cost to the owner, architect, construction manager, or general contractor.
- D. Regulatory Requirements: Work and materials shall be in full accord with Title 24, California Code of Regulations; Uniform Plumbing Code; California Building Code; National Electric Code; State Fire Marshall; California OSHA; National Fire Protection Association; and other applicable state or local laws or regulations. Nothing in drawings or specifications shall be construed to permit work not conforming to these Codes.

#### 1.05 WARRANTY

- A. 100-YEAR LIMITED WARRANTY - On all PlayBooster®, PlayShaper® and PlaySense® aluminum posts, stainless steel fasteners, clamps, beams and caps, against structural failure due to corrosion/natural deterioration or manufacturing defects, and on PlayBooster, Evos™ and Weevos™ steel posts and arches against structural failure due to material or manufacturing defects.
- B. 15-YEAR LIMITED WARRANTY - On all plastic components (including TuffTimbers™ edging), all steel components (except 100-year steel posts), Mobius® climbers, decks and TenderTuff™ coatings (except Wiggle Ladders, Chain Ladders and Swing Chain) against structural failure due to material or manufacturing defects. TuffTurf® tiles against material or manufacturing defects.
- C. 10-YEAR LIMITED WARRANTY - On concrete products against structural failure due to natural deterioration or manufacturing defects. Does not cover minor chips, hairline cracks or efflorescence.
- D. 8-YEAR LIMITED WARRANTY - On Aeronet™ climbers and climbing cables against defects in materials or manufacturing defects. On CoolToppers® fabric against failure from significant fading, deterioration, breakdown, mildew, outdoor heat, cold or discoloration. This warranty is limited to the design loads as stated in the specifications found in the technical information.
- E. 3-YEAR LIMITED WARRANTY - On all other parts, i.e.: CableCore® products, swing seats and hangers, grills, Mobius climber handholds, Wiggle Ladders, Chain Ladders and Swing Chain, Track Ride trolleys and bumpers, all rocking equipment including Sway Fun® gliders, PVC belting material, HealthBeat™ hydraulic cylinders, Seesaws, Wiggle Ring Bridge, etc., against failure due to corrosion/natural deterioration or manufacturing defects.
- F. This warranty does not include any cosmetic issues or wear and tear from normal use. It is valid only if the play structures and/or equipment are erected to conform with Landscape Structures' installation instructions and maintained according to the maintenance procedures furnished by Landscape Structures Inc. For a full text of the warranty, contact your playground consultant.



**PART 2 – PRODUCTS****2.01 MANUFACTURERS**

- A. Landscape Structures (basis of design).
- B. Miracle Playground Sales.
- C. Approved Equal.

**2.02 MATERIALS**

- A. Provide each item listed herein or shown on drawings of quality noted or approved equal. All material shall be new, full weight, standard in all respects and in first-class condition. Insofar as possible, all materials used shall be of same brand or manufacture throughout for each class of material or equipment. Materials shall be of domestic manufacture and shall be tested within Continental United States.
- B. All the materials used in the manufacturing of PlayBooster® and PlayShaper® play structures have a proven track record of durability and are widely used in the playground industry. All play structures have been certified and validated to be in conformance with the ASTM F1487 Standard. Play structures displaying the CSA and TUV logos are certified to those standards. They also conform to the U.S. Consumer Products Safety Commission (CPSC) Guidelines. Unless otherwise noted, all play structures are considered accessible according to the 2010 ADA Standard for Accessible Design.
- C. Material: All materials shall be structurally sound and suitable for safe play. Durability shall be ensured on all steel parts by the use of time-tested coatings such as zinc plating, galvanizing, ProShield® finish, TenderTuff™ coating, etc. Colors shall be specified.
- D. Fasteners: Primary fasteners shall be socketed and pinned tamperproof in design, stainless-steel (SST) per ASTM F 879 unless otherwise indicated (see specific product installation/specifications). All primary fasteners shall include a locking patch type material that will meet the minimum torque requirements of IFI-125. Manufacturer to provide special tools for pinned tamperproof fasteners.
- E. TenderTuff Coating: Metal components to be TenderTuff-coated shall be thoroughly cleaned in a hot phosphate wash system, then primed with a water-based thermosetting solution. Primed parts shall be preheated prior to dipping in UV stabilized, liquid polyvinyl chloride (PVC), then salt cured at approximately 400 degrees. The finished coating shall be approximately .080" thick at an 85 durometer with a minimum tensile strength of 1700 psi and a minimum tear strength of 250 lbs./inch. Standard colors are available, all with a matte finish.
- F. ProShield Finish: All metal components with ProShield finish shall be thoroughly cleaned and pretreated through a multi-stage wash system. Parts are then thoroughly dried, preheated and processed through a set of automatic powder spray guns where a minimum .002" of epoxy primer is applied. A minimum .004" of architectural-grade Super Durable polyester TGIC powder is applied. The average ProShield film thickness is .006".

1. ProShield is formulated and tested per the following ASTM standards. Each color must meet or exceed the ratings listed below:
  - a. Hardness (D3363) rating 2H.
  - b. Flexibility (D522) pass 1/8" mandrel.
  - c. Impact (D2794) rating minimum 80 inch-pounds.
  - d. Salt Fog Resistance (B117 and D1654) 4,000 hours and rating 6 or greater.
  - e. UV Exposure (G154, 340 bulb) 3,000 hours, rating delta E of 2, and 90 percent gloss retention\*.
  - f. Adhesion (D3359, Method B) rating 5B.

The Paint Line shall employ a "checkered" adhesion test daily. Standard colors are available.

\* Certain colors may exceed delta E of 2. Contact Landscape Structures for exceptions.

- G. There shall be a minimum of (4) slots in each face to accommodate face mounting of components. Decks shall be manufactured from a single piece of low carbon 12 GA (.105") sheet steel conforming to ASTM specification A-1011. The sheet shall be perforated with a return flange on the perimeter to provide the reinforcement necessary to ensure structural integrity. There shall be no unsupported area larger than 3.5 square feet. The unit shall then be TenderTuff-coated brown or gray only. Decks shall be designed so that all sides are flush with the outside edge of the supporting posts.
- H. Concrete Products: Two processes are used to produce concrete products. (See specific product installation/specification documents.)
  1. Glass Fiber Reinforced Concrete (GFRC) Products: Glass fiber is alkali-resistant (AR) with high tensile properties formulated for concrete. GFRC nominal product thickness is 1" with a unit weight of about 12 lbs. per square foot and an average ultimate flexural strength of 2,100 psi per ASTM C947. Finish: Exterior latex paint suited for concrete applications.
  2. Precast Concrete Products: Wet-cast solid, molded concrete with an average compressive strength of 5,000 psi per ASTM C39. Unit weight range of about 115-145 lbs. per cubic foot. Finish: Exterior latex paint suited for concrete applications.
- I. Rotationally Molded Polyethylene Parts: These parts shall be molded using prime natural linear low-density polyethylene having a tensile strength of 2400 psi per ASTM D638. Rotational molding resin is compounded with color and UV-stabilizing additives with a nominal wall thickness typically 1/4" with some variation depending upon product type. Standard colors are available.
- J. Recycled Permalene Parts: These parts shall be manufactured from 3/4" high-density polyethylene that has been specially formulated for optimum UV stability and color retention. Products shall meet or exceed density of .960 G/cc per ASTM D1505, tensile strength of 2400 PSI per ASTM D638. Available in a three-layer product with (2) .100" thick colored exterior layers over a .550" thick recycled Black interior core. Standard colors are available.
- K. Footings: Unless otherwise specified, the bury on all footings shall be 34" below Finished Grade (FG) on all in-ground play events/posts. Other types of anchoring are available upon request.
- L. Hardware Packages: All shipments shall include individual component-specific hardware packages. Each hardware package shall be labeled with the part number, description, a component diagram

- showing the appropriate component, package weight, a bar code linking the hardware package to the job number, assembler's name, date and time the package was assembled, work center number and work order number.
- M. Installation Documentation: All shipments shall include a notebook or packet of order-specific, step-by-step instructions for assembly of each component, including equipment assembly diagrams, estimated hours for assembly, footing dimensions, concrete quantity for direct bury components, fall height information, area required information and detailed material specifications.
  - N. Packing List: All shipments shall include a packing list for each skid/container, specifying the part numbers and quantities on each skid or within each container.
  - O. Packaging: All components shall be individually wrapped or bulk wrapped and placed on skids (pallets) then shrink-wrapped to provide protection during shipment. Small parts and hardware packages will be placed in crates for shipment. Other components shall be individually wrapped or bulk wrapped to provide protection during shipment.
  - P. Maintenance Kit: An order-specific maintenance kit shall be provided for each structure order. The kit will include a notebook or packet with a second set of installation documents and order-specific maintenance documentation with recommendations on how often to inspect, what to look for and what to do to keep the equipment in like-new condition. The kit also includes touch-up primer, appropriate color touch-up paint, sandpaper, appropriate color touch-up PVC and additional installation tools for the tamperproof fasteners.

## 2.03 MANUFACTURED UNITS

### A. PlayBooster General Specifications (ages 5-12)

#### 1. Main Components:

(DESIGNERS!! Items below shall be chosen on a site-by-site basis)

- a. Vertical Ascent 56" DK
  - b. Casade Climber 64" DK DM
  - c. Square Tenderdeck
  - d. Triangular Tenderdeck
  - e. Kick Plate 8" Rise
  - f. Curved Transfer Module Left 48" DK DM
  - g. Panels – Permalene
  - h. Chimes Reach Panel Ground Level
  - i. Double Swoosh Slide
  - j. Firepole Perm Handholds 64" DK DB
  - k. WhooshWinder Slide 72" Dk DB
2. Posts: Post length shall vary depending upon the intended use and shall be a minimum of 42" above the deck height. All posts shall be ProShield finished to specified color. All posts shall have a "finished grade marker" positioned on the post identifying the 34" bury line required for correct installation and the top of the loose fill protective surfacing. Top caps for posts shall be aluminum die cast from 369.1 alloy and ProShield finished to match the post color. All caps shall

be factory installed and secured in place with (3) self-sealing rivets. A molded low-density polyethylene cap, with drain holes, shall be pressed onto the bottom end of the post to increase the footing area.

3. Steel Posts: All steel PlayBooster posts are manufactured from 5" O.D. tubing with a wall thickness of .120" and shall be galvanized after rolling and shall have both the I.D. and the cut ends sprayed with a corrosion resistant coating. Steel Post Mechanical Properties:
  - a. Yield Strength (min): 50,000 PSI.
  - b. Tensile Strength (min): 55,000 PSI.
  - c. Elongation: 25% in 2 inches.
  - d. Modulus of Elasticity:  $29.5 \times 10^6$  PSI
4. Aluminum Posts: All aluminum PlayBooster posts are manufactured from 6005-T5 extruded tubing conforming to ASTM B-221. Posts shall have a 5" outside diameter with a .125" wall thickness. Aluminum Post Mechanical Properties:
  - a. Yield Strength (min): 35,000 PSI.
  - b. Tensile Strength (min): 38,000 PSI.
  - c. Elongation: 10% in 2 inches.
  - d. Modulus of Elasticity:  $10 \times 10^6$  PSI
5. Arch Posts: Aluminum arch posts shall be manufactured from 6005-T5 alloy. The arch shall be formed to a 21" center line radius to complement the 42" center-to-center module. The arch shall be of one continuous piece construction. There shall be no welds or additional pieces mechanically fastened to manufacture the arch. Each arch shall be designed to provide a minimum of 90 1/2" clear span from the deck to the inside of the arch at the radius peak. Arches shall be ProShield finished to a specified color.
6. Clamps: All clamps are ProShield finished and, unless otherwise noted, shall be die cast using a 369.1 aluminum alloy and have the following mechanical properties:
  - a. Ultimate Tensile: 47,000 PSI.
  - b. Yield Strength: 28,000 PSI.
  - c. Elongation: 7% in 2 inches.
  - d. Shear Strength: 29,000 PSI.
  - e. Endurance Limit: 20,000 PSI.
  - f. Each functional clamp assembly shall have an appropriate number of half clamps and shall be fastened to mating parts with (2) 3/8" x 1 1/8" pinned button head cap screws (SST) and (2) stainless-steel (SST) recessed "T" nuts. A 1/4" aluminum drive rivet with stainless steel pin is used to ensure a secure fit to the post.
7. PlayBooster® clamps have three functional applications and shall be named as follows:
  - a. Offset hanger clamp assembly
  - b. Deck hanger clamp assembly
  - c. Hanger clamp assembly
8. Netplex Clamps: All clamps are ProShield finished and, unless otherwise noted, shall be die cast using a 369.1 aluminum alloy and have the following mechanical properties:
  - a. Ultimate Tensile: 47,000 PSI.
  - b. Yield Strength: 28,000 PSI.

- c. Elongation: 7% in 2 inches.
  - d. Shear Strength: 29,000 PSI.
  - e. Endurance Limit: 20,000 PSI.
  - f. Each functional clamp assembly shall have an appropriate number of rope clamps and back clamps and shall be fastened to each other with (2) 5/8" x 1 1/2" pinned button head cap screws (SST) and (2) stainless-steel (SST) recessed "T" nuts. Either a face clamp shall be fastened to rope clamp with (2) 3/8" by 1-3/8" pinned button head cap screws or a single tab casting plate shall be fastened to rope clamp with (4) 3/8" by 1-3/8" pinned button head cap screws with 3/8" SAE flat washers. A 1/4" x 5/8" aluminum drive rivet with stainless steel pin is used to ensure a secure fit to the post.
9. Geoplex Clamps: All clamps are ProShield finished and, unless otherwise noted, shall be fabricated from:
- a. 7GA using .179" (4.54 mm) T316 stainless steel.
  - b. Ultimate Tensile: 84,000 PSI.
  - c. Yield Strength: 25,000 PSI.
  - d. Each functional clamp assembly shall have an appropriate number of locking clamps and shall be fastened to mating parts with (2) 3/8" x 7/8" pinned button head cap screws (SST) with (2) 3/8" SAE flat washers. A 1/4" aluminum drive rivet with stainless steel pin is used to ensure a secure fit to the post.
10. Steel-reinforced cables: Made of tightly woven, polyester-wrapped, six-stranded galvanized steel cable. These abrasion-resistant, color-stable cables are extremely durable and vandal resistant. Available in Black or Red. Some products available in Black only or Red only.
11. PlayOdyssey Structural Frame: Post length of the double ladder/central column shall vary depending upon the deck height and shall be flush with the bottom of a deck infill or a minimum of 46" above the deck height. All posts shall be ProShield finished to specified color. All posts shall have a "finished grade marker" positioned on the post identifying the 60" bury line required for correct installation and the top of the loose fill protective surfacing. Post caps shall be aluminum die cast from 369.1 alloy and ProShield finished to match the post color. All caps shall be factory installed and secured in place with (3) self-sealing rivets. A molded low-density polyethylene cap, with drain holes, shall be pressed onto the bottom end of the ladder posts to increase the footing area. Ladders are bolted together below grade to act as a single column for installation purposes. The deck support weldments/arms are comprised of 5/16" (.313") steel conforming to 1010 steel per ASTM A635 and welded to a 52" steel post. Arms are secured to each ladder post with (4) 5/8" x 1 1/2" pinned button head cap screws through (2) 1/4" flanges.
12. PlayOdyssey Optional Aluminum Roof Posts: All formed aluminum PlayOdyssey roof posts are manufactured from 6005-T5 extruded tubing conforming to ASTM B-221. Posts shall have a 5" outside diameter with a .125" wall thickness. Post sleeve shall have 4.675" outside diameter with a .150" wall thickness. Post cap shall be aluminum die cast from 369.1 alloy and ProShield finished to match the post color. All caps shall be factory installed and secured in place with (3) self-sealing rivets.

13. Vibe® Handholds: Rotomolded shell, with 7 GA (.179") HRPO steel sheet insert that is zinc plated then ProShield finished. Standard colors are available.
14. Vibe Roof: Rotomolded shell, with 12 GA (.105") HRPO steel sheet insert that is zinc plated then ProShield finished. Standard colors are available.
15. Vibe Enclosures: Rotomolded shell, with 7 GA (.179") HRPO steel sheet insert that is zinc plated then ProShield finished. Standard colors are available. Option of 10 activity panels available in standard Permalene® colors. Also available bubble or window panel made of 1/4" clear polycarbonate.

B. Smart Play (ages 2-5)

1. Main Components:

(DESIGNERS!! Items below shall be chosen on a site-by-site basis)

- a. Motion with Play Table DB
  - b. Exit Footer. Finish: Proshield
  - c. Tunnel Section
  - d. Bongo
  - e. Panels – Permalene
  - f. Marble
  - g. Race Track
  - h. Bell and Striker
  - i. Slide
2. Fasteners: Primary fasteners shall be socketed and pinned tamperproof in design, stainless steel (SST) per ASTM F 879 unless otherwise indicated (see specific product installation/specifications).
  3. Belt: .315" (8,00 mm) Thick mini rough top rubber belting with polyester fabric plys, black in color.
  4. Mid-Support: Weldment comprised of 1.315" (33,40 mm) O.D. RS-20 (.080" - .090") (2,03 mm - 2,28 mm) galvanized steel tubing and 1/4" (6,35 mm) mounting plate. Finish: ProShield, color specified.
  5. Attachment Block: U.V. stabilized high-density polyethylene, tan in color.
  6. Chain: Steel 3/16" (4,75 mm) straight link chain, 800 lb. (362,87 kilograms) working load limit. Finish: TenderTuff, color specified.
  7. Post: Weldment comprised of 2.375" (60,33 mm) O.D. RS20 (.095"-.105") (2,41 mm - 2,67 mm) wall galvanized steel tubing, 1/4" (6,35 mm) HRPO steel sheet and 7 GA. (.179") (4,55 mm) HRPO steel sheet. Finish: ProShield, color specified.
  8. GripX Deck Surface: 3/4" (19,05 mm) Thick Permalene®, black in color.
  9. Deck Frame: Fabricated from 1/4" (6,35 mm) HRPO steel sheet. Finish: ProShield, color specified.
  10. Roof: Fabricated from 7 GA. (.179") (4,55 mm) HRPO steel sheet. Finish: ProShield, color specified.
  11. Tunnel Support: Weldment comprised of 2.375" (60,33 mm) O.D. RS20 (.095"-.105") (2,41 mm - 2,67 mm) wall galvanized steel tubing, and 1/8" (.125") (3,18 mm) HRPO steel sheet. Finish: ProShield, color specified.

12. Chain Ladder Footer: Weldment comprised of 1.900" (48,26 mm) O.D. RS20 (.090"-.100") (2,29 mm - 2,54 mm) wall galvanized steel tubing and 1/4" (6,35 mm) HRPO steel sheet. Finish: ProShield, color specified.
13. Belt Climber Frame: Weldment comprised of 1.315" (33,40 mm) O.D. RS20 (.080" - .090") (2,03 mm-2,29 mm) galvanized steel tubing, 1/4" (6,35 mm) HRPO steel sheet and 1/8" (.125") (3,18 mm) HRPO steel sheet. Finish: ProShield, color specified.
14. Puzzle Handrail: Weldment comprised of 1.315" (33,40 mm) O.D. RS20 (.080" - .090") (2,03 mm-2,29 mm) galvanized steel tubing, and 1/4" (6,35 mm) HRPO steel sheet. Finish: ProShield, color specified.
15. Race Track Tab: Fabricated from 7 GA. (.179") (4,55 mm) HRPO steel sheet. Finish: ProShield, color specified.
16. Race Track Frame: Fabricated from 1/8" (.125") (3,18 mm) HRPO steel sheet. Finish: ProShield, color specified.
17. End Panel Supt.: Weldment comprised of 1/4" (6,35 mm) HRPO steel sheet and 3/8" (9,53 mm) re-bar. Finish: ProShield, color specified.
18. Bell Striker: Recycled Permalene, color specified.
19. Bell: Fabricated from 10 GA. (.135") (3,42 mm) HRPO low carbon steel. Finish: ProShield, color specified.
20. Slide: Rotationally molded from U.V. stabilized linear low-density polyethylene, color specified.

C. PlayShaper® General Specifications (ages 2-5)

1. Posts: 2 3/8" square aluminum posts shall have a minimum wall thickness of .125" and be extruded of 6005-T5 aluminum alloy and have rounded corners and ribbed faces for maximum safety. A cast aluminum top cap shall be installed at the factory with stainless steel knurled spacers and aluminum drive rivets. Flanges for panels and deck supports shall be extruded of 6061-T6 aluminum alloy and slide into slots extruded in posts. Flanges and deck supports shall be attached in the factory with stainless steel knurled spacers and aluminum drive rivets. All direct bury posts shall have a "finished grade marker" positioned on the post identifying the 34" bury line and the top of the required surfacing. A molded low-density polyethylene cap, with drain holes, shall be pressed onto the bottom end of the post to increase the footing area. Posts shall have a post number sticker for installation purposes. All surface mount posts shall be continuously welded to a 1/4" x 6" square 6061-T6 aluminum surface mount plate and allow for 2" of protective surfacing. Posts shall be ProShield finished to a specified color. Aluminum Post Mechanical Properties:
  - a. Yield Strength (min): 35,000 PSI.
  - b. Tensile Strength (min): 38,000 PSI.
  - c. Elongation: 10% in 2 inches.
  - d. Modulus of Elasticity: 10 x 10<sup>6</sup> PSI.
2. Arch Posts: Arch posts shall have the same shape as the posts and be extruded from 6063-T4 aluminum alloy. Roof support flanges shall be of the same shape and material as the panel flanges. Arch shall be formed in a 180-degree arc on a 21" center line radius. Arches shall be secured to standard length posts with solid aluminum sleeves that are tapped to receive (16) 3/8" x 5/8" pinned button head cap screws per arch. Arch posts shall be ProShield finished to a specified color.

A. Free Standing Equipment.

1. Chinning Bar Aluminum DB.
2. Turning Bar DB.
3. Welcome Sign.
4. Single Post Swing Frame 8'-0" Beam Height with Belt Seat ProGuard Chains.

**PART 3 – EXECUTION**

3.01 INSPECTION

- A. Check areas scheduled to receive play equipment has reached necessary compaction.

3.02 ERECTION

- A. Install compartments rigidly, straight, plumb, and level and in accordance with manufacturer's installation instructions.
- B. Installation methods shall conform to manufacturer's recommendation for anchorage and attachment of components to each other.
- C. Cut all exposed threads off bolts flush with nut or cut excess and provide an acorn nut.

3.03 ADJUSTMENT AND CLEANING

- A. Adjust and align all components.
- B. Clean exposed surfaces of compartments, hardware, and fittings.
- C. Remove protective maskings. Clean surfaces.
- D. Field touch-up of scratches or damaged enamel finish will not be permitted.
- E. Replace damaged or scratched materials with new materials.

END OF SECTION



## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 2025-01-31 – Added a 3-part spec for vinyl curtains to this section.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- District does not want motorized blinds/shades to be used on project. If designer feels that blinds/shades need to be motorized, they should obtain approval from District.
- District is okay with the use of rolling Mecho-type shades.
- The use of mini-blinds shall be limited to non-abusive locations where students do not have direct contact with blinds. This typically means mini-blinds could be used at higher clearstory windows.
- All seems/edges shall be fully hemmed.

SECTION 12 20 00  
WINDOW TREATMENTS

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Provide window curtains and track systems in accordance with project documents and plans.
- B. Related specification sections:
  - 1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
  - 2. Section 06 10 00 – Rough Carpentry.
  - 3. Section 09 29 00 – Gypsum Board Assemblies.
  - 4. Section 09 51 00 – Acoustical Ceilings.

**1.2 QUALITY ASSURANCE**

- A. Provide curtains, track, and hardware from a firm that has specialized in the fabrication and installation of such work for at least five (5) years in projects of similar size and scope.
- B. Provide curtains, track, and hardware as complete units produced by a single manufacturer, including the necessary mounting brackets, hardware, fittings, fastenings, and installation.
- C. Installation shall be performed by an authorized manufacturer's representative experienced in the installation and maintenance of such assemblies.

**1.3 STANDARDS**

- A. Except as modified by governing codes and contract documents, comply with applicable provisions and recommendations of the following:
  - 1. Fabrics are able to withstand a temperature of not more than 160° F.
  - 2. Provide curtains that conform to NFPA 701 Fire Tests for Flame and Resistant Textiles and Films, and California Title 19 regulations.
    - a. Identify fabrics with appropriate markings of applicable testing and inspecting agency.

**1.4 SUBMITTALS**

- A. Manufacturer's Data: Include durability, laundry temperature limit, fade resistance, and fire-test response characteristics for each type of curtain fabric indicated.
- B. Shop drawings: Submit drawings and a schedule showing layout and configurations, sizes of curtains, number of carriers, anchorage details, and conditions requiring accessories. Indicate dimensions taken from field measurements. Include details on blocking above ceiling and in walls.
- C. Verification Samples: Submit Full-size units of each type of the following products:

1. Curtains: Submit 12" square swatch (memo) samples illustrating fabric color, pattern repeat, and weave for each fabric specified.
  2. Curtain Track: Submit sample assembly not less than 4" long included a full-size carrier, end cap, and pull out.
- D. Maintenance Instructions: Submit manufacturer's printed instructions for cleaning and maintenance of the products.

#### 1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Subcontractor shall not install tracks or curtains until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceiling is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for project when occupied for its intended use.
- B. Inspect materials at delivery to assure that specified products have been received and are free of damage.
- C. Field measurements: Verify dimensions by field measurements before fabrication.
- D. Schedule with construction progress to avoid delaying the work.

#### 1.6 WARRANTY

- A. Provide a written warranty agreeing to repair or replace fabric curtains, hardware or materials due to faulty workmanship or installation for a period of one (1) year.

### PART 2 – PRODUCTS

#### 2.1 MANUFACTURER

- A. Provide curtain system as produced by one manufacturer.
- B. Approved manufacturer: ModoMed. 800.258.8817. [www.Modomed.com](http://www.Modomed.com)
- C. Or Approved Equal.

#### 2.2 MATERIALS

- A. Curtain Fabric: Provide curtains fabricated with the specified materials. No substitutions permitted.
  1. Manufacturer/Mill: As selected by Architect Pattern: Sure-Chek Vinyl without Mesh. 10 gauge thickness. Width and length as required to fully cover window openings as shown on drawings.
  2. Color: Chosen from full line of manufacturer's standard colors.
  3. Fabric Width: TBD
  4. Repeat: TBD

5. Railroaded/Non-Railroaded: Non-Railroaded.

B. Curtain Track:

1. Classic Track System

- a. Material: Extruded 6063 aluminum 0.06 wall thickness; satin anodized aluminum finish.
- b. Dimensions:  $\frac{3}{4}$  inches high by 1-3/8 inches wide
- c. Provide straight and bent sections as indicated on drawings.
- d. Provide factory fabricated curved track with 12-inch radius bends.
- e. Finish: Satin coat anodized aluminum.

2. Track Accessories:

- a. Splices: Aluminum Splices. (Part No. MTPSPICE-ALM).
- b. End Caps: Aluminum. (Part No. MTPEND-ALM).
- c. Spool Carriers: 2.5 carriers per linear foot (Part No. MTPCARR-98-S-25).
- d. Snap Out: Aluminum, provide one per each configuration (Part No. MTPSNAP-ALM)

2.3 FABRICATION

A. Fabricate curtains to comply with the following requirements:

B. Fabric to be tabled and squared.

C. Width: Equal to track length from which curtain is hung plus 10% added fullness, but not less than 12" of added fullness.

D. Length: Equal to ceiling to bottom of window sill height minus 2 inches from finished ceiling at top, and plus 6 inches below window sill at bottom.

E. Construction: Double lock stitched to top of curtain fabric, with a 1-1/4" wide triple thick top seam.

F. Grommets: Provide nickel-plated  $\frac{1}{2}$ " rust-proof grommets inserted in the top hem of mesh at 6" on center.

G. Hem Construction:

1. Top Hem: To be 1-1/2" wide, double thick and double lock stitched to mesh with a 1/2" wide seam.
2. Side and Bottom Hems: not less than 1" wide double thick and single stitched.
3. All hems and seams to be sewn with 100% mercerized cotton thread. Nylon thread is not acceptable.
4. All seams to be flat with no puckering.

H. Vertical Seams (for non-railroaded fabrics or panel construction only): Not less than  $\frac{1}{2}$ " wide, double thick and double stitched.

I. Fabric Railroaded: Fabrics are to be railroaded when possible to provide a seamless curtain. All other patterns are to be pattern matched and sewn with vertical seams.

- J. Maintenance labels: Each curtain is to have a ModoMed label sewn into the top fabric seam. Label indicates materials meet Standards and Regulations, also indicates the size.

### **PART 3 – EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, adjoining construction and conditions under which the work is to be installed. The work shall not proceed until unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Install all materials level and plumb, according to manufacturer's written instructions.
- B. Surface Mounted Track: Fasten surface-mounted tracks at intervals of not more than 24 inches and within 4 inches of end of track. Fasten support at each splice and tangent point of each corner. Center fasteners in track to ensure unencumbered carrier operation. Attach track to ceiling as follows:
  - 1. Mechanically fasten directly to bottom of concrete deck with anchor screws.
  - 2. Mechanically fasten directly to finished ceiling with toggle bolts.
  - 3. Mechanically fasten to furring through suspended ceiling with screw and tube spacer.
  - 4. Mechanically fasten to suspended ceiling grid with screws.
- C. Track Accessories: Install end caps, splices, pull outs, carriers, and other accessories as required for a secure and operational installation.
- D. Curtain Carriers: Provide curtain carriers adequate for 6 inch spacing along the full length of the curtain.
- E. Curtains: Hang curtains on each curtain track. Test for smooth operation of carriers.

#### **3.3 PROTECTION**

- A. Protect installed products until the completion of the project.
- B. Touch-up, repair, or replace damaged products prior to final acceptance by District.
- C. Remove debris and clean surfaces per manufacturer's instructions upon completion.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 09/30/2022 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

## SECTION 21 00 50

## BASIC FIRE SPRINKLER MATERIALS AND METHODS

**PART 1 - GENERAL**

## 1.01 SUMMARY

## A. Section Includes:

1. Electric motors.
2. Motor starters.
3. Valve Boxes.
4. Access doors.
5. Expansion loops.
6. Insulation.

## 1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. This Section is part of each Division 21 Section.

## 1.03 ADDITIONAL REQUIREMENTS

- A. Furnish and install incidental work not shown or specified necessary to provide a complete and workable system.
- B. Make temporary connections required to maintain services during the course of the Contract without additional cost to Owner. Notify Owner seven days in advance before interrupting services.

## 1.04 REFERENCES AND STANDARDS

- A. Where material or equipment is specified to conform to referenced standards, it shall be assumed that the most recent edition of the standard in effect at time of bid shall be used.
  1. ANSI - American National Standards Institute.
  2. ASME - American Society of Mechanical Engineers.
  3. ASTM - American Society for Testing and Materials.
  4. CCR - California Code of Regulations.
    - a. Title 8 - Division of Industrial Safety, Subchapter 7; General Industry Safety Orders, Articles 31 through 36.
  5. NCPWB - National Certified Pipe Welding Bureau.
  6. CEC - California Electrical Code.
  7. NEMA - National Electrical Manufacturers' Association.
  8. NFPA - National Fire Protection Association, as amended by the CBC.
  9. OSHA - Occupational Safety and Health Act.

10. UL - Underwriters' Laboratories, Inc.

B. Requirements of Regulatory Agencies:

1. The publications listed below form part of this Specification. Comply with provisions of these publications except as otherwise shown or specified.
  - a. California Building Code, 2022.
  - b. California Electrical Code, 2022.
  - c. California Energy Code, 2022.
  - d. California Fire Code, 2022.
  - e. California Green Building Standards Code, 2022.
  - f. California Mechanical Code, 2022.
  - g. California Plumbing Code, 2022.
  - h. California Code of Regulations, Title 24.
  - i. California Health and Safety Code.
  - j. CAL-OSHA.
  - k. California State Fire Marshal, Title 19 CCR.
  - l. DSA - Division of the State Architect. Interpretive Regulations (IR's).
  - m. National Fire Protection Association, as amended by the CBC.
  - n. Occupational Safety and Health Administration.
  - o. Other applicable state laws.
2. Nothing in Drawings or Specifications shall be construed to permit work not conforming to these codes, or to requirements of authorities having jurisdiction. It is not the intent of Drawings or Specifications to repeat requirements of codes except where necessary for clarity.

1.05 DRAWINGS

- A. Examine Contract Documents prior to bidding of Work and report discrepancies in writing to Architect.
- B. Drawings showing location of equipment and materials are diagrammatic and job conditions will not always permit installation in location shown. The fire protection Drawings show general arrangement of equipment and materials, etc., and shall be followed as closely as existing conditions, actual building construction, and work of other trades permit.
  1. Architectural and structural Drawings are part of the Work. These Drawings furnish Contractor with information relating to design and construction of the Project. Architectural Drawings take precedence over fire protection Drawings.
  2. Because of the small scale of fire protection Drawings, not all offsets, fittings, and accessories required are shown. Investigate structural and finish conditions affecting the Work and arrange Work accordingly. Provide offsets, fittings, and accessories required to meet conditions. Inform Architect immediately when job conditions do not permit installation of equipment and materials in locations shown. Obtain Architects' approval prior to relocation of equipment and materials.
  3. Relocate equipment and materials installed without prior approval of Architect. Remove and relocate equipment and materials at Contractors' expense upon Architects' direction.



4. Minor changes in locations of equipment, piping, ducts, etc., from locations shown shall be made when directed by the Architect at no additional cost to the Owner providing such change is ordered before such items of work, or work directly connected to same are installed and providing no additional material is required.
- C. Execute work mentioned in Specifications and not shown on Drawings, or vice versa, the same as if specifically mentioned or shown in both.

#### 1.06 FEES AND PERMITS

- A. Obtain and pay for permits and service required in installation of the Work. Arrange for required inspections and secure approvals from authorities having jurisdiction. Comply with the requirements of Division 01.
- B. Arrange for utility connections and pay charges incurred, including excess service charges.
  1. Bear the cost of construction related to utility services, from point of connection to utility services shown on Contract Documents. This includes piping, excavation, backfill, meters, boxes, check valves, backflow prevention devices, general service valves, concrete work, and the like, whether or not Work is performed by Contractor, local water/sanitation district, public utility, other governmental agencies or agencies' assigns.
- C. Obtain permits to operate compressed air tanks required to be furnished as part of this Work. Pay costs, and perform tests required to obtain permits. Post permits framed under glass in a conspicuous place on or near tanks, or as required by authorities having jurisdiction.

#### 1.07 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  1. General:
    - a. Coordinate Work in this Section with trades covered in other Specification Sections to provide a complete and operable installation of highest quality workmanship.
  2. Electrical Coordination:
    - a. Refer to the Electrical Drawings and Specifications, Division 26, for service voltage and power feed wiring for equipment specified in this Section. Contractor has full responsibility for the following items of work:
      - 1) Review the Electrical Drawings and Division 26 Specifications to verify that electrical services provided are adequate and compatible with equipment requirements.
      - 2) If additional electrical services are required above that indicated on Electrical Drawings and in Division 26, such as more control interlock conductors, larger feeder, or separate 120 volt control power source, include cost to furnish and install additional electrical services as part of bid.
      - 3) Prior to proceeding with installation of additional electrical work, submit detailed drawings indicating exact scope of additional electrical work.

3. Mechanical Coordination:

- a. Arrange for pipe spaces, chases, slots and openings in building structure during progress of construction, to accommodate mechanical system installation.
- b. Coordinate installation of supporting devices. Set sleeves in poured-in-place concrete and other structural components during progress of construction.
- c. Coordinate requirements for access panels and doors for mechanical items requiring access where concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.08 SUBMITTALS - GENERAL

- A. Refer to Division 01 Submittals Section(s) for additional requirements.
- B. Provide submittal of materials proposed for use as part of this Project. Product names in Specifications and on Drawings are used as standards of quality. Furnish standard items on specified equipment at no extra cost to the Contract regardless of disposition of submittal data. Other materials or methods shall not be used unless approved in writing by Architect. Architect's review will be required even though "or equal" or synonymous terms are used.
  1. Partial or incomplete submittals will not be reviewed.
  2. Quantities are Contractor's responsibility and will not be reviewed.
  3. Provide materials of same brand or manufacturer for each class of equipment or material.
  4. Identify each item by manufacturer, brand, trade name, number, size, rating, or other data necessary to properly identify and review materials and equipment. Words "as specified" are not sufficient identification.
  5. Identify each submittal item by reference to items' Specification Section number and paragraph, by Drawing and detail number, and by unit tag number.
  6. Organize submittals in same sequence as in Specification Sections.
  7. Show physical arrangement, construction details, finishes, materials used in fabrications, provisions for piping entrance, access requirements for installation and maintenance, physical size, mechanical characteristics, foundation and support details, and weight.
    - a. Submit shop drawings, performance curves, and other pertinent data, showing size and capacity of proposed materials.
    - b. Specifically indicate, by drawn detail or note, that equipment complies with each specifically stated requirement of Contract Documents.
    - c. Drawings shall be drawn to scale and dimensioned (except schematic diagrams). Drawings may be prepared by vendor but must be submitted as instruments of Contractor, thoroughly checked and signed by Contractor before submission to Architect for review.
    - d. Catalog cuts and published material may be included with supplemental scaled drawings.
- C. Review of submittals will be only for general conformance with design concept and general compliance with information given in Contract Documents. Review will not include quantities, dimensions, weights or gauges, fabrication processes, construction methods, coordination with work of other trades, or construction safety precautions, which are sole responsibility of Contractor. Review of a component of an assembly does not indicate acceptance of an assembly. Deviations from Contract Documents not clearly identified by Contractor are Contractor's responsibility and will not be reviewed by Architect.

- D. Within reasonable time after award of contract and in ample time to avoid delay of construction, submit to Architect shop drawings or submittals on all items of equipment and materials provided. Provide submittal in at least seven copies and in complete package.
  - 1. Shop drawings and submittals shall include Specification Section, Paragraph number, and Contract Drawing unit symbol or detail number for reference. Organize submittals into booklets for each Specification section and submit in loose-leaf binders with index. Deviations from Contract Documents shall be clearly identified and appear at the beginning of submittal package and shall be referenced to applicable Contract Documents requirements.
- E. Furnish to Project Inspector complete installation instructions on material and equipment before starting installation.

#### 1.09 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for fire protection systems materials and products.
- B. Shop Drawings.
- C. Provide product data for insulation products, including insulation, insulation facings, jackets, adhesives, sealants, and coatings, indicating compliance with requirement that these products contain less than 0.1 percent (by mass) polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations.
- D. Product Data for California Green Building Standards Code Compliance: For adhesives and sealants, including primers, documentation of compliance including printed statement of VOC content and chemical components.
- E. Sustainable Design Submittals:
  - 1. Product Data: For adhesives and sealants, documentation of compliance including printed statement of VOC content and chemical components.
  - 2. Laboratory Test Reports: For adhesives and sealants, indicating compliance with requirements for low-emitting materials.

#### 1.10 INFORMATIONAL SUBMITTALS

- A. Provide coordination drawings for fire protection systems in accordance with the requirements of Specification Section 21 10 00.
- B. Provide layouts for fire protection systems, for inclusion in coordinated layout specified in Section 23 80 00. Comply with requirements for layouts specified in Section 23 80 00.

#### 1.11 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:
  - 1. Refer to Division 01 for complete instructions.

2. Furnish three complete sets of Operating and Maintenance Manual bound in hardboard binder, and one compact disc containing complete Operating and Maintenance Manual in searchable PDF format. Provide Table of Contents. Provide index tabs for each piece of equipment in binder and disc. Start compiling data upon approval of submittals.
  - a. Sets shall incorporate the following:
    - 1) Product Data.
    - 2) Shop Drawings.
    - 3) Record Drawings.
    - 4) Service telephone number, address and contact person for each category of equipment or system.
    - 5) Complete operating instructions for each item of fire sprinkler system.
      - a) Original manual of NFPA-25 for fire sprinkler system.
    - 6) Copies of guarantees/warranties for each item of equipment or systems.
    - 7) Test data as specified.
    - 8) Typewritten maintenance instructions for each item of equipment listing lubricants to be used, frequency of lubrication, inspections required, adjustment, etc.
    - 9) Manufacturers' bulletins with parts numbers, instructions, etc., for each item of equipment.
    - 10) A complete list or schedule of scheduled valves giving the number of the valve, location and the rooms or area controlled by the valve. Identify each valve with a permanently attached metal tag stamped with number to match schedule. Post list in frame under plastic on wall in mechanical room or where directed by Architect.
    - 11) Check test and start reports for each piece of fire protection equipment provided as part of the Work.
    - 12) Commissioning and Preliminary Operation Tests required as part of the Work.
  - b. Post service telephone numbers and addresses in an appropriate place designated by Architect.
- B. Record Drawings:
  1. Refer to Division 01, Record Documents, for requirements governing Work specified herein.
  2. Upon completion of the work, deliver to Architect the following:
    - a. Originals of drawings showing the Work exactly as installed.
    - b. One complete set of reproducible drawings showing the Work exactly as installed.
    - c. One compact disc with complete set of drawings in PDF format showing the Work exactly as installed.
    - d. Provide Contractor's signature, verifying accuracy of record drawings.
    - e. Obtain the signature of the Project Inspector for all record drawings.

## 1.12 SUBSTITUTIONS

- A. Refer to Division 01 for complete instructions. Requirements given below are in addition to or are intended to amplify Division 01 requirements. In case of conflict between requirements given in this Section and those of Division 01, Division 01 requirements shall apply.
- B. It is the responsibility of Contractor to assume costs incurred because of additional work and or changes required to incorporate proposed substitute into the Project. Refer to Division 01 for complete instructions.
- C. Substitutions will be interpreted to be manufacturers other than those specifically listed in Contract Documents by brand name, model, or catalog number.
- D. Only one request for substitution will be considered for each item of equipment or material.
- E. Substitution requests shall include the following:
  - 1. Reason for substitution request.
  - 2. Complete submittal information as described herein; see "Submittals."
  - 3. Coordinated scale layout drawings depicting position of substituted equipment in relation to other work, with required clearances for operation, maintenance and replacement.
  - 4. List optional features required for substituted equipment to meet functional requirements of the system as indicated in Contract Documents.
  - 5. Explanation of impact on connected utilities.
  - 6. Explanation of impact on structural supports.
- F. Installation of reviewed substitution is Contractors' responsibility. Any mechanical, electrical, structural, or other changes required for installation of substituted equipment or material must be made by Contractor without additional cost to Owner. Review by Architect of substituted equipment or material, will not waive these requirements.
- G. Contractor may be required to compensate Architect for costs related to substituted equipment or material.

## 1.13 DELIVERY, STORAGE AND HANDLING

- A. Protect equipment and materials delivered to Project site from weather, humidity and temperature variations, dirt, dust and other contaminants.

## 1.14 FIELD CONDITIONS

- A. Contractor shall visit Project site and examine existing conditions in order to become familiar with Project scope. Verify dimensions shown on Drawings at Project site. Bring discrepancies to the attention of Architect. Failure to examine Project site shall not constitute basis for claims for additional work because of lack of knowledge or location of hidden conditions that affect Project scope.
- B. Information on Drawings relative to existing conditions is approximate. Deviations from Drawings necessary during progress of construction to conform to actual conditions shall be approved by Architect and shall be made without additional cost to Owner. The Contractor shall be held

responsible for damage caused to existing services. Promptly notify Architect if services are found which are not shown on Drawings.

#### 1.15 WARRANTY

- A. Refer to Division 01 for warranty requirements, and duration and effective date of Contractor's Standard Guarantee.
- B. Repair or replace defective work, material, or part that appears within warranty period, including damage caused by leaks.
- C. On failure to comply with warranty requirements within a reasonable length of time after notification is given, Architect/Owner shall have repairs made at Contractor's expense.

### PART 2 - PRODUCTS

#### 2.01 GENERAL

- A. Materials or equipment of the same type shall be of the same brand wherever possible. All materials shall be new and in first class condition.
- B. All sizes, capacities, and efficiency ratings shown are minimum.
- C. Refer to Section 21 10 00 for specific system piping materials.

#### 2.02 MATERIALS

- A. No material installed as part of this Work shall contain asbestos.
- B. California Green Building Code Compliance:
  - 1. Fire protection equipment shall not contain CFCs.
  - 2. Fire protection equipment shall not contain Halons.

#### 2.03 ELECTRIC MOTORS

- A. U.S. Motors, Century Electric, General Electric, Lincoln, Gould or equal. Minimum efficiencies shall be as defined by IEEE 112 Test Method B and NEMA MG1. Provide NEMA 3R enclosure where exposed to outdoors.

#### 2.04 MOTOR STARTERS

- A. Square D, Allen Bradley, or equal, in NEMA Type 1 enclosure, unless otherwise specified or required. Minimum starter size shall be Size 1. Provide NEMA 3R enclosure where exposed to outdoors.
- B. Where three phase motors are provided for two-speed operation, provide two speed motor starters.
  - 1. All three-phase starters shall have the following:

- a. Provide magnetic motor starters for equipment provided under the fire protection Work. Starters shall be non-combination type. Provide part winding or reduced voltage start motors where shown or as hereinafter specified. Minimum size starter shall be Size 1.
- b. Cover mounted hand-off-automatic switch. Starters installed exposed in occupied spaces shall have key operated HOA switch.
- c. Three ambient compensated thermal overload.
- d. Fused control transformer (for 120 or 24 volt service).
- e. Pilot lights, integral with starters. Starters located outdoors shall be installed in NEMA IIIIR enclosures.

## 2.05 VALVE BOXES

### A. General:

1. Where several valves or other equipment are grouped together, provide larger boxes of rectangular "vault" type adequately sized for condition and similar in construction to those specified above.
  2. Provide valve box extensions as required to set bottom of valve box tight up to top of piping in which valve is installed.
  3. Provide a tee handle wrench for each size, Alhambra Foundry Co. #A-3008, or equal.
- B. Valve Boxes in Traffic Areas: Provide Christy No. G5 traffic valve box, Brooks, or equal, 10-3/8 inches inside diameter with extensions to suit conditions, with cast iron or steel locking cover. Provide Owner with set of special wrenches or tools as required for operation of valves.
- C. Valve Boxes in Non-Traffic Areas: Provide Christy No. F22, Brooks, or equal, 8 inches inside diameter by 30 inches long, with cast iron or steel locking cover. Provide Owner with set of special wrenches or tools as required for operation of valves. Cut bottom of plastic body for operation of valves.
- D. Valve Box (Rectangular Vault Type): Precast concrete or cast iron with cast iron or steel locking type covers lettered to suit service – Brooks No. 3-TL, Christy No. B3, Fraser No. 3, Alhambra A-3004 or A-3005, Alhambra E-2202, or E-2702, or equal, with extension to suit conditions.

## 2.06 ACCESS DOORS

- A. Where floors, walls, or ceilings must be penetrated for access to fire protection equipment or devices, provide access doors, 14 inch by 14 inch minimum size in usable opening. Where entrance of a serviceman may be required, provide 20 inch by 30 inch minimum usable opening. Locate access doors/panels for non-obstructed and easy reach.
1. Access doors less than 7'-0" above floors and exposed to public access shall have keyed locks.
- B. Access doors shall match those supplied in Division 08, except as noted in this Section.
- C. Provide stainless steel access doors for use in toilet rooms, shower rooms, kitchens and other damp areas. Provide steel access doors with prime coat of baked-on paint for other areas.
- D. Do not locate access doors in highly visible public areas such as lobbies, waiting areas, and primary entrance areas. Coordinate with Architect when access is required in these areas.

- E. Where specific information or details relating to access panels different from the above is shown or given on Drawings or other Divisions of work, that information shall supersede this specification.
- F. Manufacturers: Subject to compliance with requirements, available manufacturers offering products which may be incorporated into the Work include Milcor, Karp, Nystrom, or Cesco, equal to the following:
  - 1. Milcor:
    - a. Style K (plaster)
    - b. Style DW (gypsum board)
    - c. Style M (masonry)
    - d. Style "Fire Rated" where required

## 2.07 EXPANSION LOOPS

- A. Manufactured assembly consisting of inlet and outlet elbow fittings, two sections of flexible metal hose and braid, and 180-degree return bend or center section of flexible hose. Flexible hose shall consist of corrugated metal inner hose and braided outer sheath. Provide UL listed assembly selected for 4 inches of movement.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
  - 1. Metraflex Inc., Fireloop series.
  - 2. Unisource Manufacturing, Inc., V series.

## 2.08 EQUIPMENT IDENTIFICATION

- A. Identify each piece of equipment with a permanently attached engraved bakelite plate, 1/2 inch high white letters on black background.
- B. Text of Signs: Provide identification of equipment unit number, and room or area served. Coordinate name of area served with final room names and numbers for the facility. In addition, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

## 2.09 PIPE IDENTIFICATION

- A. Identify each piping system and indicate the direction of flow by means of Seton, Inc., Marking Services Inc., Reef Industries, Inc., or equal, pre-tensioned, coiled semi-rigid plastic pipe labels formed to circumference of pipe, requiring no fasteners or adhesive for attachment to pipe.
- B. The legends and flow arrows shall conform to ASME A13.1.

## 2.10 INSULATION WORK

- A. General:



1. Adhesives shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
2. Adhesives and 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."
3. The term "piping" used herein includes pipe, valves and fittings.
  - a. Apply insulating cement to fittings, valves and strainers and trowel smooth to equal the thickness of adjacent covering. Cover with jacket to match piping. Extend covering on valves up to bonnet. Leave strainer cleanout plugs accessible.
  - b. Provide pre-formed PVC valve and fitting covers.
  - c. Provide Calcium Silicate rigid insulation and sheet metal sleeve, 18 inch minimum length at each pipe hanger. Seal ends of insulation to make vapor tight with jacket.
4. Test insulation, jackets, and lap-seal adhesives as a composite product and confirm flame spread of not more than 25 and a smoke developed rating of not more than 50 when tested in accordance with UL723, ASTM E84, or NFPA 255.
5. Clean thoroughly, test and have approved, piping and equipment before installing insulation and/or covering.
6. Repair damage to existing pipe insulation whether or not caused during Work of the Contract, to match existing adjacent insulation for thickness and finish, but conforming to flame spread and smoke ratings specified above.

B. Insulation of Piping:

1. Insulate fire protection piping located outside building exposed to weather with minimum 3-1/2 pounds per cubic foot density fiberglass with ASJ-SSL jacket. Insulation thickness for all pipe sizes: 2 inches.
2. Where insulated piping is exposed to the weather apply aluminum jacket secured with 1/2-inch stainless-steel bands on 12-inch centers. Insulation shall be vapor tight before applying metal jacket, and aluminum fitting covers. Install jacketing with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Cover fittings with glass cloth, two coats of Foster Sealfas 30-36, and factory-fabricated aluminum fitting covers, of same material, finish, and thickness as jacket. Insulation shall be vapor tight before applying metal jacket and fitting covers.
  - a. Fitting covers:
    - 1) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    - 2) Tee covers.
    - 3) Flange and union covers.
    - 4) End caps.
    - 5) Beveled collars.
    - 6) Valve covers.
    - 7) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
  - b. Pipes 10 inches diameter and smaller: Minimum .016-inch-thick jacket.
  - c. Pipes 12 inches diameter and larger: Minimum .020-inch-thick jacket.

**PART 3 - EXECUTION****3.01 EXISTING MATERIALS**

- A. Remove existing equipment, piping, wiring, construction, etc., which interferes with Work of this Contract. Promptly return to service upon completion of work in the area. Replace items damaged by Contractor with new material to match existing.
- B. Removed materials which will not be reinstalled, and which are not claimed by Owner shall become property of Contractor and shall be removed from Project site. Consult Owner before removing any material from Project site. Carefully remove materials claimed by Owner to prevent damage and deliver to Owner-designated storage location.
- C. Existing piping and wiring not reused and are concealed in building construction may be abandoned in place and all ends shall be capped or plugged. Remove unused piping and wiring exposed in Equipment Rooms or occupied spaces. Material shall be removed from Project premises. Disconnect power, water, gas, pump or any other active energy source from piping or electrical service prior to abandoning in place.
- D. Existing piping and equipment modified or altered as part of this Work shall comply with the most recent applicable code requirements.

**3.02 FRAMING, CUTTING AND PATCHING**

- A. Special framing, recesses, chases and backing for Work of this Section, unless otherwise specified, are covered under other Specification Sections.
- B. Contractor is responsible for placement of pipe sleeves, hangers, inserts, supports, and location of openings for the Work.
- C. Cutting, patching, and repairing of existing construction to permit installation of equipment, and materials is responsibility of Contractor. Repair or replace damage to existing work with skilled mechanics for each trade.
- D. Cut existing concrete construction with a concrete saw. Do not utilize pneumatic devices.
- E. Core openings through existing construction for passage of new piping and conduits. Cut holes of minimum diameter to suit size of pipe and associated insulation installed. Coordinate with building structure, and obtain Structural Engineer's approval prior to coring through existing construction.

**3.03 DEMOLITION**

- A. Refer to Division 01 Sections "Cutting and Patching" and/or "Selective Demolition" for general demolition requirements and procedures.
- B. Disconnect, dismantle and remove fire protection systems, equipment, and components indicated to be removed. Coordinate with all other trades.
  - 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 to remain with same or compatible piping material.
  3. Equipment to Be Removed: Drain down and cap remaining 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.

### 3.04 ELECTRICAL REQUIREMENTS

- A. Provide adequate working space around electrical equipment in compliance with the California Electrical Code. Coordinate the fire protection Work with the electrical Work to comply.
- B. Furnish necessary control diagrams and instructions for controls. Before permitting operation of equipment which is furnished, installed, or modified under this Section, Contractor shall review associated electrical work, including overload protection devices, and assume complete responsibility for correctness of electrical connections and protective devices. Motors and control equipment shall conform to the Standards of the National Electrical Manufacturers' Association. Equipment and connections exposed to weather shall be installed in NEMA IIIR enclosures with factory wired strip heaters in each starter enclosure and temperature control panel where required to inhibit condensation.
- C. All line voltage and low voltage wiring and conduit associated with fire protection system are included in this Section. Wiring and conduit shall comply with Division 26.
- D. Electric Motors:
1. Motors shall be rated for continuous operation at 115% of nameplate amperage but shall be selected to operate at less than nameplate amperage throughout entire operating cycle. Motors found to exceed nameplate amperage shall be promptly replaced at no cost to Owner. Horsepower shown is minimum and shall be increased as necessary to comply with above requirements. Furnish motors with splash-proof or weatherproof housings, where required or recommended by motor manufacturer. Match the nameplate voltage rating with electrical service supplied. Check electrical Drawings. Provide transformer for each motor not wound specifically for system voltage.
- E. Motor Starters:
1. Provide magnetic motor starters for equipment provided under the fire protection Work. Starters shall be non-combination type. Provide part-winding or reduced voltage start motors on motors 50 – HP and larger, or where shown or as hereinafter specified. Minimum size starter shall be Size 1. Three-phase starters shall have the following:
    - a. Cover-mounted hand-off-automatic switch. Starters installed exposed in occupied spaces shall have key operated HOA switch.
    - b. Three ambient compensated thermal overload.

- c. Fused control transformer (for 120 or 24 volt service).
  - d. Pilot lights, integral with the starters. Starters located outdoors shall be in NEMA IIR enclosures.
- 2. Starters for single-phase motors shall have thermal overloads, Westinghouse Type MSTOLSLIP, Square D, or equal, toggle-operated with pilot light, NEMA I enclosure for starters located indoors, NEMA IIR enclosure for starters located outdoors.
  - 3. Provide OSHA label indicating that the device starts automatically.

### 3.05 PIPING SYSTEM REQUIREMENTS

- A. Drawing plans, schematic and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

### 3.06 PRIMING AND PAINTING

- A. Perform priming and painting on the equipment and materials as specified herein.
- B. See Division 09 Painting Section(s) for detailed requirements.
- C. Priming and Painting:
  - 1. Exposed ferrous metals, including piping, which are not galvanized or factory-finished shall be primed and painted.
    - a. Black Steel Piping:
      - 1) Primer: One coat gray Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, comparable products by Rust-Oleum, Kelly Moore, or equal.
      - 2) Topcoat: Two coats gray Sherwin-Williams Pro Industrial Waterbased Alkyd Urethane Enamel, comparable products by Rust-Oleum, Kelly Moore, or equal.
  - 2. Metal surfaces of items to be jacketed or insulated except piping shall be given two coats of primer unless furnished with equivalent factory finish. Items to be primed shall be properly cleaned by effective means free of rust, dirt, scale, grease and other deleterious matter and then primed with the highest grade zinc rich primer. After erection or installation, primed surfaces shall be properly cleaned of foreign or deleterious matter that might impair proper bonding of subsequent paint coatings. Abrasion or other damage to shop or field prime coat shall be properly repaired and touched up with same material used for original priming.
  - 3. Where equipment is provided with nameplate data, the nameplate shall be masked off prior to painting. When painting is completed, remove masking material.

### 3.07 EXCAVATING

- A. Perform excavating required for Work of this Section. Provide the services of a pipe/cable locating service prior to excavating activities to determine location of existing utilities.

- B. Unless shown otherwise, provide 3 foot minimum cover for fire piping, or 1 foot below frost line, whichever results in deepest installation. Trim trench bottom by hand or provide a 4 inch deep minimum bed of sand to provide a uniform grade and firm support throughout entire length of pipe. For PVC pipe, bed pipe in 4 inch sand bed. Pipe bedding materials should be clean crushed rock, gravel or sand of which 100 percent will pass a 1 inch sieve. For pipes that are larger than 10 inches in diameter, at least 95 percent should pass a 3/4 inch sieve, and for pipes 10 inches in diameter or smaller, 100 percent should pass a 1/2 inch sieve. Other materials should have minimum sand equivalent of 50. Only a small proportion of native soils will meet these requirements without extensive processing; therefore, importation of pipe bedding materials should be anticipated. Pipe bedding materials shall be compacted in lifts not exceeding 6 inches in compacted thickness. Each lift shall be compacted to not less than 90 percent relative compaction at or above the optimum moisture content, in accordance with ASTM Specification D2940, except that bedding materials graded such that less than 100 percent will pass a No. 200 sieve shall be compacted in 6 inch lifts using a single pass of a flat-plate, vibratory compactor or vibratory drum. Pipe bedding materials should extend at least to the spring line.
- C. Maintain warning signs, barricades, flares, and red lanterns as required.
- D. For trenches 5 feet or more in depth, submit copy of permit, and detailed drawings showing shoring, bracing, sloping, or other provisions to be made for worker protection from hazard of caving ground during excavation of such trenches. Obtain a permit from Division of Industrial Safety prior to beginning excavations. A copy of permit shall be available at the Project site.

### 3.08 BACKFILLING

- A. Backfill shall comply with applicable provisions of Division 31 of these Specifications.
- B. Except under existing or proposed paved areas, walks, roads, or similar surfaces, backfill for other types of pipe shall be made using suitable excavated material or other approved material. Place backfill in 8 inch layers, measured before compaction, and compact with impact hammer to at least 90 percent relative compaction per ASTM D2940.
  - 1. Backfill plastic pipe and insulated pipe with sand for minimum distance of 12 inches above the top of pipe. Compact using mechanical tamping equipment.
- C. Entire backfill for excavations under existing or proposed pavements, walks, roads, or similar surfaces, under new slabs on grade, shall be made with clean sand compacted with mechanical tamping equipment vibrator to at least 90 percent relative compaction per ASTM D2940. Remove excess earth. Increase minimum compaction within uppermost two feet of backfill to 95 percent.
- D. Replace or repair to its original condition sod, concrete, asphalt paving, or other materials disturbed by trenching operation. Repair within warranty period.
- E. Thrust Blocks:
  - 1. Provide concrete anchors or thrust blocks on PVC and cast iron water lines installed underground. Install thrust blocks at changes in direction and at connections to mains 1-1/2 inches and larger. Form thrust blocks by pouring concrete between pipes and trench wall. Thrust blocks shall be adequate in size and placed to take thrusts created by the maximum internal

water pressure; sizing and placement shall be per manufacturer's recommendations and in accordance with requirements of NFPA 24.

2. Anchor piping to building construction.

### 3.09 PIPING SYSTEMS INSTALLATION

- A. At time of final connection, and prior to opening valve to allow pressurization of water piping from existing systems, on site or off site, perform a pressure test to indicate static pressure of existing systems. If pressure on fire protection piping is greater than 175 psi, inform Architect immediately. Do not allow piping systems to be pressurized without written consent of the Architect.
- B. General:
  1. Piping shall be concealed unless shown or otherwise directed. Allow sufficient space for ceiling panel removal.
  2. Installation of piping shall be made with appropriate fittings. Bending of piping will not be accepted.
  3. Install piping to permit application of insulation where required and to allow valve servicing.
  4. Where piping or conduit is left exposed within a room, the piping or conduit shall be run true to vertical, horizontal, or intended planes. Where possible, uniform margins are to be maintained between parallel lines and/or adjacent wall, floor, or ceiling surfaces.
  5. Horizontal runs of pipes and/or electrical conduit suspended from ceilings shall provide for maximum headroom clearance. The clearance shall not be less than 6'-6" without written approval from Architect.
  6. Close ends of pipe immediately after installation. Leave closure in place until removal is necessary for completion of installation.
  7. Each piping system shall be thoroughly flushed and proved clean before connection to equipment.
  8. Install exposed polished or enameled connections with special care showing no tool marks or threads at fittings.
  9. Install horizontal valves with valve stem above horizontal.
  10. Use reducing fittings; bushings shall not be allowed. Use eccentric reducing fittings wherever necessary to provide free drainage of lines and passage of air.
  11. Verify final equipment locations for roughing-in.
  12. Service Markers: Mark location of each plugged or capped pipe with 4 inch round by 30 inch long concrete marker, set flush with finished grade. Provide 2-1/2 inch diameter engraved brass plate as part of service marker.
  13. Where piping is installed in walls within one inch of face of stud, provide 16 gauge sheet metal shield plate on face of stud. The shield plate shall extend minimum 1-1/2 inches beyond outside diameter of pipe.
- C. Expansion Loops:
  1. Install expansion loops where piping crosses building expansion or seismic joints, between buildings, between buildings and canopies, and as indicated on Drawings.
  2. Install expansion loops of sizes matching sizes of connected piping.
  3. Install grooved-joint expansion joints to grooved-end steel piping.

4. Materials of construction and end fitting type shall be consistent with pipe material and type of gas or liquid conveyed by piping system in which expansion loop is installed.

D. Sleeves:

1. Install Adjust-to-Crete, Pipeline Seal and Insulator, or equal, pipe sleeves of sufficient size to allow for free motion of pipe, 24 gauge galvanized steel. The space between pipe and sleeves through floor slabs on ground, through outside walls above or below grade, through roof, and other locations, as directed, shall be caulked with oakum and mastic and made watertight. The space between pipe and sleeve and between sleeve and slab or wall shall be sealed watertight.
2. At Contractor's option, Link-Seal, Metraflex Metraseal, or equal, casing seals may be used in lieu of caulking. Wrap pipes through slabs on grade with 1 inch thick fiberglass insulation to completely isolate pipe from concrete.

E. Floor, Wall, and Ceiling Plates:

1. Fit pipes, with or without insulation, passing through walls, floors, or ceilings, and hanger rods penetrating finished ceilings with chrome-plated or stainless escutcheon plates.

F. Firestopping:

1. Pack annular space between pipe sleeves and pipe through floors and walls with UL listed fire stop, and seal at ends. Pipe penetrations shall be UL listed, Hilti, 3M Pro-Set, or equal.
  - a. Install fire caulking behind fire protection services installed within fire rated walls, to maintain continuous rating of wall construction.
2. Provide SpecSeal Systems UL fire rated sleeve/coupling penetrators, or equal, for each pipe penetration or fixture opening passing through floors, walls, partitions or floor/ceiling assemblies. Penetrators shall comply with UL Fire Resistance Directory (Latest Edition), and with Chapter 7, CBC requirements.
3. Sleeve penetrators shall have built in anchor ring for waterproofing and anchoring into concrete pours or use special fit cored hole penetrator for cored holes.
4. Copper and steel piping shall have SpecSeal, or equal, plugs on both sides of penetrator to reduce noise and to provide waterproofing.
5. All above systems to be installed in strict accordance with manufacturer's instructions.
6. Alternate firestopping systems are acceptable if approved as equal. Contractor is responsible for determining suitability of alternate products for their intended use, and shall assume all risks and liabilities in connection with the use of alternate products.

G. Flashing:

1. Flashing for penetrations of metal or membrane roof for fire protection items shall be coordinated with roofing manufacturer and roofing installer for specific roofing type utilized. The work of this section shall include furnishing, layout, sizing, and coordination of penetrations required for fire protection work.
  - a. Furnish and install flashing and counterflashing in strict conformance with requirements of the roofing manufacturer. Submit shop drawing details for review prior to installation.

- b. Furnish and install counterflashing above each flashing required. Elmdor/Stoneman Model 1540, or equal.
2. For other types of roofing systems, furnish and install around each pipe, where pipe passes through roof, a flashing and counterflashing. Flashing shall be made of four pound seamless sheet lead with 6 inch minimum skirt and steel reinforced boot. Counterflashing shall be cast iron. Elmdor/Stoneman Model 1100-4, or equal.

#### H. Hangers and Supports:

1. General: Support equipment and piping so that it is firmly held in place by approved iron hangers and supports and special hangers as required. Hangers and supports shall be UL listed for fire protection service. Components shall support weight of equipment, pipe, fluid, and pipe insulation based on spacing between supports with minimum factor of safety of five based on ultimate strength of material used. Do not exceed manufacturer's load rating. Pipe attachments or hangers, shall be of same size as pipe or tubing on which used, or nearest size available. Architect shall approve hanger material before installation. Do not support piping with plumbers' tape, wire rope, wood, or other makeshift devices. Where building structural members do not match piping support spacing, provide "trapeze" (bridging) support members attached to building structural members by methods approved by structural Engineer.
  - a. Materials, design, and type numbers per Manufacturers' Standardization Society (MSS), Standard Practice (SP)-58.
2. Hanger components shall be provided by one manufacturer. B-Line, Grinnell, Tolco, Afcon, Loos & Co., Uni-Strut, or equal.
3. Hanger and Supports:
  - a. Vertical Piping: Tolco Fig. 6, or equal, clamps attached to pipe above each floor to rest on floor. Provide intermediate support for vertical piping greater than 25 feet in length.
  - b. Individually Suspended Piping: Tolco Fig. 200 or Fig. 1 Clevis, complete with threaded rod, or equal.

| <u>Pipe Size</u> | <u>Rod Size</u> |
|------------------|-----------------|
| 4" and Smaller   | 3/8"            |
| 5" to 6"         | 5/8"            |

- c. Trapeze Suspension: Sch-10 or Sch-40 steel pipe trapeze member in accordance with NFPA 13 published load ratings.
- d. Pipe Clamps and Straps: B-Line B2000 or B2400, Tolco, Fig. 200 or Fig. 1, or equal. Where used for seismic support systems, provide B-line B2400, Tolco fig. 69 series retainer pipe straps, or equal.
- e. Concrete Inserts: B-line B221 continuous insert or B2500 spot insert, or equal. Do not use actuated fasteners for support of overhead piping unless approved by Architect.
- f. Steel Connectors: Tolco Fig. 65 beam clamps with Fig. 69 retainer straps, or equal.



- g. Deck Connectors: Afcon Fig. 610 steel ceiling plate, or equal, where approved by structural Engineer.

4. Support to Structure:

- a. Wood Structure: Provide and install wood blocking as required to suit structure. Provide lag screws or through bolts with length to suit requirements, and with size (diameter) to match the size of hanger rods required.

- 1) Do not install Lag screws in tension without written review and acceptance by Structural Engineer.

|                      |                           |
|----------------------|---------------------------|
| Side Beam Angle Clip | B-Line B3062--MSS Type 34 |
| Side Beam Angle Clip | B-Line B3060              |
| Ceiling Flange       | B-Line B3199              |

- 2) Blocking for support of piping shall be not less than 2 inch thick for piping up to 2 inch size. Provide 3 inch blocking for piping up through 5 inch size, and 4 inch blocking for larger piping. Provide support for blocking in accordance with Structural Engineers requirements.
- 3) Where lag screws are used, length of screw shall be 1/2 inch less than the wood blocking. Pre-drill starter holes for each lag screw.

- b. Steel Structure: Provide and install additional steel bracing as required to suit structure. Provide through bolts with length to suit requirements of structural components. Burning or welding on structural member may only be done if approved by Architect.

5. Pipe hanger and support spacing: Locate hangers and supports at each change of direction, within one foot of elbow, and spaced per NFPA 13, and per pipe manufacturer's listing, except as noted below.
6. Provide support for piping through roof, arranged to anchor piping solidly in place at the roof penetration.
7. Provide rigid insulation and a 12 inch long, 18 gauge galvanized sheet iron shield between the covering and the hanger whenever hangers are installed on the outside of the pipe covering.
8. Insulate copper piping from ferrous materials and hangers with two layers of 3 inch wide, 10 mil polyvinyl tape wrapped around pipe.
9. Provide a support or hanger close to each change of direction of pipe either horizontal or vertical and as near as possible to concentrated loads.
10. Suspend rods from concrete inserts with removable nuts where suspended from concrete decks. Power actuated inserts will not be allowed.

### 3.10 UNION AND FLANGE INSTALLATION

- A. Install Watts, Epco, Nibco, or equal, dielectric unions or flanges at points of connection between copper or brass piping or material and steel pipe or material. Bushings or couplings shall not be used.

- B. Install unions in piping NPS 2" and smaller and flanges in piping NPS 2-1/2" and larger whether shown or not at each connection to equipment and tanks, and at connections to automatic valves.
- C. Locate unions for easy removal of equipment, tanks, or valves.

### 3.11 ACCESS DOOR INSTALLATION

- A. Furnish and install access doors wherever required whether shown or not for easy maintenance of fire protection systems. Access doors shall provide for complete removal and replacement of equipment.

### 3.12 CONCRETE WORK

- A. Concrete work required for Work of this Section shall be included under another section of the Specification, unless otherwise noted, including reinforced concrete bases for pumps, tanks, compressors unless the work is specifically indicated on Drawings to be furnished under this Section.
- B. Thrust blocks, underground anchors, and pads for cleanouts, valve access boxes and washer boxes are included under this Section of the Specifications. Concrete shall be 3000 psi test minimum. Refer to Division 03 for concrete types.

### 3.13 PIPE IDENTIFICATION

- A. Provide temporary identification of each pipe installed, at time of installation. Temporary identification shall be removed and replaced with permanent identification as part of the Work.
- B. Apply legend and flow arrow at valve locations; at points where piping enters or leaves a wall, partition, cluster of piping or similar obstruction, at each change of direction, and at approximately 20'-0" intervals on pipe runs. Variations or changes in locations and spacing may be made with approval of Architect. There shall be at least one marking in each room. Markings shall be located for maximum visibility from expected personnel approach.
  - 1. Apply legend and flow arrow at approximately 10'-0" intervals in science classrooms and science prep rooms.
- C. Wherever two or more pipes run parallel, markings shall be supplied in the same relative location on each.
- D. Apply markings after painting and cleaning of piping and insulation is completed.

### 3.14 EXPANSION ANCHORS IN HARDENED CONCRETE:

- A. Refer to Structural Drawings.
- B. Qualification Tests: The specific anchor shall have a current ICC-ES report and have been evaluated in cracked concrete in accordance with Acceptance Criteria AC193. The design shear and withdrawal load shall not be more than 80% of allowable load listed in the current ICC-ES report and manufacturer's recommendations for the specific anchor.

- C. Installation: The anchors must be installed in accordance with the requirements given in ICC Research Committee Recommendations for the specific anchor.
- D. Testing: Fifty percent of anchors shall be load-tested on each job to twice the allowable capacity in tension, except that if the design load is less than 75 pounds; only one anchor in ten need be tested. If any anchor fails, all anchors must be tested. The load test shall be performed in the presence of the project inspector.
- E. The load may be applied by any method that will effectively measure tension in the anchor, such as direct pull with a hydraulic jack, a torque wrench calibrated using the specific anchor, or calibrated spring-loading devices. Anchors in which torque is used to expand the anchor without applying tension to the bolt may not be verified with a torque wrench.

### 3.15 TESTS AND ADJUSTMENTS

- A. Test installations in accordance with the following requirements and all applicable codes:
  - 1. Project Inspector should witness tests of piping systems.
  - 2. Notify Architect at least seven days in advance of tests.
  - 3. Notify local fire department of time and date of fire systems testing.
  - 4. Piping shall be tested at completion of roughing-in, or at other times as directed by Architect.
  - 5. Furnish necessary materials, test pumps, gases, instruments and labor required for testing.
  - 6. Isolate from system equipment that may be damaged by test pressure.
  - 7. Make connections to existing systems with flanged connection. During testing of new work, provide a slip-in plate to restrict test pressure to new systems only. Remove plate and complete connection to existing system at completion of testing.
    - a. Project Inspector shall witness final connection to system.
- B. Test Schedule: No loss in pressure or visible leaks shall show after four hours at pressures indicated:

| <u>System Tested</u>  | <u>Test Pressure PSI</u> | <u>Test With</u>                    |
|-----------------------|--------------------------|-------------------------------------|
| Fire Sprinkler Piping | 200                      | Water                               |
| Compressed Air        | 200                      | Air & Non-corrosive Leak Test Fluid |
| Dry Standpipes        | 300                      | Water                               |
| Wet Standpipes        | 200                      | Water                               |

- 1. Piping, including underground piping, connected to fire sprinkler system shall be tested and certified in accordance with NFPA requirements, except where requirements listed in this Section exceed requirements of NFPA.
- 2. Non-corrosive leak test fluid shall be suitable for use with piping material specified, and with type of gas conveyed by piping system.

- C. Should material or work fail in any of these tests, it shall be immediately removed and replaced with new material, and portion of work replaced shall again be tested by Contractor at his own expense.
- D. Lubricate each item of equipment, including motors, before operation.

### 3.16 TRACER WIRE INSTALLATION

- A. Provide tracer wire for non-metallic water pipe in ground outside of buildings. Use AWG #14 tracer wire with blue colored low density high molecular weight polyethylene insulation, and lay continuously on pipe so that it is not broken or stressed by backfilling operations. Secure wire to the piping with tape at 18 inch intervals. Solder all joints.
- B. Terminals: Precast concrete box and cast iron locking traffic cover, Brooks 3TL, or equal; cover marked with name of service; 6 inches of loose gravel below box. Plastic terminal board with brass bolts; identify line direction with plastic tags. Test for continuity between terminals, after backfilling, in presence of Inspector.
- C. Alternate: Use electronically detectable plastic tape with metallic core, Terra Tape D, manufactured by Reef Industries, Inc., Seton, Inc., Marking Services, Inc., or equal; tape 2 inches wide, continuously imprinted "CAUTION WATER LINE BELOW". Install, with printed side up, directly over pipe, 18 inches below finish grade. Backfill material shall be as previously specified for the particular condition where pipe is installed, but avoid use of crushed rock or of earth with particles larger than 1/2 inch within the top 12 inches of backfill. Take precautions to ensure that tape is not damaged or misplaced during backfill operations. Terminal boxes not required.

### 3.17 CHECK, TEST AND START REQUIREMENTS

- A. An authorized representative of the equipment manufacturer shall perform check, test and start of each piece of fire protection equipment. The representative may be an employee of the equipment manufacturer, or a manufacturer-certified contractor. Submit written certification from the manufacturer stating that the representative is qualified to perform the check test and start of the equipment.
  - 1. As part of the submittal process, provide a copy of each manufacturer's printed startup form to be used.
  - 2. Some items of specified equipment may require that check, test and start of equipment must be performed by the manufacturer, using manufacturer's employees. See specific equipment Articles in these Specifications for this requirement.
  - 3. Provide all personnel, test instruments, and equipment to properly perform the check, test and start work.
  - 4. When work has been completed, provide copies of reports for review, prior to final observation of work.
- B. Provide copies of the completed check, test and start report of each item of equipment, bound with the Operation and Maintenance Manual.
- C. Upon completion of the work, provide a schedule of planned maintenance for each piece of equipment. Indicate frequency of service, recommended spare parts and methods for adjustment and alignment of all equipment components. Provide a copy of the schedule with each operating

and maintenance manual. Provide a copy of certification from the Owner's representative indicating that they have been properly instructed in maintenance requirements for the equipment installed.

### 3.18 COMMISSIONING AND PRELIMINARY OPERATIONAL TESTS

- A. Prior to observation to determine final acceptance, put fire protection systems into service and check that work required has been done, including but not limited to the following condensed check list. Provide indexed report to tabulating the results of tests.
  - 1. Equipment has been started, checked, lubricated and adjusted in accordance with manufacturer's recommendations.
  - 2. Correct rotation of motors and ratings of overload heaters are verified.
  - 3. All manufacturers' certificates of start-up specified have been delivered to Owner.
  - 4. All equipment has been cleaned, and damaged painted finishes touched up.
  - 5. Missing or damaged parts have been replaced.
  - 6. Flushing of piping systems has been completed and water treatment equipment, where specified, is completed.
  - 7. Equipment labels, pipe marker labels, ceiling markers and valve tags are installed.
  - 8. Valve tag schedules, corrected control diagrams, sequence of operation lists and start-stop instructions have been posted.
  - 9. Maintenance manuals have been delivered and Owner training has been completed.
- B. Review of Contractor's Tests:
  - 1. Tests made by Contractor or manufacturers' representatives are subject to observation and review by Owner. Provide timely notice prior to start of each test, in order to allow for observation of testing. Upon completion of tests, provide letter to confirm that testing has been successful.
- C. Test Logs:
  - 1. Maintain test logs listing the tests on mechanical systems showing dates, items tested, inspectors' names, remarks on success or failure of tests.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 09/30/2022 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

SECTION 21 10 00  
FIRE SPRINKLER SYSTEMS

**PART 1 - GENERAL**

1.01 SUMMARY

A. Section Includes:

1. Sprinkler heads.
2. Pipe and Fittings.
3. Valves.
4. Fire hydrant.
5. Reduced pressure backflow preventer.
6. Double check valve backflow preventer.
7. Water flow alarm switch.
8. Fire Department connection.
9. Post indicator valve.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 21 00 50 Basic Fire Sprinkler Materials and Methods.

1.03 REFERENCES AND STANDARDS

- A. It is the intent of these Specifications to provide for complete and operating fire protection automatic sprinkler system in full compliance with the following standards:
1. National Fire Protection Association (NFPA) Standard No. 13, 2022, as amended by the CBC.
  2. CBC Chapter 9.
- B. The work shall also be in accordance with local or state requirements that apply.

1.04 DESCRIPTION OF WORK

- A. Work of this section includes, but is not necessarily limited to, the following:
- B. An existing fire sprinkler system is in place, consisting of a fire sprinkler riser for each zone with the main supply line and zone control valve for each floor, branch lines, and tees to each sprinkler head. Extend and modify the existing system as required to properly protect the building in accordance with NFPA 13 criteria.
- C. Furnish all coordination, labor, materials, tools, and equipment to install a wet pipe automatic fire sprinkler system as described in this Specification Section, and shown on Contract Drawings.

1. The Work includes, but is not limited to the following:
  - a. Complete automatic fire risers, including valves, fire department connections, flow switches, pressure switch and service mains as indicated on Drawings.
  - b. Complete interior wet type automatic fire protection spray type sprinkler distribution system, including overhead service and branch mains, lateral supply piping, supports, hangers, seismic bracing, and heads, as indicated on Drawings.
  - c. Required tests and inspections.
  - d. Provide electrical work required to complete the system. Contractor shall be responsible for providing complete and operable systems, including electrical wiring. Install wiring in conduit, in accordance with Division 26.
  - e. Protected areas include areas above and below the finished ceilings, exterior exposure, canopies, stairways, rooms, areaways, entry, etc, and other areas requiring sprinklers.
  - f. Tags, identification labels and instruction manuals for proper operation and maintenance.

#### 1.05 ADMINISTRATIVE REQUIREMENTS

##### A. Sequencing:

1. It is expected that the Project shall progress according to the following sequence of events:
  - a. Upon award of bid, Contractor shall begin preparing coordination drawings. See Coordination Article.
  - b. Completed coordination drawings shall be submitted to Architect for review. See Submittals Article in this Section and in Section 21 00 50.
  - c. Engineer will determine need for Project re-submittal to DSA:
    - 1) No DSA re-submittal required: Coordination drawings will be returned to Contractor with comments noted and Contractor shall proceed with fabrication and erection of system in accordance with Contract Documents and reviewed submittal.
    - 2) DSA re-submittal required: Engineer will incorporate changes depicted in coordination drawings into Contract Drawings and hydraulic calculations for re-submittal to DSA. Upon DSA approval of re-submittal, Contractor shall proceed with fabrication and erection of system in accordance with modified Contract Documents.
  - d. Contractor shall issue Request for Information (RFI) for each field change required after approval of coordination drawings or approval of DSA re-submittal has been obtained. Contractor shall not proceed with changes prior to RFI response.
  - e. Contractor shall inform Architect immediately if deviating from this sequence of events.
2. The coordination process may not be used to redesign an automatic fire sprinkler system by the Contractor. Only those changes required for coordination with the work of other trades will be allowed.

##### B. Coordination:

1. Coordinate Work in this Section with trades covered in other Sections of Specifications to provide a complete and operable installation of highest quality workmanship.



2. Coordinate location of fire protection piping, mains and branches, to avoid interference with work by other trades. Plumbing drainage piping and ductwork shall have right-of-way over fire protection piping. Wherever conflicts exist, fire protection piping shall be offset or rerouted at no additional cost to Owner. Provide locations of piping for use in Coordinated Layout called for in Specification Section 23 80 00.
3. Piping shall be concealed, except where so indicated or where absolutely necessary to be exposed. Exposed piping shall be placed as approved by Architect prior to installation. Heads shall be fully coordinated with architectural reflected ceiling plan and placed in center of ceiling tiles.
4. On-site measurement of pipe will be required. Offsets, pipe, fittings, drains, etc., required to meet job conditions shall be furnished and installed at no extra cost to Owner.
5. Additional heads required by NFPA 13 regulations shall be provided at no extra cost, if required as a result of Contractors' coordination. Location of heads and mains shall not be changed unless approved by Architect.
6. Coordinate layout and installation of sprinklers with other construction penetrating ceilings, including light fixtures, HVAC equipment, and partition assemblies.
7. The Architect shall decide any differences or disputes concerning coordination, interference or extent of work, and his decision shall be final.
8. Contract Drawings are schematic. Rerouting of pipe and the addition, deletion or relocation of sprinkler heads may be necessary. Contractor shall prepare coordination drawings documenting changes. Contractor shall not proceed with fabrication or installation of fire protection system prior to approval of coordination drawings by Architect.
  - a. Re-submittal of revised Contract Drawings and calculations to DSA will be required when changes to the system design, made during Project coordination phase, alter parameters used in calculations furnished to DSA for permitting purposes. If re-submittal to DSA is required, mechanical Engineer shall prepare revised Drawings and hydraulic calculations. Contractor shall not proceed with fabrication or installation of fire protection system prior to approval of revised calculations by DSA.
  - b. Contractor-proposed changes to supports, anchorages, and seismic restraints for fire protection system shall conform to the following.
    - 1) Calculations performed for use in selection of supports, anchorages, and seismic restraints shall utilize criteria indicated in Structural Contract Documents.
    - 2) Supports, anchorage and seismic restraints for piping and equipment shall be an OSHPD pre-approved system such as Tolco, Afcon, ISAT, Badger, Mason, or equal. Pipes and equipment shall be seismically restrained in accordance with requirements of current editions of California Building Code and NFPA 13. System shall have current OPM number and shall meet additional requirements of authority having jurisdiction. Provide supporting documentation required by the reviewing authority and the Architect and Engineer. Provide layout drawings showing piping and restraint locations.
      - a) Bracing of Piping and Equipment: Specifically state how bracing attachment to structure is accomplished. Provide shop drawings indicating seismic restraints, including details of anchorage to building. In-line equipment must be braced independently of piping, and in conformance with applicable building codes. Provide calculations to show that pre-approval numbers have been correctly applied in accordance with general information notes of pre-approval documentation.

- 3) In lieu of the above or for non-standard installations not covered in the above pre-approved systems, Contractor shall provide layout drawings showing piping, equipment, and restraint locations, and detailing supports, attachments and restraints. Furnish supporting calculations and legible details sealed by a California registered structural engineer, in accordance with California Building Code, and NFPA 13.
- 4) Additional Requirements: In addition to the above, conform to State and local requirements.

#### 1.06 DRAWINGS

- A. Contractor shall thoroughly examine architectural, structural, and other Drawings provided as part of this Contract.
- B. Number of sprinkler heads indicated on Contract Drawings shall not be reduced. Provide additional heads required for coordination and to obtain approvals. Coordinate suitable head locations and spacing with Architect.
- C. Installation Criteria: Provide complete fire protection systems as indicated and as required by authority having jurisdiction.
  1. When there is conflict between requirements of authority having jurisdiction or requirements of other agencies and these Drawings and Specifications, requirements of authority having jurisdiction and recommendations of standards agencies shall govern.
  2. Install entire system in accord with applicable codes, standards, and regulations.
  3. The automatic sprinkler system shall conform to requirements of the National Fire Protection Association, Standard No. 13, as amended by the CBC.
  4. FM Compliance: Comply with Factory Mutual "Approval Guide."
  5. Supply equipment and accessories in accordance with requirements of applicable national, state and local codes.
  6. Items of a given type shall be the products of the same manufacturer.
  7. Scheduled equipment performance is minimum capacity required.
  8. Scheduled electrical capacity shall be considered as maximum available.

#### 1.07 ACTION SUBMITTALS

- A. For additional requirements, refer to Section 21 00 50, Basic Fire Sprinkler Materials and Methods.
- B. Product Data: Submit manufacturer's technical product data and installation instructions for fire protection systems materials and products.
- C. Samples: Provide one sample of each sprinkler head type.

#### 1.08 INFORMATIONAL SUBMITTALS

- A. For additional requirements, refer to Section 21 00 50, Basic Fire Sprinkler Materials and Methods.
- B. Welding operator qualification certificates.
- C. Office of the State Fire Marshall (OSFM) certification cards for automatic fire extinguishing systems sprinkler pipefitters.

D. Coordination Drawings: Submit in accordance with Division 01, and as follows:

1. Provide minimum 1/4 inch equals one foot scaled coordination drawings showing plan and pertinent section or elevation views of fire protection piping, equipment, and accessories. Drawings shall be reproducible and work represented shall be fully coordinated with structure, other disciplines, and with finishes. Drawings shall be presented on a single size sheet. Coordination drawings shall have title block, key plan, north arrow and sufficient grid lines to provide cross-reference to DSA approved Drawings.
2. Coordination drawings shall depict changes and additions to fire protection system required for coordination with work of other trades. Changes and additions shall be clouded.
3. Note on coordination drawings piping which will project beyond finished surfaces of normally occupied rooms, exterior of building or other locations which will expose system to view.
4. Coordination drawings shall be provided with note affirming that the fire sprinkler system shown has been coordinated with the HVAC Contractor for inclusion in Coordinated Layout specified in Section 23 80 00. Provide signature of person responsible for information supplied and date of transmission.

E. For proposed changes to supports, anchorage, and seismic restraints shown on DSA approved Contract Drawings, submit details and calculations prepared, sealed, and signed by a California registered structural engineer. Comply with requirements of Coordination Article in this Section.

F. Test Reports: As indicated in paragraph "Tests."

1. Sprinkler pressure test.
2. Standpipe pressure test.
3. Alarm system test.
4. Underground piping test.

1.09 CLOSEOUT SUBMITTALS

A. For additional requirements, refer to Section 21 00 50, Basic Fire Sprinkler Materials and Methods.

B. Operation and Maintenance Manual:

1. Operation and Maintenance Manual in accordance with Section 21 00 50. Include an original copy of NFPA 25, California edition, in Operation and Maintenance Manual for fire sprinkler system.
2. Guarantees in accordance with Division 01.

1.10 TEMPORARY CONNECTIONS

A. Temporary connections required to maintain services during the course of the Contract shall be made without additional cost to Owner. The normal function of the building must not be interrupted; notify Owner minimum seven days in advance before interrupting any service.

### 1.11 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of fire protection products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer Qualifications: A firm with at least five years of successful installation experience on projects with fire sprinkler piping systems similar to that required for this Project.
  - 1. A State of California Fire Protection Contractor's license (C-16) is required.
- C. Fire Sprinkler Fitter Certification:
  - 1. Automatic fire extinguishing systems sprinkler pipefitters shall be certified by Office of the State Fire Marshall (OSFM).

## PART 2 - PRODUCTS

### 2.01 GENERAL

- A. The equipment to be furnished under this Specification shall be standard product of manufacturer. Where two or more units of the same class of equipment are required, these units shall be products of a single manufacturer; however, component parts of system need not be products of the same manufacturer.

### 2.02 MATERIALS AND EQUIPMENT

- A. Unless otherwise shown on Drawings, specified, or directed by Architect, materials and equipment used in installation of sprinkler systems shall be listed as approved by FM or UL for fire protection systems, and shall be the latest design of the manufacturer.

### 2.03 SPRINKLER HEADS

- A. Provide spray pattern type sprinkler heads, of ordinary degree temperature rating, except that sprinkler heads for installation in vicinity of heating equipment, and in other areas noted on Drawings, shall have temperature ratings required for such locations by NFPA 13.
- B. Sprinkler heads shall be upright, pendent or sidewall, as required.
  - 1. Heads in ceilings of occupied spaces with recessed lights shall be chrome plated, semi-recessed pendent type, with white escutcheon.
  - 2. Sprinkler heads in rooms with surface mounted lights shall be chrome plated pendant style, with two-piece white escutcheon.
  - 3. Provide head guards in equipment rooms and storage rooms and all other locations where subject to damage.
  - 4. Upright heads in areas with no ceilings shall be rough bronze finish.
  - 5. Provide quick response type heads in light and ordinary hazard occupancies.
  - 6. Side wall heads may be used (except in extended coverage type) to cover special areas where overhead piping and heads are impractical or considered a visual problem by the Architect or Owner. Side wall heads shall be chrome finish.

7. Outdoor heads, if required shall be dry or freeze resistant.
  8. Adjustable drop nipples are not acceptable.
- C. Recessed sprinkler heads shall have chrome finish and adjustable chrome finish escutcheons; exposed pendent heads in finished ceilings shall have chrome finish and white ceiling escutcheons. Concealed (flush) heads shall be all brass, with white cover plate.
1. Provide oversized escutcheons where required to meet the requirements of ASCE 7.
- D. Spare Heads: Furnish spare heads equal to one percent of total number of heads installed under Contract, but not less than twelve. Spare head types furnished shall be representative of types and temperature ratings of heads installed, and in proportion to number of each type and temperature rating of heads installed. Furnish not less than two sprinkler head wrenches, with at least one wrench for each type of sprinkler head installed. Place spare heads and wrenches in wall mounted box manufactured for this purpose.

## 2.04 PIPE AND FITTINGS

- A. For Installation Aboveground: Schedule 40 black steel pipe, ASTM A 53 with ductile or cast iron screwed fittings.
1. Schedule 10 black steel pipe, ASTM A 135 or ASTM A 795, with grooved fittings and associated couplings may be used for pipe sizes 2 inches through 5 inches. Provide NFPA 13-specified wall thickness for pipe sizes 6 inches through 10 inches. Threading of piping will not be accepted.
- B. For Installation Underground to 12 inches Above Ground:
1. Pipe and fittings shall be approved for fire protection use.
  2. Underground Piping Outside Building: PVC Pipe: AWWA C900 or UL 1285, Class 200, with bell end with gasket, and with spigot end. PVC Fittings: AWWA C900 or UL 1285, Class 200, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
      - 1) Diamond Plastics Corporation.
      - 2) J.M. Eagle, Inc.
  3. Underground Piping Below Building Footing and Slab: One-piece, 304 stainless steel 90-degree fitting, with AWWA C900 bell-and-spigot gasketed inlet connection with lugs on inlet end, and AWWA C606 groove on outlet end, for connection to in-building riser using AWWA C606 grooved couplers and gaskets.
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
      - 1) Ames Fire and Waterworks, a Watts Water Technologies Company.
      - 2) Wilkins, a Zurn Company.
- C. Standpipes: Schedule 40 galvanized steel with 300 psi galvanized fittings.

- D. Mechanical tees, saddle fittings, bushings and mechanical sprinkler head fittings shall not be used.

## 2.05 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105.
- B. Material: Linear low-density PE film of 0.008-inch minimum thickness.
- C. Form: Tube.
- D. Color: Natural.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. Northtown Pipe Protection Products; Polywrap.

## 2.06 VALVES

- A. Angle, Check, and Globe Valves: Fed. Spec WW-V-51; Class A, type as suitable for application.
  - 1. Select check valves for installation in vertical lines recommended by manufacturer as suitable for vertical installation. Install in vertical lines only where flow is upward.
- B. Gate Valves:
  - 1. Sizes 1-1/2 inches or less: Fed. Spec WW-V-54, Class A.
  - 2. Sizes above 1-1/2 inches: Fed. Spec WW-V-58, Class A, designation OS or OF, as required. Provide OS&Y type, 175 pound rated working pressure.
  - 3. Furnish and deliver to Owner one wrench of each size required for operating underground valves.
- C. Drain Valves: angle, or globe. Fed. Spec WW-V-51; Class A, type as suitable for application.
  - 1. UL listed and FM approved combination test and drain fittings may be used.
- D. Zone Control Valves: UL listed, outside screw and yoke or butterfly. Valves shall be sealed open with approved seal. Provide weatherproof actuator housing, with two single pole, double throw switches.
  - 1. Supervisory Switch: Fit the control valves on the fire sprinkler risers with supervisory switch, with single pole double throw switch actuator installed to change switch position when valve is being closed.
- E. Sprinkler Inspector's Test Fittings:
  - 1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
  - 2. Pressure Rating: 175-psig minimum.
  - 3. Body Material: Cast- or ductile-iron housing with sight glass.
  - 4. Integral factory or field-installed pressure relief valve.
  - 5. Size: Same as connected piping.
  - 6. Inlet and Outlet: Threaded.

**2.07 FIRE HYDRANT**

- A. Dry barrel or wet barrel, as required by local fire district, with 5 inch minimum diameter, 36 inch bury, two 2-1/2 inch hose nozzles, one 4-1/2 inch pumper nozzle, installed in accordance with manufacturers requirements.
  - 1. Manufacturer and installation of hydrant shall conform to standards of the local authority. Hydrant and fire line shall comply with NFPA 24.
  - 2. Hydrant shall conform to, and installation shall comply with the requirements of the local Department of Public Works, and the requirements of the local fire district. Confirm required color of hydrants prior to installation.

**2.08 REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTER**

- A. Provide reduced-pressure principle backflow preventer assembly, including shutoff valves on inlet and outlet, and strainer on inlet, equal to Febco 860 or 880, as required. Backflow preventer shall include test cocks, and pressure differential relief valve located between two positive seating check valves. Construct in accordance with ASSE Standard 1013.
- B. Provide minimum 13 gage one or two piece expanded metal backflow preventer enclosure, sized to suit size of backflow preventer. Furnish with mounting hardware and provision for locking enclosure in closed position. Install on concrete pad, in accordance with manufacturer's installation instructions.
  - 1. Manufacturer: Subject to compliance with requirements and local fire and water authorities having jurisdiction, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. LeMeur Welding and Manufacturing: BF series.
    - b. Backflow Protection Co.: Ultimate Tuff Cage.
- C. Provide padlock and chain to lock valves in open position, and give key to Project Inspector.
  - 1. Padlocks shall be as specified under Section 08 70 00.
  - 2. Chain shall be of carbon steel, 3/8 inch wire diameter, fully welded links and weight of 140 pounds per 100 linear feet. Chain shall be hot galvanized.
- D. Provide capped connections at each test cock. Install in accordance with requirements of authorities having jurisdiction.
- E. Provide water flow alarm switch at each main valve. Arrange to provide alarm if valves are closed.
- F. For units installed within buildings, provide drain, connected to unit, to collect spillage from atmospheric vent. Run drain to nearest floor sink or drain.
- G. Provide two concrete filled, 6-inch diameter pipe bollards to protect exposed piping from motor vehicle damage.

H. Manufacturer: Subject to compliance with requirements and local fire and water authorities having jurisdiction, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

1. Ames Fire and Waterworks: a division of Watts Water Technologies, Inc.
2. Febco: a division of Watts Water Technologies, Inc.
3. Watts Water Technologies, Inc.
4. Wilkins: a Zurn Company.
5. Conbraco Industries, Inc.

## 2.09 DOUBLE CHECK DETECTOR VALVE BACKFLOW PREVENTERS

A. Provide double detector check valve assembly consisting of two spring loaded brass check valves, two cast iron bronze fitted gate valves and four test cocks, equal to Febco Model 856 or 876 as required. Construct in accordance with ASSE Standard 1048.

B. Provide minimum 13 gage one or two piece expanded metal backflow preventer enclosure, sized to suit size of backflow preventer. Furnish with mounting hardware and provision for locking enclosure in closed position. Install on concrete pad, in accordance with manufacturer's installation instructions.

1. Manufacturer: Subject to compliance with requirements and local fire and water authorities having jurisdiction, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

- a. LeMeur Welding and Manufacturing: BF series
- b. Backflow Protection: Ultimate Tuff Cage.

C. Provide padlock and chain to lock valves in open position, and give key to Project Inspector.

1. Padlocks shall be as specified under Section 08 70 00.
2. Chain shall be of carbon steel, 3/8 inch wire diameter, fully welded links and weight of 140 pounds per 100 linear feet. Chain shall be hot galvanized.

D. Provide water flow alarm switch at each main valve. Arrange to provide alarm if valves are closed.

E. For units installed within buildings, provide drain, connected to unit, to collect spillage from atmospheric vent. Run drain to nearest floor sink or drain.

F. Provide capped connections at each test cock. Install in accordance with requirements of authority having jurisdiction.

G. Provide two concrete filled, 6 inch diameter pipe bollards to protect exposed piping from motor vehicle damage.

H. Manufacturer: Subject to compliance with requirements and local fire and water authorities having jurisdiction, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

1. Ames Fire and Waterworks: A division of Watts Water Technologies, Inc.



2. Febco: A division of Watts Water Technologies, Inc.
3. Watts Water Technologies, Inc.
4. Wilkins: A Zurn Company.
5. Conbraco Industries, Inc.

#### 2.10 WATER FLOW ALARM SWITCH

- A. UL listed water flow alarm switch suitable for variable pressure, complete with instantaneous recycling retard and two single pole double throw electrical contacts. Provide continuously monitored water flow alarm switch and trouble sensor, automatically transmitted to an approved control alarm station.

#### 2.11 FIRE DEPARTMENT CONNECTION

- A. Post mounted, complying with Local Fire Marshal standards cast brass two-way inlet body with drop clappers. Furnish with two brass double female snoots with rigid end N.P.T.X. pin lug house thread swivels, plugs and chain.
- B. Provide check valve in piping between inlet connection and fire protection system. Provide ball drip at low point of piping, below grade on the inlet side of the check valve, and drain to gravel sump. Provide gravel sump with minimum 3 cubic feet of course gravel.

#### 2.12 POST INDICATOR VALVE

- A. Mueller, American Cast Iron Pipe Co., or equal, UL-listed; provide handle lock and water flow alarm switch.

#### 2.13 UNION AND FLANGES

- A. Size and Type:
  1. Steel 2 inches and smaller: 150 pound screwed black or galvanized malleable iron, match pipe, ground joint, brass to iron seat.
  2. Steel 2-1/2 inches and larger: 150 pound black flange union, flat faced, full gasket.
- B. Gaskets: 1/16 inch thick rubber Garlock #122, Johns-Manville, or equal.
- C. Flange Bolts: Open hearth bolt steel, square heads, with cold pressed hexagonal nuts, cadmium plated when installed below ground. Provide copper plated steel bolts and nuts or brass bolts and nuts for brass flanges.

#### 2.14 GAUGES

- A. Marsh "Quality Gage", U.S. Gage, Danton 800, or equal, U.L. listed, with bronze bushed movement and front recalibration. Dials shall be white with black numerals, 3-1/2 inch dial face. Normal reading shall be at midscale. Provide a three-way valve on each gauge connection.

## 2.15 SEISMIC SEPARATION ASSEMBLY

- A. Provide seismic separation assembly as defined in NFPA 13 at locations where piping crosses building seismic joints and at locations where required to prevent pipe breakage due to building movement.
  - 1. At Contractors option, provide Metraflex "Fireloop" UL listed assembly, or equal at each seismic joint location, in lieu of seismic separation assembly.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Installation of the sprinkler system shall not be started until complete plans and specifications (including water supply information and type of existing sprinkler system, if any) have been approved by DSA.
  - 1. Piping shall be concealed unless shown or otherwise directed.
  - 2. Where piping is left exposed within a room, it shall be run true to vertical, horizontal or intended planes. Where possible, uniform margins shall be maintained between parallel lines and/or adjacent wall, floor or ceiling surfaces.
  - 3. Horizontal runs of pipes and/or electrical conduit suspended from ceilings shall provide for maximum headroom clearance. This clearance shall not be less than 6'-6" without written approval from Architect.
  - 4. Minor changes in locations of equipment, piping, etc., from locations shown shall be made when directed by Architect at no additional cost to Owner, providing such change is ordered before such items of work, or work directly connected to same, are installed, and providing no additional material is required.
  - 5. Grade all piping as required by NFPA 13.
  - 6. Close ends of pipe immediately after installation; leave closure in place until removal is necessary for completion of installation.
  - 7. Piping systems shall be thoroughly flushed and proved clean before connection to equipment.
  - 8. Pipe discharge of each drain valve to floor sink or drain.

### 3.02 HANGER AND SUPPORT INSTALLATION

- A. General: Support piping so that it is firmly held in place by approved iron hangers and supports and by special hangers as required in accordance with NFPA 13. Hangers shall support loads specified in NFPA 13, and, in addition, shall support weight of pipe, fluid and pipe insulation, based on spacing between supports with minimum factor of safety of five based on ultimate strength of material used. Do not exceed manufacturer's load rating. Pipe attachments, or hangers, shall be of same size as pipe or tubing on which used, or nearest larger size available. Materials, design, and type numbers per Manufacturers' Standardization Society (MSS) Standard Practice SP-58, provide branch line restraints where hangers exceed 6 inches long, in accordance with NFPA 13. Install concrete anchors required. Hanger material shall be approved by Architect before installation. Do not support piping by plumbers' tape, wire, rope, wood or other makeshift devices.
- B. Suspend rods from angle clips, in accordance with Section 21 00 50.

### 3.03 SEISMIC REQUIREMENTS

- A. Comply with CBC, Volume 2, Chapter 16A and CBC Chapter 9 and NFPA 13.
- B. Items of equipment shown or specified to be anchored shall maintain integrity at point of anchor after being subjected to accelerations equivalent to those established herein
- C. Anchors: Piping shall be provided with anchors for protection of piping against damage due to earthquakes, as required by CBC Chapter 16A, NFPA 13, and other sections of this Specification.

### 3.04 TESTS

- A. At various stages and upon completion, the system shall be tested in the presence of the enforcing agency.
- B. Upon completion and prior to acceptance of the installation, subject entire new system to tests required by NFPA 13, and furnish Owner with certificates as appropriate.

### 3.05 IDENTIFICATION

- A. Coordinate requirements with the authority having jurisdiction.
- B. Provide brass valve tags at each system valve, indicating valve service.
- C. Provide signage at each sprinkler valve, with sign indicating specific portion of system controlled by valve.
- D. Provide signage at each outdoor alarm device, with sign indicating which authority to call if device is activated.
- E. Prior to final acceptance, Contractor shall provide accurate color-coded Building Plan at riser location, clearly depicting fire protection system area of coverage, location of inspectors' test/drain connection and auxiliary drain connections. Provide this information at each system or building at riser location for building. Plan(s) shall be one-half size and plastic laminated.
- F. Provide hydraulic data signage permanently attached to risers, indicating location, basis of design, water supply and pressure requirements of system.

### 3.06 ELECTRICAL WIRING

- A. Coordination of wiring systems is part of this work. Contractor shall ensure that the following is completed.
  - 1. Work provided in other Specification Sections:
    - a. Supervised wiring to fire alarm control panel.
    - b. Supervised wiring from main waterflow indicator to fire alarm panel.
    - c. Supervised wiring from sprinkler flow switches to fire alarm panel.
    - d. Supervised wiring from valve water flow alarm switches to fire alarm panel.
  - 2. Work provided in this Specification Section:

- a. Wiring diagrams for devices.
- b. Other wiring not specified to provide an operating system.

### 3.07 SPRINKLER HEAD INSTALLATION

- A. Heads shall be placed upright where on exposed piping, unless otherwise noted, and in pendant position on concealed piping, unless noted otherwise, with deflectors parallel to the ceiling or roof slope. Clearance between deflectors and ceilings, electric, or heating equipment, or other obstruction shall be in accordance with the requirements of NFPA 13. Provide sprinkler head guards where heads are subject to mechanical damage, for example, at mechanical rooms, and storage rooms and gymnasiums.
- B. Mount box containing spare sprinkler heads and wrenches on wall in location selected by Owner.
- C. Do not install pendent sprinkler heads until flushing of piping has been completed.
- D. Provide return bend as illustrated in NFPA 13 (NFPA exceptions do not apply) for each sprinkler head installed in finished ceiling.

### 3.08 PIPING INSTALLATION

- A. Pipe shall be assembled in accordance with the applicable requirements of NFPA 13 and NFPA 24.
- B. Install pipe encasement on underground and under-slab metal piping.
- C. Provide concrete thrust blocks for underground and underslab piping in accordance with NFPA 24 and CBC.

### 3.09 VALVE IDENTIFICATION

- A. All valves shall be identified by permanent metal tags or other approved means.

### 3.10 DRAIN INSTALLATION

- A. Auxiliary drains shall be installed on low points in each system.
  - 1. Five or fewer trapped gallons will not require a drain valve but may be drained through a plugged fitting. Drain valves shall be in accordance with requirements of NFPA 13.
- B. Install one inspector's test drain on sprinkler system. Extend drain to outside in location approved by Architect. Water discharge shall be positioned such that landscaping will not be damaged.
- C. Drain valves shall be piped to a safe place of discharge and discharge shall be visible either by open-end drainpipe or sight drain fitting.
- D. Provide flushing connections at ends of cross-mains.

### 3.11 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers where indicated on Drawings. Provide available manufacturers drain connection, pipe drain outlet to nearest floor sink or drain.

1. Where drain pans are shown on Drawings, pipe drain pan outlet to nearest floor sink or drain.

### 3.12 SLEEVE INSTALLATION

- A. Install AMI Products, Adjus-to-Crete, or equal, pipe sleeves of sufficient size to allow for free motion of pipe, 24 gauge galvanized steel. The space between pipe and sleeves through floor slabs on ground, through outside walls above or below grade, through roof, and other locations as directed shall be caulked with oakum and mastic and made watertight. The space between pipe and sleeve and between sleeve and slab or wall shall be sealed watertight.
- B. Holes through existing concrete walls or floors shall be core drilled. The space between pipe and hole through floor slabs on ground, through outside walls above or below grade, through roof and other locations as directed shall be made watertight.
- C. At walls below grade: Link-Seal casing seals, or equal, may be used in lieu of caulking. Pipes penetrating walls below grade shall be anchored at wall.

### 3.13 FLOOR, WALL, AND CEILING PLATE INSTALLATION

- A. Fit pipes with or without insulation passing through walls, floors, or ceilings, and hanger rods penetrating finished ceilings with chrome plated or stainless steel plates.

### 3.14 FIRESTOPPING

- A. The annular space between pipe sleeves and pipe passing through all floors and walls shall be packed with incombustible mastic or other suitable material, in accordance with U.L. Fire Resistance Directory.
- B. Penetrations in fire rated assemblies shall also be protected in accordance with CBC Chapter 7, Section 712, and UL Fire Resistance Directory.

### 3.15 UNION AND FLANGE INSTALLATION

- A. Install unions whether shown or not at each connection to equipment and at one connection to each valve or cock.
- B. Locate the unions for easy removal of the equipment or valve.

### 3.16 CLEANING

- A. Upon completion of tests, clean equipment, piping, etc., installed under this Section of the Specifications.

### 3.17 PIPING SYSTEM FLUSHING

- A. Entire system shall be flushed out and cleaned after completion of piping, and prior to installation of sprinkler heads. Flush shall be continued until water runs clear at drain connections.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 09/30/2022 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 01/31/2025 – Revised 2.14, paragraph A to reference Section 22 05 53 – Plumbing Identification. Revised 2.15, paragraph A to reference Section 22 05 53 – Plumbing Identification. Deleted 2.15, paragraph B. Revised 3.09, H, paragraph 1 to reference newly added Section 22 05 29 – Plumbing Pipe Supports and Anchors. Deleted 3.09, H, paragraphs 2 thru 12. Revised 3.14, paragraph A to reference Section 22 05 53 – Plumbing Identification. Deleted 3.14, paragraphs B thru E.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

## SECTION 22 00 50

## BASIC PLUMBING MATERIALS AND METHODS

**PART 1 - GENERAL****1.01 SUMMARY****A. Section Includes:**

1. Electric motors.
2. Motor starters.
3. Strainers.
4. Valve boxes.
5. Gauges.
6. Thermometers.
7. Access Doors.
8. Expansion loops.
9. Flexible joints.
10. Insulation.

**1.02 RELATED REQUIREMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. This Section is a part of each Division 22 Section.

**1.03 ADDITIONAL REQUIREMENTS**

- A. Furnish and install any incidental work not shown or specified which is necessary to provide a complete and workable system.
- B. Make all temporary connections required to maintain services during the course of this Contract without additional cost to the Owner. Notify the Owner seven days in advance before disturbing any service.
- C. Plumbing work done under this contract shall not adversely affect the operation of the existing plumbing systems.

**1.04 REFERENCES AND STANDARDS**

- A. Where material or equipment is specified to conform to referenced standards, it shall be assumed that the most recent edition of the standard in effect at the time of bid shall be used.
  1. CSA – Canadian Standards Association International.
  2. ANSI - American National Standards Institute.
  3. ASTM - American Society for Testing and Materials.
  4. CCR - California Code of Regulations.

- a. Title 8 - Division of Industrial Safety, Subchapter 7; General Industry Safety Orders, Articles 31 through 36.
  5. NCPWB - National Certified Pipe Welding Bureau.
  6. CEC - California Electrical Code.
  7. NEMA - National Electrical Manufacturers' Association.
  8. NFPA - National Fire Protection Association.
  9. OSHA - Occupational Safety and Health Act.
  10. UL - Underwriters' Laboratories, Inc.
- B. Requirements of Regulatory Agencies:
1. The publications listed below form part of this specification; comply with provisions of these publications except as otherwise shown or specified.
    - a. California Building Code, 2022.
    - b. California Electrical Code, 2022.
    - c. California Energy Code, 2022.
    - d. California Fire Code, 2022.
    - e. California Green Building Standards Code, 2022.
    - f. California Mechanical Code, 2022.
    - g. California Plumbing Code, 2022.
    - h. California Code of Regulations, Title 24.
    - i. California Health and Safety Code.
    - j. CAL-OSHA.
    - k. California State Fire Marshal, Title 19 CCR.
    - l. National Fire Protection Association.
    - m. Occupational Safety and Health Administration.
    - n. Other applicable state laws.
  2. Nothing in Drawings or specifications shall be construed to permit work not conforming to these codes, or to requirements of authorities having jurisdiction. It is not the intent of Drawings or specifications to repeat requirements of codes except where necessary for clarity.

#### 1.05 DRAWINGS

- A. Examine Contract Documents prior to bidding of work and report discrepancies in writing to Architect.
- B. Drawings showing location of equipment and materials are diagrammatic and job conditions will not always permit installation in location shown. The Plumbing Drawings show general arrangement of equipment and materials, etc., and shall be followed as closely as existing conditions, actual building construction, and work of other trades permit.
1. Architectural and Structural Drawings shall be considered part of the Work. These Drawings furnish Contractor with information relating to design and construction of the Project. Architectural Drawings take precedence over Plumbing Drawings.
  2. Because of the small scale of Plumbing Drawings, not all offsets, fittings, and accessories required are shown. Investigate structural and finish conditions affecting the Work and arrange



Work accordingly. Provide offsets, fittings, and accessories required to meet conditions. Inform Architect immediately when job conditions do not permit installation of equipment and materials in the locations shown. Obtain the Architects approval prior to relocation of equipment and materials.

3. Relocate equipment and materials installed without prior approval of the Architect. Remove and relocate equipment and materials at Contactors' expense upon Architects' direction.
  4. Minor changes in locations of equipment, piping, etc., from locations shown shall be made when directed by the Architect at no additional cost to the Owner providing such change is ordered before such items of work, or work directly connected to same are installed and providing no additional material is required.
- C. Execute work mentioned in Specifications and not shown on Drawings, or vice versa, the same as if specifically mentioned or shown in both.

#### 1.06 FEES AND PERMITS

- A. Obtain and pay for all permits and service required in installation of this work; arrange for required inspections and secure approvals from authorities having jurisdiction. Comply with requirements of Division 01.
- B. Arrange for utility connections and pay charges incurred, including excess service charges.
1. Bear the cost of construction related to utility services, from point of connection to utility services shown on Contract Documents. This includes piping, excavation, backfill, meters, boxes, check valves, backflow prevention devices, general service valves, concrete work, and the like, whether or not Work is performed by Contractor, local water/sanitation district, public utility, other governmental agencies or agencies' assigns.
- C. Prior to the start of construction, contact local gas company representative and coordinate location of gas meter and piping. In addition, coordinate time required for installation, in order to avoid delay to the Project.
- D. Coordination:
1. General:
    - a. Coordinate plumbing Work with trades covered in other Specifications Sections to provide a complete, operable and sanitary installation of the highest quality workmanship.
  2. Electrical Coordination:
    - a. Refer to the Electrical Drawings and Specifications, Division 26, for service voltage and power feed wiring for equipment specified under this section. Contractor has full responsibility for the following items of work:
      - 1) Review the Electrical Drawings and Division 26 Specifications to verify that electrical services provided are adequate and compatible with equipment requirements.
      - 2) If additional electrical services are required above that indicated on Electrical Drawings and in Division 26, such as more control interlock conductors, larger feeder, or separate

120 volt control power source, include cost to furnish and install additional electrical services as part of the bid.

- 3) Prior to proceeding with installation of additional electrical work, submit detailed drawings indicating exact scope of additional electrical work.

3. Mechanical Coordination:

- a. Arrange for pipe spaces, chases, slots and openings in building structure during progress of construction, to accommodate mechanical system installation.
- b. Coordinate installation of supporting devices. Set sleeves in poured-in-place concrete and other structural components during progress of construction.
- c. Coordinate requirements for access panels and doors for mechanical items requiring access where concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
- d. Coordinate with other trades equipment locations, pipe, duct and conduit runs, electrical outlets and fixtures, air inlets and outlets, and structural and architectural features. Provide information on location of piping and seismic bracing to other trades as required for a completely coordinated project.

1.07 SUBMITTALS - GENERAL

- A. Refer to Division 01 Submittals Section(s) for additional requirements.
- B. Submittal packages may be submitted via email as PDF electronic files, or as printed packages. PDFs shall be legible at actual size (100 percent). Provide seven copies of printed submittal packages.
- C. Provide submittal of materials proposed for use as part of this Project. Product names in Specifications and on Drawings are used as standards of quality. Furnish standard items on specified equipment at no extra cost to the Contract regardless of disposition of submittal data. Other materials or methods shall not be used unless approved in writing by Architect. Architect's review will be required even though "or equal" or synonymous terms are used.
  1. Partial or incomplete submittals will not be considered.
  2. Quantities are Contractor's responsibility and will not be reviewed.
  3. Provide materials of the same brand or manufacturer for each class of equipment or material.
  4. Identify each item by manufacturer, brand, trade name, number, size, rating, or other data necessary to properly identify and review materials and equipment. Words "as specified" are not sufficient identification.
  5. Identify each submittal item by reference to items' Specification Section number and paragraph, by Drawing and detail number, and by unit tag number.
  6. Organize submittals in same sequence as in Specification Sections.
  7. Show physical arrangement, construction details, finishes, materials used in fabrications, provisions for piping entrance, access requirements for installation and maintenance, physical size, mechanical characteristics, foundation and support details, and weight.
    - a. Submit Shop Drawings, performance curves, and other pertinent data, showing size and capacity of proposed materials.
    - b. Specifically indicate, by drawn detail or note, that equipment complies with each specifically stated requirement of Contract Documents.

- c. Drawings shall be drawn to scale and dimensioned (except schematic diagrams). Drawings may be prepared by vendor but must be submitted as instruments of Contractor, thoroughly checked and signed by Contractor before submission to Architect for review.
  - d. Catalog cuts and published material may be included with supplemental scaled drawings.
- D. Review of submittals will be only for general conformance with design concept and general compliance with information given in Contract Documents. Review will not include quantities, dimensions, weights or gauges, fabrication processes, construction methods, coordination with work of other trades, or construction safety precautions, which are sole responsibility of Contractor. Review of a component of an assembly does not indicate acceptance of an assembly. Deviations from Contract Documents not clearly identified by Contractor are Contractor's responsibility and will not be reviewed by Architect.
- E. Within reasonable time after award of contract and in ample time to avoid delay of construction, submit to Architect Shop Drawings or submittals on all items of equipment and materials provided. Provide submittal in at least seven copies and in complete package.
  - 1. Shop Drawings and submittals shall include Specification Section, Paragraph number, and Drawing unit symbol or detail number for reference. Organize submittals into booklets for each Specification section and submit in loose-leaf binders with index. Deviations from the Contract Documents shall be prominently displayed in the front of the submittal package and referenced to the applicable Contract requirement.
- F. Furnish to the Project Inspector complete installation instructions on material and equipment before starting installation.

#### 1.08 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for plumbing systems materials and products.
- B. Shop Drawings.
- C. Sustainable Design Submittals:
  - 1. Product Data: For adhesives and sealants, documentation of compliance including printed statement of VOC content and chemical components.
  - 2. Laboratory Test Reports: For adhesives and sealants, indicating compliance with requirements for low-emitting materials.
- D. Pipe, pipe or plumbing fittings, fixtures, solder and flux installed in a system providing water for human consumption shall comply with lead free requirements of the California Health and Safety Code Section 11 68 75. Provide submittal information for products third-party certified by an approved laboratory as complying with California Health and Safety Code Section 11 68 75.
- E. Delegated-Design Submittals: For seismic supports, anchorages, restraints, and vibration isolators indicated to comply with performance requirements and design criteria.

1. Calculations performed for use in selection of seismic supports, anchorages, and restraints shall utilize criteria indicated in Structural Contract Documents.
2. Include design calculations and details for selecting vibration isolators and vibration isolation bases complying with performance requirements, design criteria, and analysis data signed and sealed by the California registered structural engineer responsible for their preparation.
3. Supports, anchorages and restraints for piping, ductwork, and equipment shall be an HCAI pre-approved system such as TOLCO, ISAT, Mason, or equal. Pipes, ducts and equipment shall be seismically restrained in accordance with requirements of current edition of California Building Code. System shall have current OPM number and shall meet additional requirements of authority having jurisdiction. Provide supporting documentation required by the reviewing authority and the Architect and Engineer. Provide layout drawings showing piping, ductwork and restraint locations.
  - a. Bracing of Piping and Equipment: Specifically state how bracing attachment to structure is accomplished. Provide shop drawings indicating seismic restraints, including details of anchorage to building. In-line equipment must be braced independently of piping, and in conformance with applicable building codes. Provide calculations to show that pre-approval numbers have been correctly applied in accordance with general information notes of pre-approval documentation. Gas pipe bracing shall be designed in accordance with California Building Code Section 1615A.1.22 and ASCE 7-10 Section 13.6. Coefficient  $I_p = 1.5$  shall be used for gas piping bracing calculations.
  - b. In lieu of the above or for non-standard installations not covered in the above pre-approved systems, Contractor shall provide layout drawings showing piping, ductwork, and restraint locations, and detail supports, attachments and restraints, and furnish supporting calculations and legible details sealed by a California registered structural engineer, in accordance with 2016 California Building Code
4. Additional Requirements: In addition to the above, conform to all state and local requirements.

#### 1.09 INFORMATIONAL SUBMITTALS

- A. Provide layouts for plumbing systems, for inclusion in coordinated layout specified in Section 23 80 00. Comply with requirements for layouts specified in Section 23 80 00.

#### 1.10 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:
  1. Refer to Division 01 for complete instructions.
  2. Furnish three complete sets of Operation and Maintenance Manual bound in hardboard binder, and one compact disc containing complete Operation and Maintenance Manual in searchable PDF format. Provide Table of Contents. Provide index tabs for each piece of equipment in binder and disc. Begin compiling data upon approval of submittals.
    - a. Sets shall incorporate the following:
      - 1) Product Data.
      - 2) Shop Drawings.
      - 3) Record Drawings.

- 4) Service telephone number, address and contact person for each category of equipment or system.
- 5) Complete operating and maintenance instructions for each item of plumbing equipment and systems.
- 6) Copies of guarantees/warranties for each item of equipment and systems.
- 7) Test data and system balancing reports.
- 8) Typewritten maintenance instructions for each item of equipment listing lubricants to be used, frequency of lubrication, inspections required, adjustment, etc.
- 9) Manufacturers' bulletins with parts numbers, instructions, etc., for each item of equipment.
- 10) Control diagrams and literature.
- 11) A complete list or schedule of all scheduled valves giving the number of the valve, location and the rooms or area controlled by the valve. Identify each valve with a permanently attached metal tag stamped with number to match schedule. Post list in frame under plastic on wall in mechanical room or where directed by Architect.
- 12) Check test and start reports for each piece of plumbing equipment provided as part of the Work.
- 13) Commissioning and Preliminary Operation Tests required as part of the Work.

- b. Post service telephone numbers and/or addresses in an appropriate place as designated by the Architect.

B. Record Drawings:

1. Refer to Division 01, Record Documents, for requirements governing Work specified herein.
2. Upon completion of the work, deliver to Architect the following:
  - a. Originals of drawings showing the Work exactly as installed.
  - b. One complete set of reproducible drawings showing the Work exactly as installed.
  - c. One compact disc with complete set of drawings in PDF format showing the Work exactly as installed.
  - d. Provide Contractor's signature, verifying accuracy of record drawings.
  - e. Obtain the signature of the Project Inspector for all record drawings.

1.11 SUBSTITUTIONS

- A. Refer to Division 01 for complete instructions. Requirements given below are in addition to or are intended to amplify Division 01 requirements. In the case of conflict between requirements given herein and those of Division 01, Division 01 requirements shall apply.
- B. It is the responsibility of Contractor to assume costs incurred because of additional work and or changes required to incorporate proposed substitute into the Project. Refer to Division 01 for complete instructions.
- C. Substitutions will be interpreted to be all manufacturers other than those specifically listed in the Contract Documents by brand name, model or catalog number.
- D. Only one request for substitution will be considered for each item of equipment or material.

- E. Substitution requests shall include the following:
  - 1. Reason for substitution request.
  - 2. Complete submittal information as described herein; see "Submittals."
  - 3. Coordinated scale layout drawings depicting position of substituted equipment in relation to other work, with required clearances for operation, maintenance and replacement.
  - 4. List optional features required for substituted equipment to meet functional requirements of the system as indicated in Contract Documents.
  - 5. Explanation of impact on connected utilities.
  - 6. Explanation of impact on structural supports.
- F. Installation of reviewed substitution is the Contractors' responsibility. Any mechanical, electrical, structural, or other changes required for installation of reviewed substituted equipment or material must be made by the Contractor without additional cost to the Owner. Review by the Architect of the substituted equipment or material, including dimensioned Drawings will not waive these requirements.
- G. Contractor may be required to compensate the Architect for costs related to substituted equipment or material.

#### 1.12 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of plumbing systems products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Contractor's Qualifications: Firm with at least 5 years of successful installation experience on projects with plumbing systems work similar to that required for this Project.
- C. California Health and Safety Code Compliance: For products covered under the scope of HSC 116875 for potable water service. Products for potable water service shall be third-party certified by an approved laboratory as complying with California Health and Safety Code Section 11 68 75.
- D. Comply with applicable portions of California Plumbing Code pertaining to selection and installation of plumbing materials and products.
- E. All materials and products shall be new and shall match existing.

#### 1.13 DELIVERY, STORAGE, AND HANDLING

- A. Protect equipment and piping delivered to Project site from weather, humidity and temperature variations, dirt, dust and other contaminants.

#### 1.14 FIELD CONDITIONS

- A. Contractor shall visit Project site and examine existing conditions in order to become familiar with Project scope. Verify dimensions shown on Drawings at Project site. Bring discrepancies to the attention of Architect. Failure to examine Project site shall not constitute basis for claims for additional work because of lack of knowledge or location of hidden conditions that affect Project scope.

- B. Information on Drawings relative to existing conditions is approximate. Deviations from Drawings necessary during progress of construction to conform to actual conditions shall be approved by the Architect and shall be made without additional cost to the Owner. The Contractor shall be held responsible for damage caused to existing services. Promptly notify the Architect if services are found which are not shown on Drawings.

#### 1.15 WARRANTY

- A. Refer to Division 01 for warranty requirements, and duration and effective date of Contractor's Standard Guarantee.
- B. Repair or replace defective work, material, or part that appears within the warranty period, including damage caused by leaks.
- C. On failure to comply with the warranty requirements within a reasonable length of time after notification is given, the Architect/Owner shall have the repairs made at the Contractor's expense.

### PART 2 - PRODUCTS

#### 2.01 GENERAL

- A. Materials or equipment of the same type shall be of the same brand wherever possible. All materials shall be new and in first class condition.
- B. All sizes, capacities, and efficiency ratings shown are minimum, except that gas capacity is maximum available.
- C. Refer to Sections 22 10 00 and 23 80 00 for specific system piping materials.

#### 2.02 MATERIALS AND PRODUCTS

- A. No material installed as part of this Work shall contain asbestos.
- B. Insulation products, including insulation, insulation facings, jackets, adhesives, sealants and coatings shall not contain polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations in amounts greater than 0.1 percent (by mass).

#### 2.03 ELECTRIC MOTORS

- A. General Motor Requirements: Comply with NEMA MG 1 unless otherwise indicated. Comply with IEEE 841 for severe-duty motors.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. U.S. Motors.
    - b. Century Electric.
    - c. General Electric.
    - d. Lincoln.
    - e. Gould.

- B. Motor Characteristics: Designed for continuous duty at ambient temperature of 40 deg. C and at altitude of 3300 feet above sea level. Capacity and torque shall be 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.
1. Motors exceeding the nameplate amperage shall be promptly replaced at no cost to the Owner. Horsepower shown is minimum and shall be increased as necessary to comply with above requirements. Furnish motors with splash-proof or weatherproof housings, where required or recommended by the manufacturer. Match the nameplate voltage rating with the electrical service supplied. Check Electrical Drawings. Provide a transformer for each motor not wound specifically for system voltage.
- C. Polyphase Motors: NEMA MG 1, Design B, medium induction motor, premium efficiency as defined in NEMA MG 1. Select motors with service factor of 1.15. Provide motor with random-wound, squirrel cage rotor, and permanently lubricated or regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading. Temperature rise shall match insulation rating. Provide Class F insulation.
1. Multispeed motors shall have separate windings for each speed.
- D. Polyphase Motors with Additional Requirements:
1. 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.
  2. Motors Used with Variable Frequency Controllers:
    - a. Separately Connected Motors: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
    - b. 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.
    - c. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
    - d. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
    - e. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
    - f. Each motor shall be provided with a shaft grounding device for stray current protection.
  3. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.
- E. Single-Phase Motors:
1. Select motors with service factor of 1.15.
  2. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
    - a. Permanent-split capacitor.
    - b. Split phase.
    - c. Capacitor start, inductor run.
    - d. Capacitor start, capacitor run.



3. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
  4. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
  5. Motors 1/20 HP and Smaller: Shaded-pole type.
- F. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

#### 2.04 MOTOR STARTERS

- A. Square D, Allen Bradley, or equal, in NEMA Type 1 enclosure, unless otherwise specified or required. Minimum starter size shall be Size 1. Provide NEMA 3R enclosure where exposed to outdoors.
- B. Provide magnetic motor starters for equipment provided under the Mechanical Work. Starters shall be non-combination type. Provide part winding or reduced voltage start motors where shown or as hereinafter specified. Minimum size starter shall be Size 1.
1. All starters shall have the following:
    - a. Cover mounted hand-off-automatic switch. Starters installed exposed in occupied spaces shall have key operated HOA switch.
    - b. Ambient compensated thermal overload.
    - c. Fused control transformer (for 120 or 24 volt service).
    - d. Pilot lights, integral with the starters. Starters located outdoors shall be in NEMA IIIR enclosures.
  2. Where three phase motors are provided for two-speed operation, provide two speed motor starters.
  3. Starters for single-phase motors shall have thermal overloads. NEMA I enclosure for starters located indoors, NEMA IIIR enclosure for starters located outdoors.
  4. Provide OSHA label indicating the device starts automatically.

#### 2.05 STRAINERS FOR POTABLE WATER SYSTEMS

- A. Strainers: Full line size, conforming to lead-free requirements of California Health and safety Code Section 11 68 75. "Y" pattern, 125 psi SWP minimum, with 304 stainless steel screens. Install all strainers with a blow-off hose valve with hose adapter. Strainer shall have gasketed cover with straight thread.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. 3 inches and smaller: bronze or brass body, threaded ends, with 20 mesh screen. Watts LF777SI, Wilkins SXL.
    - b. 4 inches and larger: Cast iron body, flanged ends, 1/16 inch or 1/8 inch screen as normally supplied for each size. Watts 77F-DI-125, Mueller 758.

## 2.06 STRAINERS FOR NON-POTABLE WATER SYSTEMS

- A. Charles M. Bailey #100A, Armstrong, Muessco, or equal, Fig. 11 "Y" pattern, 125 psi WP minimum, with monel screens with 20 square mesh for 2 inches and smaller and 3/64 inch perforations for 2-1/2 inches and larger. Install all strainers with a blow-off hose valve with hose adapter. Strainer shall have gasketed cover with straight thread.

## 2.07 VALVE BOXES

### A. General:

1. Where several valves or other equipment are grouped together, provide larger boxes of rectangular "vault" type adequately sized for condition and similar in construction to those specified above.
  2. Provide valve box extensions as required to set bottom of valve box tight up to top of piping in which valve is installed.
  3. Provide a tee handle wrench for each size, Alhambra Foundry Co. #A-3008, or equal.
- B. Valve Boxes in Traffic Areas: Provide Christy No. G5 traffic valve box, Brooks, or equal, 10-3/8 inches inside diameter with extensions to suit conditions, with cast iron or steel locking cover. Provide Owner with set of special wrenches or tools as required for operation of valves.
  - C. Valve Boxes in Non-Traffic Areas: Provide Christy No. F22, Brooks, or equal, 8 inches inside diameter by 30 inches long, with cast iron or steel locking cover. Provide Owner with set of special wrenches or tools as required for operation of valves. Cut bottom of plastic body for operation of valves.
  - D. Valve Box (Rectangular Vault Type): Precast concrete or cast iron with cast iron or steel locking type covers lettered to suit service – Brooks No. 3-TL, Christy No. B3, Fraser No. 3, Alhambra A-3004 or A-3005, Alhambra E-2202, or E-2702, or equal, with extension to suit conditions.

## 2.08 GAUGES

- A. Marsh "Series J", U.S. Gage, Danton 800, or equal, with bronze bushed movement and front recalibration. Dials shall be white with black numerals, 3-1/2 inch dial face. Normal reading shall be at mid-scale. Provide a needle valve on each gauge connection. Supply a gauge piped with branch isolation valves across the inlet and outlet of each pump and where shown on the Drawings.
- B. Provide Pete's Plug II, Sisco P/T, or equal, test plug with Nordel core {and gasketed cap}, on inlet and outlet of each coil, boiler, condenser, chiller and heat exchanger and where shown on Drawings.

## 2.09 THERMOMETERS

- A. Marsh, Taylor, Palmer, or equal, 5 inch diameter bimetal dial, adjustable from face, with adjustable positioner, located to be easily read from normal personnel approach. Normal reading shall be at mid-scale.
  1. Provide extension for insulation.
  2. Provide thermometers with steel bulb chambers and brass separable sockets.

- B. Provide Pete's Plug II, Sisco P/T, or equal, test plug with Nordel core, on inlet and outlet of each coil, boiler, and heat exchanger and provide two digital electronic test thermometers for each range of fluid temperature and where shown on Drawings.

#### 2.10 ACCESS DOORS

- A. Where floors, walls, or ceilings must be penetrated for access to mechanical equipment, provide access doors, 14 inch by 14 inch minimum size in usable opening. Where entrance of a serviceman may be required, provide 20 inch by 30 inch minimum usable opening. Locate access doors/panels for non-obstructed and easy reach.
  - 1. All access doors less than 7'-0" above floors and exposed to public access shall have keyed locks.
- B. Access doors shall match those supplied in Division 08 in all respects, except as noted herein.
- C. Provide stainless steel access doors for use in toilet rooms, shower rooms, kitchens and other damp areas. Provide steel access doors with prime coat of baked-on paint for all other areas.
- D. Do not locate access doors in highly visible public areas such as lobbies, waiting areas, and primary entrance areas. Coordinate with the Architect when access is required in these areas.
- E. Where specific information or details relating to access panels different from the above is shown or given on the Drawings or other Divisions of work, then that information shall supersede this specification.
- F. Manufacturers: Subject to compliance with requirements, available manufacturers offering products which may be incorporated into the Work include Milcor, Karp, Nystrom, or Cesco, equal to the following:
  - 1. Milcor
    - a. Style K (plaster).
    - b. Style DW (gypsum board).
    - c. Style M (Masonry).
    - d. Style "Fire Rated" where required.

#### 2.11 THERMAL AND SEISMIC EXPANSION LOOPS

- A. Manufactured assembly consisting of inlet and outlet elbow fittings, two sections of flexible metal hose and braid, and 180-degree return bend. Return bend section shall have support lug and plugged FPT drain. Flexible hose shall consist of corrugated metal inner hose and braided metal outer sheath. Assemblies shall be constructed from materials compatible with the fluid or gas being conveyed and shall be suitable for the system operating pressure and temperature. Provide assembly selected for 4 inches of movement.
- B. Provide CSA certified expansion loops for use in natural or propane gas piping systems.
- C. Where used in potable water systems, provide expansion loops of certified lead-free construction.

- D. Basis-of-Design Product: Subject to compliance with requirements, provide Metraflex Inc., Metraloop series, or comparable product by one of the following, or equal:

1. Flexicraft Industries.

#### 2.12 FLEXIBLE JOINTS

- A. Where indicated on Drawings, provide Metraflex Metrasphere, Style R, Mason Industries, or equal, Spherical Expansion Joints. Provide control units at each expansion joint, arranged to limit both expansion and compression.
- B. Flexible joints at entry points to building shall be Barco Ductile iron, Advanced Thermal Systems, or equal, threaded style with stainless ball and mineral filled seal.

#### 2.13 PIPE GUIDES

- A. Where flexible connections are indicated on Drawings, provide Metraflex style IV, B-Line, or equal, pipe guides in locations recommended by manufacturer. Maximum spacing from flexible connection to first pipe guide is 4 pipe diameters, and maximum spacing from second pipe guide is 14 pipe diameters.

#### 2.14 EQUIPMENT IDENTIFICATION

- A. Refer to Section 22 05 53 – Plumbing Identification.

#### 2.15 PIPE IDENTIFICATION

- A. Refer to Section 22 05 53 – Plumbing Identification.

#### 2.16 INSULATION WORK

- A. General:
1. For insulating domestic hot water pumps, refer to Section 22 50 00, Plumbing Equipment,
  2. Insulation products, including insulation, insulation facings, jackets, adhesives, sealants and coatings shall not contain polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations in amounts greater than 0.1 percent (by mass).
  3. Adhesives and sealants shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
  4. The term "piping" used herein includes pipe, valves, strainers and fittings.
  5. Apply insulating cement to fittings, valves and strainers and trowel smooth to the thickness of adjacent covering. Cover with jacket to match piping. Extend covering on valves up to the bonnet. Leave strainer cleanout plugs accessible.
  6. Provide pre-formed PVC valve and fitting covers.
  7. Provide Calcium Silicate rigid insulation and sheet metal sleeve, 18 inch minimum length at each pipe hanger. Seal ends of insulation to make vapor tight with jacket.
  8. Test insulation, jackets and lap-seal adhesives as a composite product and confirm flame spread of not more than 25 and a smoke developed rating of not more than 50 when tested in accordance with UL723 or ASTM E84.

9. Clean thoroughly, test and have approved, all piping and equipment before installing insulation and/or covering.
10. Repair all damage to existing pipe and equipment insulation whether or not caused during the work of this contract, to match existing adjacent insulation for thickness and finish, but conforming to flame spread and smoke ratings specified above.

B. Insulation of Piping:

1. Insulate domestic hot and tempered water with minimum 3-1/2 pounds per cubic foot density fiberglass with ASJ-SSL jacket. Insulation thickness shall be the following:
  - a. Pipe 3/4 inches and smaller: 1 inch thick.
  - b. Pipe 1 inch through 1-1/2 inches: 1-1/2 inches thick.
  - c. Pipe 2 inches and larger: 2 inches thick.
2. Insulate domestic hot water piping under slab on grade with Owens Corning Foamglas, preformed pipe insulation, or equal. Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Cover pipe and fittings with insulation manufacturer's recommended jacketing. Insulation thickness shall be the following:
  - a. Pipe 3/4 inches and smaller: 2 inches thick.
  - b. Pipe 1 inch and larger: 3 inches thick.
3. Insulate domestic cold water piping located within building, outside of insulation envelope in outside walls, vented attic spaces, and unheated spaces, including equipment rooms and below raised floor with 1 inch thick molded fiberglass, minimum 3-1/2 pound per cubic foot density, with ASJ-SSL jacket.
4. Insulate domestic cold water piping located outside building exposed to weather with minimum 3-1/2 pounds per cubic foot density fiberglass with ASJ-SSL jacket. Insulation thickness for all pipe sizes: 2 inches.
5. Insulate roof drain and overflow drain bodies, horizontal sections of rainwater leader piping and overflow piping, and condensate drains within the building envelope with 1 inch thick fiberglass, minimum 3-1/2 pound per cubic foot density, with ASJ-SSL jacket.
6. Insulate condensate drain piping in freezer with 3/4 inch thick Therma-Cel, Armaflex, or equal. Seal water tight per manufacturer's directions. Install heat tape prior to insulation of piping, in accordance with manufacturer's directions.
7. Insulate electrically heat-traced grease waste piping under slab on grade with Owens Corning Foamglas, preformed pipe insulation, or equal. Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Cover pipe and fittings with insulation manufacturer's recommended jacketing. Insulation thickness for all pipe sizes: 3 inches.
8. Exposed insulated piping within the building shall have a Zeston 2000 25/50, Proto Lo-Smoke, or equal, PVC jacket and fitting cover installed over the insulation, applied per manufacturer's instructions. Insulation shall be vapor tight before applying PVC jacket and fitting covers. Verify suitability with manufacturer of insulation. Insulation with pre-applied polymer jacket may be substituted at Contractor's option.
9. Where insulated piping is exposed to the weather apply aluminum jacket secured with 1/2 inch stainless-steel bands on 12 inch centers. Insulation shall be vapor tight before applying metal jacket, and aluminum fitting covers. Install jacketing with 2-inch overlap at longitudinal seams and

d end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Cover fittings with glass cloth, two coats of Foster Sealfas 30-36, and factory-fabricated aluminum fitting covers, of same material, finish, and thickness as jacket. Insulation shall be vapor tight before applying metal jacket and fitting covers.

a. Fitting covers:

- 1) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
- 2) Tee covers.
- 3) Flange and union covers.
- 4) End caps.
- 5) Beveled collars.
- 6) Valve covers.
- 7) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

b. Jacket thickness:

- 1) Pipes 10 inches diameter and smaller: Minimum .016 inch thick jacket with smooth finish.
- 2) Pipes 12 inches diameter and larger: Minimum .020 inch thick jacket with smooth finish.

### PART 3 - EXECUTION

#### 3.01 EXISTING MATERIALS

- A. Remove existing equipment, piping, wiring, construction, etc., which interferes with Work of this Contract. Promptly return to service upon completion of work in the area. Replace items damaged by Contractor with new material to match existing.
- B. Removed materials which will not be re-installed and which are not claimed by Owner shall become property of Contractor and shall be removed from Project site. Consult Owner before removing any material from Project site. Carefully remove materials claimed by Owner to prevent damage and deliver to Owner-designated storage location.
- C. Existing piping and wiring not reused and are concealed in building construction may be abandoned in place and all ends shall be capped or plugged. Remove unused piping and wiring exposed in Equipment Rooms or occupied spaces. Material shall be removed from Project premises. Disconnect power, water, gas, pump or any other active energy source from piping or electrical service prior to abandoning in place.
- D. Existing piping, ductwork, and equipment modified or altered as part of this Work shall comply with the most recent applicable code requirements.

#### 3.02 FRAMING, CUTTING AND PATCHING

- A. Special framing, recesses, chases and backing for Work of this Section, unless otherwise specified, are covered under other Specification Sections.

- B. Contractor is responsible for placement of pipe sleeves, hangers, inserts, supports, and location of openings for the Work.
- C. Cutting, patching, and repairing of existing construction to permit installation of equipment, and materials is the responsibility of Contractor. Repair or replace damage to existing work with skilled mechanics for each trade.
- D. Cut existing concrete construction with a concrete saw. Do not utilize pneumatic devices.
- E. Core openings through existing construction for passage of new piping and conduits. Cut holes of minimum diameter to suit size of pipe and associated insulation installed. Coordinate with building structure, and obtain Structural Engineer's approval prior to coring through existing construction.

### 3.03 PLUMBING DEMOLITION

- A. Refer to Division 01 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.
- B. Disconnect, dismantle and remove mechanical systems, equipment, and components indicated to be removed. Coordinate with all other trades.
  - 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 to remain with same or compatible piping material. Refrigerant system must be evacuated per EPA requirements.
  - 3. Equipment to Be Removed: Drain down and cap remaining 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.

### 3.04 ELECTRICAL REQUIREMENTS

- A. Provide adequate working space around electrical equipment in compliance with the California Electrical Code. Coordinate the Mechanical Work with the Electrical Work to comply.
- B. Furnish necessary control diagrams and instructions for the controls. Before permitting operation of any equipment which is furnished, installed, or modified under this Section, review all associated electrical work, including overload protection devices, and assume complete responsibility for the correctness of the electrical connections and protective devices. Motors and control equipment shall conform to the Standards of the National Electrical Manufacturers' Association. All equipment and connections exposed to the weather shall be NEMA IIR with factory-wired strip heaters in each starter enclosure and temperature control panel where required to inhibit condensation.
- C. All line voltage and low voltage wiring and conduit associated with the Temperature Control System are included in this Section. Wiring and conduit shall comply with Division 26.

### 3.05 PIPING SYSTEM REQUIREMENTS

- A. Drawing plans, schematic 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.

### 3.06 PRIMING AND PAINTING

- A. Perform priming and painting on the equipment and materials as specified herein.
- B. See Division 09 Painting Section(s) for detailed requirements.
- C. Priming and Painting:
  - 1. Exposed ferrous metals, including piping, which are not galvanized or factory-finished shall be primed and painted.
    - a. Black Steel Piping:
      - 1) Primer: One coat gray Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, comparable products by Rust-Oleum, Kelly Moore, or equal.
      - 2) Topcoat: Two coats gray Sherwin-Williams Pro Industrial Waterbased Alkyd Urethane Enamel, comparable products by Rust-Oleum, Kelly Moore, or equal.
  - 2. Metal surfaces of items to be jacketed or insulated except piping shall be given two coats of primer unless furnished with equivalent factory finish. Items to be primed shall be properly cleaned by effective means free of rust, dirt, scale, grease and other deleterious matter and then primed with the best available grade of zinc rich primer. After erection or installation, all primed surfaces shall be properly cleaned of any foreign or deleterious matter that might impair proper bonding of subsequent paint coatings. Any abrasion or other damage to the shop or field prime coat shall be properly repaired and touched up with the same material used for the original priming.
  - 3. Where equipment is provided with nameplate data, the nameplate shall be masked off prior to painting. When painting is completed, remove masking material.

### 3.07 EXCAVATING

- A. Perform all excavating required for work of this Section. Provide the services of a pipe/cable locating service prior to excavating activities to determine location of existing utilities.
- B. Unless shown otherwise, provide a minimum of 2'-6" cover above top of pipe to finished grade for all service piping, unless otherwise noted. Trim trench bottom by hand or provide a 4 inch deep minimum bed of sand to provide a uniform grade and firm support throughout entire length of pipe. For all PVC pipe and for PE gas pipe, bed the pipe in 4 inch sand bed. Pipe bedding materials should be clean crushed rock, gravel or sand of which 100 percent will pass a 1 inch sieve. For pipes that are larger than 10 inches in diameter, at least 95 percent should pass a 3/4 inch sieve, and for pipes 10 inches in diameter or smaller, 100 percent should pass a 1/2 inch sieve. All other materials should have a minimum sand equivalent of 50. Only a small proportion of the native soils will meet these



requirements without extensive processing; therefore, importation of pipe bedding materials should be anticipated. Pipe bedding materials shall be compacted in lifts not exceeding 6 inches in compacted thickness. Each lift shall be compacted to not less than 90 percent relative compaction at or above the optimum moisture content, in accordance with ASTM Specification D2940, except that bedding materials graded such that 100 percent of the material will pass a No. 200 sieve shall be compacted in 6 inch lifts using a single pass of a flat-plate, vibratory compactor or vibratory drum. Pipe bedding materials should extend at least to the spring line.

- C. Maintain all warning signs, barricades, flares, and red lanterns as required.
- D. For all trenches 5 feet or more in depth, submit copy of permit detailed drawings showing shoring, bracing, sloping, or other provisions to be made for worker protection from the hazard of caving ground during the excavation of such trenches. Obtain a permit from the Division of Industrial Safety prior to beginning excavations. A copy of the permit shall be available at the site at all times.

### 3.08 BACKFILLING

- A. Backfill shall comply with applicable provisions of Division 31 of these Specifications.
- B. Except under existing or proposed paved areas, walks, roads, or similar surfaces, backfill for other types of pipe shall be made using suitable excavated material or other approved material. Place backfill in 8 inch layers, measured before compaction, and compact with impact hammer to at least 90 percent relative compaction per ASTM D2940.
  - 1. Backfill plastic pipe and insulated pipe with sand for a minimum distance of 12 inches above the top of the pipe. Compact using mechanical tamping equipment.
- C. Entire backfill for excavations under existing or proposed pavements, walks, roads, or similar surfaces, under new slabs on grade, shall be made with clean sand compacted with mechanical tamping equipment vibrator to at least 90 percent relative compaction per ASTM D2940. Remove excess earth. Increase the minimum compaction within the uppermost two feet of backfill to 95 percent.
- D. Replace or repair to its original condition all sod, concrete, asphalt paving, or other materials disturbed by the trenching operation. Repair within the guarantee period as required.

### 3.09 PIPING SYSTEMS INSTALLATION

- A. At time of final connection, and prior to opening valve to allow pressurization of water and gas piping from existing systems, on site or off site, perform a pressure test to indicate static pressure of existing systems. If pressure on water piping is greater than 80 psi, or gas pressure is not as indicated on Contract Documents, inform Architect immediately. Do not allow piping systems to be pressurized without written consent of the Architect.
- B. General:
  - 1. All piping shall be concealed unless shown or otherwise directed. Allow sufficient space for ceiling panel removal.

2. Installation of piping shall be made with appropriate fittings. Bending of piping will not be accepted.
3. Install piping to permit application of insulation and to allow valve servicing.
4. Where piping or conduit is left exposed within a room, the same shall be run true to plumb, horizontal, or intended planes. Where possible, uniform margins are to be maintained between parallel lines and/or adjacent wall, floor, or ceiling surfaces.
5. Horizontal runs of pipes and/or electrical conduit suspended from ceilings shall provide for a maximum headroom clearance. The clearance shall not be less than 6'-6" without written approval from the Architect.
6. Close ends of pipe immediately after installation. Leave closure in place until removal is necessary for completion of installation.
7. Each piping system shall be thoroughly flushed and proved clean before connection to equipment.
8. Pipe the discharge of each relief valve, air vent, backflow preventer, and similar device to floor sink or drain.
9. Install exposed polished or enameled connections with special care showing no tool marks or threads at fittings.
10. Install horizontal valves with valve stem above horizontal.
11. Use reducing fittings; bushings shall not be allowed. Use eccentric reducing fittings wherever necessary to provide free drainage of lines and passage of air.
12. Verify final equipment locations for roughing-in.
13. Service Markers: Mark the location of each plugged or capped pipe with a 4 inch round by 30 inch long concrete marker, set flush with finish grade. Provide 2-1/2 inch diameter engraved brass plate as part of monument marker.
14. Furnish and install anchors or thrust blocks on PVC water lines in the ground, at all changes in direction of piping, and at all connections or branches from mains 1-1/2 inch and larger. Form anchors or thrust blocks by pouring concrete between pipe and trench wall. Thrust blocks shall be of adequate size and so placed as to take thrusts created by maximum internal water pressure. Sizing and placement shall be per manufacturer's recommendations, CPC, and IAPMO installation standards. Anchor piping to building construction.
15. Sanitary Sewer and Storm Drain: Grade piping inside building uniformly 1/4 inch per foot if possible but not less than 1/8 inch per foot. Run piping as straight as possible. Make piping connections between building piping and outside service pipe with cast iron reducers or increasers. Slope sewers uniformly between given elevations where invert elevations are shown.
16. Where piping is installed in walls within one inch of the face of stud, provide a 16 gauge sheet metal shield plate on the face of the stud. The shield plate shall extend a minimum of 1-1/2 inches beyond the outside diameter of the pipe.

C. Expansion Loops:

1. Install expansion loops where piping crosses building expansion or seismic joints, between buildings, between buildings and canopies, and as indicated on Drawings.
2. Install expansion loops of sizes matching sizes of connected piping.
3. Install grooved-joint expansion joints to grooved-end steel piping.
4. Materials of construction and end fitting type shall be consistent with pipe material and type of gas or liquid conveyed by the piping system in which expansion loop is installed.

D. Sleeves:

1. Install Adjus-to-Crete, Pipeline Seal and Insulator, or equal, pipe sleeves of sufficient size to allow for free motion of pipe, 24 gauge galvanized steel. The space between pipe and sleeves through floor slabs on ground, through outside walls above or below grade, through roof, and other locations as directed shall be caulked with oakum and mastic and made watertight. The space between pipe and sleeve and between sleeve and slab or wall shall be sealed watertight.
  2. At Contractor's option, Link-Seal, Metraflex Metraseal, or equal, casing seals may be used in lieu of caulking. Wrap pipes through slabs on grade with 1 inch thick fiberglass insulation to completely isolate the pipe from the concrete.
- E. Floor, Wall, and Ceiling Plates:
1. Fit all pipes with or without insulation passing through walls, floors, or ceilings, and all hanger rods penetrating finished ceilings with chrome-plated or stainless escutcheon plates.
- F. Firestopping:
1. Pack the annular space between the pipe sleeves and the pipe through all floors and walls with UL listed fire stop, and sealed at the ends. All pipe penetrations shall be UL listed, Hilti, 3M Pro-Set, or equal.
    - a. Install fire caulking behind mechanical services installed within fire rated walls, to maintain continuous rating of wall construction.
  2. Provide SpecSeal Systems UL fire rated sleeve/coupling penetrators for each pipe penetration or fixture opening passing through floors, walls, partitions or floor/ceiling assemblies. All Penetrators shall comply with UL Fire Resistance Directory (Latest Edition), and in accordance with Chapter 7, CBC requirements.
  3. Sleeve penetrators shall have a built in anchor ring for waterproofing and anchoring into concrete pours or use the special fit cored hole penetrator for cored holes.
  4. Copper and steel piping shall have SpecSeal plugs on both sides of the penetrator to reduce noise and to provide waterproofing.
  5. All above Systems to be installed in strict accordance with manufacturer's instructions.
  6. Alternate firestopping systems are acceptable if approved equal. However, any deviation from the above specification requires the Contractor to be responsible for determining the suitability of the proposed products and their intended use, and the Contractor shall assume all risks and liabilities whatsoever in connection therewith.
- G. Flashing:
1. Flashing for penetrations of metal or membrane roof for mechanical items such as flues and pipes shall be coordinated with the roofing manufacturer and roofing installer for the specific roofing type. The work of this section shall include furnishing, layout, sizing, and coordination of penetrations required for the mechanical work.
    - a. Furnish and install flashing and counterflashing in strict conformance with the requirements of the roofing manufacturer. Submit shop drawing details for review prior to installation.
    - b. Furnish and install counterflashing above each flashing required. Provide Stoneman, or equal, vandalproof top and flashing combination. Provide vandalproof top for each plumbing vent through roof. Elmdor/Stoneman Model 1540, 1550, 1570, or equal.

2. For all other types of roofing system, furnish and install around each pipe, where it passes through roof, a flashing and counterflashing. All flashing shall be made of four pound seamless sheet lead with 6 inch minimum skirt and steel reinforced boot. Counterflashing shall be cast iron. For vents, provide vandalproof top and flashing combination. Elmdor/Stoneman Model 1100-4, 1100-5, 1100-7, or equal.

H. Hangers and Supports:

1. Refer to Section 22 05 29 – Plumbing Pipe Support and Anchors.

3.10 UNION AND FLANGE INSTALLATION

- A. Install Watts, Epco, Nibco, or equal, dielectric unions or flanges at points of connection between copper or brass piping or material and steel or cast iron pipe or material except in drain, waste, vent, or rainwater piping. Bushings or couplings shall not be used. Dielectric unions installed in potable water systems shall conform to the lead-free requirements of the California Health and Safety Code Section 11 68 75.
- B. Install unions in piping NPS 2" and smaller, and flanges in piping NPS 2-1/2" and larger whether shown or not at each connection to all equipment and tanks, and at all connections to all automatic valves, such as temperature control valves. Unions installed in potable water systems shall conform to the lead-free requirements of the California Health and Safety Code Section 11 68 75.
- C. Locate the unions for easy removal of the equipment, tank, or valve.

3.11 ACCESS DOOR INSTALLATION

- A. Furnish and install access doors wherever required whether shown or not for easy maintenance of mechanical systems; for example, at concealed valves, strainers, traps, cleanouts, dampers, motors, controls, operating equipment, etc. Access doors shall provide for complete removal and replacement of equipment.

3.12 CONCRETE WORK

- A. Concrete work required for work of this Section shall be included under another section of the Specification, unless otherwise noted, including poured-in-place concrete work for installing precast manholes, catch basins, etc., and shall include reinforced concrete bases for pumps, tanks, compressors, fan units, boilers, unless the work is specifically indicated on the Drawings to be furnished under this Section.
- B. Thrust blocks, underground anchors, and pads for cleanouts, valve access boxes and washer boxes are included under this Section of the Specification. Concrete shall be 3000 psi test minimum. Refer to Division 03 for concrete types.

3.13 PIPE PROTECTION

- A. Wrap bare galvanized and black steel pipe buried in the ground and to 6" above grade, including piping in conduit, with one of the following, or equal:

1. Polyethylene Coating: Pressure sensitive polyethylene coating, "X-Tru-Coat" as manufactured by Pipe Line Service Corporation or "Green Line" wrap as manufactured by Royston Products, or equal.
  - a. Field Joints and Fittings: Protecto Wrap #1170 tape as manufactured by Pipe Line Service Corporation, or Primer #200 tape by Royston Products, or equal. Installation shall be as per manufacturer's recommendation and instructions.
2. Tape Wrap: Pressure-sensitive polyvinyl chloride tape, "Transtex #V-10 or V-20", "Scotchwrap 50", Slipknot 100, PASCO Specialty & Mfg., Inc., or equal, with continuous identification. Tape shall be a minimum of 20 mils thick for fittings and irregular surfaces, two wraps, 50 percent overlap, 40 mils total thickness. Tape shall be laminated with a suitable adhesive; widths as recommended by the manufacturer for the pipe size. Wrap straight lengths of piping with an approved wrapping machine.
- B. Field Joints: Valves and Fittings: double wrap polyvinyl chloride tape as above. Provide at least two thicknesses of tape over the joint and extend a minimum of 4 inches over adjacent pipe covering. Build up with primer to match adjacent covering thickness. Width of tape of fittings shall not exceed 3 inches. Tape shall adhere tightly to all surfaces of the fittings without air pockets.
- C. Testing: Test completed wrap of piping, including all epoxy painted piping with Tinker and Razor Co. test machine (San Gabriel, CA - 818-287-5259), Pipeline Inspection Company (Houston, TX - 713-681-5837), or equal.
- D. Cleaning: Clean all piping thoroughly before wrapping.
  1. Inspection: Damaged or defective wraps shall be repaired as directed. No wrapped pipe shall be covered until approved by Architect.
- E. Sleeve copper piping/tubing installed below slab with "Polywrap-C" polyethylene sleeve, as manufactured by Northtown Pipe Protection Products, or equal. Sleeve shall be a minimum of 6 mils thick, colored blue for domestic water piping and orange for other piping. Install sleeve per manufacturer's recommendations and instructions.
- F. Sleeve copper piping/tubing installed outside building below grade with "Polywrap-C" polyethylene sleeve, as manufactured by Northtown Pipe Protection Products, or equal. Sleeve shall be a minimum of 6 mils thick, colored blue for domestic water piping. Install sleeve per manufacturer's recommendations and instructions.
- G. Sleeve cast iron and ductile iron pipe below grade and below slab with "Polywrap" polyethylene sleeve, as manufactured by Northtown Pipe Protection Products, or equal. Sleeve shall be a minimum of 8 mils thick, colored natural. Install sleeve per manufacturer's recommendations and instructions.
- H. Covering: No rocks or sharp edges shall be backfilled against the wrap or sleeve. When backfilling with other than sand, protect wrap with an outer wrapping of Kraft paper; leave in place during backfill.

### 3.14 PIPE IDENTIFICATION

- A. Refer to Section 22 05 53 – Plumbing Identification.

### 3.15 EXPANSION ANCHORS IN HARDENED CONCRETE

- A. Refer to Structural Drawings.
- B. Qualification Tests: The specific anchor shall have a current ICC-ES report and evaluated in cracked concrete in accordance with Acceptance Criteria AC193. If the specific anchor satisfies cyclic testing requirements per Acceptance Criteria AC01, Section 5.6, the full allowable shear and tension loads listed in the current ICC-ES report and manufacturer's recommendations for the specific anchor may be used. Otherwise, the design shear and tension loads shall not be more than 80% of the listed allowable shear and tension loads for the specific anchor.
- C. Installation: The anchors must be installed in accordance with the requirements given in ICC Research Committee Recommendations for the specific anchor.
- D. Testing: Fifty percent of the anchors shall be load-tested on each job to twice the allowable capacity in tension, except that if the design load is less than 75 pounds; only one anchor in ten need be tested. If any anchor fails, all anchors must be tested. The load test shall be performed in the presence of a special inspector.
- E. The load may be applied by any method that will effectively measure the tension in the anchor, such as direct pull with a hydraulic jack, a torque wrench calibrated using the specific anchor or calibrated spring-loading devices. Anchors in which the torque is used to expand the anchor without applying tension to the bolt may not be verified with a torque wrench.

### 3.16 PIPING SYSTEM PRESSURE TESTING

- A. General:
  - 1. Perform operational tests under simulated or actual service conditions, including one test of complete plumbing installation with fixtures and other appliances connected.
  - 2. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
- B. Piping Systems: Test piping systems in accordance with the following requirements and applicable codes:
  - 1. Authority having jurisdiction shall witness tests of piping systems.
  - 2. Notify Architect at least seven days in advance of testing.
  - 3. All piping shall be tested at completion of roughing-in, or at other times as directed by Architect.
  - 4. Furnish necessary materials, test pumps, gases, instruments and labor required for testing.
  - 5. Isolate from system equipment that may be damaged by test pressure.
  - 6. Make connections to existing systems with flanged connection. During testing of new work, provide a slip-in plate to restrict test pressure to new systems. Remove plate and make final connection to existing system at completion of testing.
    - a. Authority having jurisdiction shall witness final connection to system.

- C. Test Schedule: No loss in pressure or visible leaks shall show after four hours at the pressures indicated.
- D. Testing of Sanitary Sewer, Drain, Vent, and Storm Drain may be done in segments in order to limit pressure to within manufacturer's recommendations. Test to 10 feet above highest point in the system.

| <u>System Tested</u>           | <u>Test Pressure PSI</u> | <u>Test With</u>                    |
|--------------------------------|--------------------------|-------------------------------------|
| Sanitary Sewer, Drain, Vent    | 10 Ft. Hd.               | Water                               |
| Storm Drain, Condensate Drains | 10 Ft. Hd.               | Water                               |
| Domestic Water                 | 125                      | Water                               |
| Natural Gas (PE)               | 60                       | Air & Non-corrosive Leak Test Fluid |
| Natural Gas (Steel)            | 100                      | Air & Non-corrosive Leak Test Fluid |
| Compressed Air                 | 200 lb.                  | Air & Non-corrosive Leak Test Fluid |
| Deionized Water                | 50                       | Water                               |

1. Flush deionized water lines with deionized water after test and approval.
2. Non-corrosive leak test fluid shall be suitable for use with piping material specified, and with the type of gas conveyed by the piping system.

### 3.17 TRACER WIRES

- A. Provide tracer wire for non-metallic gas and water pipe in ground outside of buildings. Use AWG #14 tracer wire with low density high molecular weight polyethylene insulation, and lay continuously on pipe so that it is not broken or stressed by backfilling operations. Secure wire to the piping with tape at 18 inch intervals. Solder all joints. Tracer wire insulation shall be colored yellow for gas piping, blue for water piping.
- B. Terminals: Precast concrete box and cast iron locking traffic cover, Brooks 3TL, or equal; cover marked with name of service; 6 inches of loose gravel below box. Plastic terminal board with brass bolts; identify line direction with plastic tags. Test for continuity between terminals, after backfilling, in presence of Inspector.
- C. Alternate: Use electronically detectable plastic tape with metallic core, Terra Tape D, manufactured by Reef Industries, Inc., Seton, Inc., Marking Services, Inc., or equal; tape 2 inches wide, continuously imprinted "CAUTION WATER (GAS, etc.) LINE BELOW". Install, with printed side up, directly over pipe, 18 inches below finish grade. Backfill material shall be as specified for the particular condition

where pipe is installed, but avoid use of crushed rock or of earth with particles larger than 1/2 inch within the top 12 inches of backfill. Take precautions to insure that tape is not damaged or misplaced during backfill operations. Terminal boxes not required.

### 3.18 OPERATION OF SYSTEMS

- A. Do not operate any plumbing equipment for any purpose, temporary or permanent, until all of the following has been completed:
  - 1. Complete all requirements listed under "Check, Test and Start Requirements."
  - 2. Piping has been properly cleaned. Piping systems shall be flushed and treated prior to operation.
  - 3. Filters, strainers etc. are in place.
  - 4. Bearings have been lubricated, and alignment of rotating equipment has been checked.
  - 5. Equipment has been run under observation, and is operating in a satisfactory manner.
- B. Provide test and balance agency with one set of Contract Drawings, Specifications, Addenda, Change orders issued, applicable shop drawings and submittals and temperature control drawings.

### 3.19 CHECK, TEST AND START REQUIREMENTS

- A. An authorized representative of the equipment manufacturer shall perform check, test and start of each piece of plumbing equipment. The representative may be an employee of the equipment manufacturer, or a manufacturer-certified contractor. Submit written certification from the manufacturer stating that the representative is qualified to perform the check test and start of the equipment.
  - 1. As part of the submittal process, provide a copy of each manufacturer's printed startup form to be used.
  - 2. Some items of specified equipment may require that check, test and start of equipment must be performed by the manufacturer, using manufacturer's employees. See specific equipment Articles in these Specifications for this requirement.
  - 3. Provide all personnel, test instruments, and equipment to properly perform the check, test and start work.
  - 4. When work has been completed, provide copies of reports for review, prior to final observation of work.
- B. Provide copies of the completed check, test and start report of each item of equipment, bound with the Operation and Maintenance Manual.
- C. Upon completion of the work, provide a schedule of planned maintenance for each piece of equipment. Indicate frequency of service, recommended spare parts (including filters and lubricants), and methods for adjustment and alignment of all equipment components. Provide a copy of the schedule with each operating and maintenance manual. Provide a copy of certification from the Owner's representative indicating that they have been properly instructed in maintenance requirements for the equipment installed.



### 3.20 PRELIMINARY OPERATIONAL REQUIREMENTS AND TESTS

- A. Prior to observation to determine final acceptance, put all mechanical systems into service and check that work required for that purpose has been done, including but not limited to the following condensed check list. Provide indexed report to tabulating the results of all work.
1. All equipment has been started, checked, lubricated and adjusted in accordance with the manufacturer's recommendations.
  2. Correct rotation of motors and ratings of overload heaters are verified.
  3. Specified filters are installed and spare filters have been turned over to Owner.
  4. All manufacturers' certificates of start-up specified have been delivered to the Owner.
  5. All equipment has been cleaned, and damaged painted finishes touched up.
  6. Missing or damaged parts have been replaced.
  7. Flushing and chemical treatment of piping systems has been completed and water treatment equipment, where specified, is in operation.
  8. Equipment labels, pipe marker labels, ceiling markers and valve tags are installed.
  9. Valve tag schedules, corrected control diagrams, sequence of operation lists and start-stop instructions have been posted.
  10. Preliminary test and balance work is complete, and reports have been forwarded for review.
  11. Automatic control set points are as designated and performance of controls checks out to agree with the sequence of operation.
  12. Operation and Maintenance Manuals have been delivered and instructions to the operating personnel have been made.
- B. Prior to the observation to determine final acceptance, operate all mechanical systems as required to demonstrate that the installation and performance of these systems conform to the requirements of these specifications.
1. Operate and test all mechanical equipment and systems for a period of at least five consecutive 8 hour days to demonstrate the satisfactory overall operation of the project as a complete unit.
  2. Commence tests after preliminary balancing and adjustments to equipment have been checked. Immediately before starting tests, install air filters and lubricate all running equipment. Notify the Architect at least seven calendar days in advance of starting the above tests.
  3. During the test period, make final adjustments and balancing of equipment, systems controls, and circuits so that all are placed in first class operating condition.
  4. Where Utility District rebates are applicable, demonstrate that the systems meet the rebate program requirements.
- C. Review of Contractor's Tests:
1. All tests made by the Contractor or manufacturers' representatives are subject to observation and review by the Owner. Provide timely notice prior to start of each test, in order to allow for observation of testing. Upon the completion of all tests, provide a letter to confirm that all testing has been successful.
- D. Test Logs:
1. Maintain test logs listing the tests on all mechanical systems showing dates, items tested, inspectors' names, remarks on success or failure of the tests.

E. Preliminary Operation:

1. The Owner reserves the right to operate portions of the plumbing system on a preliminary basis without voiding the guarantee.

3.21 CERTIFICATES OF INSTALLATION

- A. Contractor shall complete applicable "Certificates of Installation" forms contained in the California Building Energy Efficiency Standards and submit to the authorities having jurisdiction for approval and issuance of final occupancy permit, as described in the California Energy Code.

3.22 DEMONSTRATION AND TRAINING

- A. An authorized representative of the equipment manufacturer shall train Owner-designated personnel in maintenance and adjustment of equipment. The representative may be an employee of the equipment manufacturer, or a manufacturer-certified contractor. Submit written certification from the manufacturer stating that the representative is qualified to perform the Owner training for the equipment installed.
1. As part of the submittal process, provide a training agenda outlining major topics and time allowed for each topic.
  2. Some items of specified equipment require that training must be performed by the manufacturer, using manufacturer's employees. See specific equipment Articles in these Specifications for this requirement.
  3. Contractor shall provide three copies of certification by Contractor that training has been completed, signed by Owner's representative, for inclusion in Operation and Maintenance Manual. Certificates shall include:
    - a. Listing of Owner-designated personnel completing training, by name and title.
    - b. Name and title of training instructor.
    - c. Date(s) of training.
    - d. List of topics covered in training sessions.
  4. Refer to specific equipment Articles for minimum training period duration for each piece of equipment.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 01/31/2025 - Section was added in its entirety.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

## SECTION 22 05 29

## PLUMBING PIPE SUPPORTS AND ANCHORS

**PART 1 - GENERAL**

## 1.01 CONDITIONS OF THE CONTRACT

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to Work of this section.
- B. This section is a Division-22 Basic Plumbing Materials and Methods section and is part of each Division-22 section making reference to pipes and pipe fittings specified herein.

## 1.02 WORK INCLUDED

- A. Types of supports and anchors specified in this section include the following:
  - 1. Horizontal-piping hangers and supports.
  - 2. Vertical-piping clamps.
  - 3. Hanger-rod attachments.
  - 4. Building attachments.
  - 5. Saddles and shields.
  - 6. Spring hangers and supports.
  - 7. Miscellaneous materials.
  - 8. Anchors.

## 1.03 QUALITY ASSURANCE

- A. Manufacturer's: Firms regularly engaged in manufacture of supports, anchors, and seals of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. UL and FM Compliance: Provide products which are Underwriters' Laboratories listed and Factory Mutual approved.
- C. Provide pipe hangers and supports of which materials, design, and manufacture comply with ANSI/MSS SP-58.
- D. Select and apply pipe hangers and supports, complying with MSS SP-69.
- E. Fabricate and install pipe hangers and supports, complying with MSS SP-89.
- F. Terminology used in this section is defined in MSS SP-90.

- G. Provide hangers and supports in conformance with SMACNA Standards, latest edition.

#### 1.04 SUBMITTALS

- A. Product Data: Submit catalog cuts, specifications, installation instructions, and dimensioned drawings for each type of support, anchor, and seal. Submit pipe hanger and support schedule showing manufacturer's figure number, size, location, and features for each required pipe hanger and support, all in accordance with Division 1.

### PART 2 - MATERIALS

#### 2.01 GENERAL

- A. Support all piping so that it is firmly held in place by approved hangers and supports and special hangers as required. All Components shall support the weight of pipe, fluid, and pipe insulation based on spacing between supports with minimum factor of safety of five based on ultimate strength of material used. Do not exceed manufacturer's load rating. Do not support piping with plumbers tape, wire, rope, wood, or other makeshift devices.
- B. Structural considerations:
  - 1. Steel or concrete or wood roof/floor system including slabs or roof deck shall be in place and complete before installation of any plumbing piping system.
  - 2. Space hangers so maximum individual hanger load will not exceed values listed in paragraph "Installation of Hangers and Supports".
  - 3. Do not attach hangers to steel roof deck.
  - 4. Do not attach hangers to bottom of concrete filled floor deck except by permission of Architect.
  - 5. Attach hangers to beams whenever possible.
- C. Provide electroplate or galvanized finish for all material used for support of piping.

#### 2.02 HORIZONTAL-PIPING HANGERS AND SUPPORT

- A. General: Except as otherwise indicated, provide factory-fabricated horizontal-piping hangers and supports complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS-SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Use felt lined J hangers for installation at copper piping.

Adjustable Steel Clevises:

B-Line B3100

MSS Type 1

|                            |              |             |
|----------------------------|--------------|-------------|
| Adjustable J Hanger        | B-Line B3690 | MSS Type 5  |
| Vee Bottom Clevis Hanger   | B-Line B3106 | with B3106V |
| Split Pipe Rings:          | B-Line B3173 | MSS Type 11 |
| Clips:                     | B-Line B3180 | MSS Type 26 |
| Single Pipe Rolls:         | B-Line B3114 | MSS Type 41 |
| Adjustable Roller Hangers: | B-Line B3110 | MSS Type 43 |

- B. Isolate copper tubing from ferrous materials and hangers with two thicknesses of 1-inch wide 10-mil polyvinyl tape, spiral-wrapped around pipe. Total width shall be minimum of 3-inches. Not required if hanger has felt lining.

### 2.03 HANGER-RODS AND ATTACHMENTS

- A. General: Except as otherwise indicated, provide factory-fabricated hanger-rods and attachments complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal- piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide lock nuts at all threaded connections.

|                          |              |             |
|--------------------------|--------------|-------------|
| Steel Turnbuckles:       | B-Line B3202 | MSS Type 13 |
| Swivel Turnbuckles:      | B-Line B3224 | MSS Type 15 |
| Steel Weldless Eye Nuts: | B-Line B3200 | MSS Type 17 |
| Threaded Rod:            | B-Line B3205 |             |

- B. Pipe hanger rod size:

| Pipe Size                    | Rod Size   |
|------------------------------|------------|
| 2 Inches and Smaller         | 3/8 Inches |
| 2-1/2 Inches to 3-1/2 Inches | 1/2 Inches |
| 4 Inches to 5 Inches         | 5/8 Inches |
| 6 Inches                     | 3/4 Inches |

8 Inches to 12 Inches

7/8 Inches

Provide 3/8 inch rod for support of PVC and CPVC and provide continuous support.

- C. Trapeze suspension: B-Line B-22, or equal, 1-5/8 Inches width channel in accordance with manufacturers published load ratings. No deflection to exceed 1/180 of a span.
1. Trapeze Supporting Rods shall have a safety factor of five; securely anchor to building structure.
  2. Provide B-Line B2000 series pipe straps, or equal. Isolate copper pipe with two thicknesses of 2 Inches wide 10 mil polyvinyl tape, 3 inches wide.

## 2.04 BUILDING ATTACHMENTS

- A. General: Except as otherwise indicated, provide factory-fabricated building attachments complying with ANSI/MSS SP-58, of one of the following types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems.

### 1. Steel Structure

|                        |              |             |
|------------------------|--------------|-------------|
| Top Beam C-Clamps:     | B-Line B3031 | MSS Type 19 |
| Center Beam Clamps:    | B-Line B3050 | MSS Type 21 |
| Welded Attachments:    | B-Line B3083 | MSS Type 22 |
| Malleable C-Clamps:    | B-Line B3036 | MSS Type 23 |
| Malleable Beam Clamps: | B-Line B3054 | MSS Type 30 |

Provide retaining straps for all single sided beam clamps and C-clamps.

2. Wood Structure: Provide and install wood blocking as required to suit structure. Provide lag screws or thru bolts with length to suit requirements, and with size (diameter) to match the size of hanger rods required. Lag screws shall not be installed in tension, without written review and acceptance by Structural Engineer.

|                      |              |             |
|----------------------|--------------|-------------|
| Side Beam Angle Clip | B-Line B3062 | MSS Type 34 |
| Side Beam Angle Clip | B-Line B3060 |             |
| Ceiling Flange       | B-Line B3199 |             |

Blocking for support of piping shall be not less than 2 inch thick for piping up to 2 inch size (water filled) or 3 inch size (vapor filled). Provide 3 inch blocking for piping up through 5 inch size, and 4 inch blocking for larger piping. Provide support for blocking in accordance with Structural Engineers requirements.

Where lag screws are used, length of screw shall be 1/2 inch less than the wood blocking. Pre-drill starter holes for each lag screw.

3. Concrete Structure: Do not use powder actuated fasteners for support of overhead piping unless approved by Architect.

|                         |              |
|-------------------------|--------------|
| Concrete Insert         | B-Line B3014 |
| Spot inserts            | B-Line B2505 |
| Equipment Anchor Bolt   | B-Line B3022 |
| Metal Deck Ceiling Bolt | B-Line B3019 |
| Light Duty Spot Inserts | B-Line B2500 |

## 2.05 SADDLES AND SHIELDS

- A. General: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.

1. Protection Saddles: Fill interior voids with segments of insulation matching adjoining insulation.

|                          |              |             |
|--------------------------|--------------|-------------|
| Welded Protection Saddle | B-Line B3160 | MSS Type 39 |
|--------------------------|--------------|-------------|

2. Thermal Hanger Shields: Constructed of 360-degree insert of high density, 100 psi, water resistant calcium silicate, encased in 360-degree sheet metal shield. Provide assembly of same thickness as adjoining insulation.

- B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering thermal hanger shields, which may be incorporated in the work include the following:

1. B-Line systems Inc.
2. McDonald Supply
3. Pipe Shields, Inc.



## 2.06 VERTICAL-PIPING CLAMPS

- A. General: Except as otherwise indicated, provide factory-fabricated vertical-piping clamps complying with ANSI/MSS SP-58, of one of the following types listed, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated clamps for copper-piping systems.

Two-Bolt Riser Clamps: B-Line B3373 - MSS Type 8

- B. Support vertical piping risers securely to the pipe above each floor slab, with the arms of the clamp resting on the slab or the structural supports.
- C. Support pipe lines passing up through the building at each floor of the building. Bolt riser clamps securely to the floor slab.
- D. Support vertical piping risers securely to the structure at 10 foot centers maximum, for locations where vertical pipe length exceeds 12 feet.

## 2.07 MANUFACTURERS OF HANGERS AND SUPPORTS

- A. Available Manufacturers: Products listed are B-Line. Subject to compliance with requirements, manufacturers offering hangers and supports, which may be incorporated in the work include the following:
1. B-Line Systems Inc.
  2. Super Strut
  3. Power Strut
  4. Mason Mfg. Co., Div. of A-T-O, Inc.
  5. Grinnell Corp.
  6. Tolco Incorporated

## 2.08 MISCELLANEOUS MATERIALS

- A. Metal Framing: Provide products complying with NEMA Standard ML1.
- B. Steel Plates: Shapes and Bars: Provide products complying with ANSI/ASTM A36.
- C. Cement Grout: Portland cement (ANSI/ASTM C150, Type I or Type III) and clean, uniformly graded, natural sand (ANSI/ASTM C404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.
- D. Heavy Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards.

- E. Pipe Guides: Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of a bolted two-section outer cylinder and base with a two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation, (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

### **PART 3 - EXECUTION**

#### **3.01 PRODUCT HANDLING AND PROTECTION**

- A. Packaged materials delivered to the site shall be in their original, unopened wrapping with labels intact. Protect materials from water, the elements and other damage during delivery, storage and handling.
- B. Materials used in shop pre-fabricated assemblies need not be in their original wrapping, but shall be protected from water, the elements and other damage under delivery, storage and handling.

#### **3.02 PREPARATORY PROVISIONS**

- A. The Contractor shall be responsible for the examination and acceptance of all conditions affecting the proper construction and/or installation of the Work of this Section and shall not proceed until all unsatisfactory conditions have been corrected. Commencing work shall be construed as acceptance of all conditions by the Contractor as satisfactory for the construction and/or installation of the Work.

#### **3.03 PREPARATION**

- A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments.
- B. Prior to installation of hangers, supports, anchors and associated work, Installer shall meet at project site with Contractor, Installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section, for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

#### **3.04 INSTALLATION OF BUILDING ATTACHMENTS**

- A. Install building attachments at required locations within concrete or on structural steel for proper piping support. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert

securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.

- B. Install building attachments for wood frame construction to structural framing or to blocking provided for this purpose. Install fasteners in wood structure or blocking in the top 1/3 of the wood structure. Provide and install blocking in accordance with the requirements of the structure it is being attached to.
1. Install blocking for manufactured joists on both sides of joist, to provide equal loading. Install side beam angle clips with thru bolts and flat washers. Secure blocking to manufactured joists in accordance with manufacture's recommendations.
  2. Where blocking is provided, coordinate the location and installation with other trades.
  3. Install ceiling flanges on bottom of solid joists only, at ceiling construction.
  4. Where lag screws are used, pre-drill holes to suit the diameter of the lag screw.

### 3.05 INSTALLATION OF HANGERS AND SUPPORTS

- A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze-type hangers where possible. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not support piping from other piping. Install seismic restraints in accordance with CBC Chapter 16 and ASCE7-10.
- B. Pipe hanger and support spacing: Locate hangers or supports at each change of direction, within one foot of elbow, and space at or within following maximum limits (feet):

| Pipe Dia.        | Steel Fluid | Steel Vapor | Copper Fluid | Copper Vapor | CPVC & PVC |
|------------------|-------------|-------------|--------------|--------------|------------|
| 1/2 – 1 inches   | 6           | 8           | 5            | 6            | 4          |
| 1-1/4 - 2 inches | 7           | 10          | 6            | 6            | 4          |
| 2-1/2 - 3 inches | 10          | 10          | 10           | 10           | 4          |
| over 4 inches    | 10          | 10          | 10           | 10           | 4          |

1. Provide continuous support channel for all CPVC piping, with a minimum of one hanger per length of pipe.
2. For cast iron soil piping:
  - a) Support piping at every other joint for piping length of less than 4 feet.

- b) For piping longer than 4 feet, provide support adjacent within 18-inches to each joint.
  - c) Hanger shall not be installed on the coupling.
  - d) Provide support at each horizontal branch connection.
  - e) Provide sway brace at 40 feet- 0 inch maximum spacing for all suspended pipe with No-Hub joints.
- 3. Where grooved couplings are used, place hanger within 2 foot each side of fittings or refer to manufacturer's pipe support and anchorage guide.
  - 4. For piping of other materials, space hangers according to manufacturer's recommendations.
- C. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping. Where hangers and supports are used, the piping shall be hung independently of other piping.
  - D. Prevent electrolysis in support of copper tubing by use of hanger, and supports which are copper plated, or by other recognized industry methods.
  - E. Provisions for Movement: Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.
  - F. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
  - G. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 are not exceeded.
  - H. Insulated Piping: Comply with the following installation requirements.
    - 1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.
    - 2. Shields: Where low-compressive-strength insulation or vapor barriers are indicated on cold and chilled water piping, install thermal hanger shields. For pipe 8 inches and over, install wood insulation saddles.
    - 3. Saddles: Where insulation without vapor barrier is indicated, install protection saddles.
  - I. Gas piping – Anchor roof curb support at roof egress, transverse at 40-foot intervals and within 18-inches of each gas appliance.

### 3.06 INSTALLATION OF ANCHORS

- A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31, and to prevent transfer of loading and stresses to connected equipment, and as indicated on the drawings.
- B. Fabricate and install anchor by welding steel shapes, plates, and bars to piping and to structure. Comply with ANSI B31 and with AWS standards.
- C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to limit movement of piping and forces to maximums recommended by manufacturer for each unit.
- D. Anchor Spacing: Where not otherwise indicated, install fixed to structure anchors at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and bends at 40-feet on center. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping, and as indicated on the Drawings.
  - 1. Provide two guides at each side of expansion loop or compensator, and at all locations indicated on the Contract Drawings.

### 3.07 EXPANSION ANCHORS IN HARDENED CONCRETE

- A. Qualification Tests: Base allowable shear and withdrawal load on qualification tests of at least three (3) test specimens, using a factor of safety of five (5) on the average of the test values, or a factor of safety of four (4) on the lowest test value, whichever is lower. Until the test data for the various anchors can be evaluated, use not more than 80% of the allowable load listed in the ICBO Research Committee Recommendation for the specific anchor, and shall comply with latest CBC.
- B. Installation: The anchors must be installed in accordance with the requirements given in ICBO Research Committee Recommendations for the specific anchor.
- C. Limitations on Anchors in Withdrawal: Anchors acting in withdrawal shall not be used for major connections such as anchoring tilt-up walls, tie-downs, heavy continuously applied loads, frequent vibratory loads, etc.
- D. Job Testing: Fifty percent of the anchors shall be load-tested on each job to twice the allowable capacity in tension, except that if the design load is less than 75 pounds; only one anchor in ten need be tested. If any anchor fails, all anchors must be tested. The load test shall be performed in the presence of the project inspector.
- E. The load may be applied by any method that will effectively measure the tension in the anchor, such as direct pull with a hydraulic jack, a torque wrench calibrated using the specific anchor,

calibrated spring-loading devices, etc. Anchors in which the torque is used to expand the anchor without applying tension to the bolt may not be verified with a torque wrench.

3.08 ADJUSTMENT OF HANGERS AND SUPPORTS

- A. Adjust hangers and supports and place grout as required under supports to bring piping to proper levels and elevations.

3.09 EQUIPMENT BASES

- A. Concrete housekeeping bases will be provided as work of Division 32. Furnish to Contractor, scaled layouts of all required bases, with dimensions of bases, and location to column center lines. Furnish templates, anchor bolts, and accessories, necessary for base construction.
- B. Provide structural steel stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide factory-fabricated tank saddles for tanks mounted on steel stands.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 01/31/2025 – Section was added in its entirety.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

## SECTION 22 05 48

## PLUMBING VIBRATION AND SEISMIC CONTROL

**PART 1 – GENERAL****1.01 CONDITIONS OF THE CONTRACT**

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to Work of this section.
- B. This section is a Division-22 Basic Plumbing Materials and Methods section and is part of each Division-22 section making reference to pipes and pipe fittings specified herein.

**1.02 WORK INCLUDED**

- A. Types of vibration isolation products specified in this section include the following:
  - 1. Vibration isolators and hangers.
  - 2. Base and rails.
  - 3. Flexible pipe connectors.
  - 4. Isolation pads.
- B. Seismic restraints, isolators and associated miscellaneous support steel.
- C. Vibration isolation products, furnished as part of factory-fabricated equipment, are specified as part of the equipment assembly in other Division 22 section.
- D. Pipe supports and anchors are specified as part of other Division 22 sections.

**1.03 QUALITY ASSURANCE**

- A. Product Qualification: Provide each type of vibration isolation unit produced by specialized manufacturer, with not less than 5 years' successful experience in production of units similar to those required for project.
- B. Manufacturer Certification: Where vibration isolation support units are indicated for minimum static deflection, provide manufacturer's certification that units have been tested and comply with indicated requirements.
- C. Design Criteria:
  - 1. SMACNA Compliance: Provide isolation and seismic snubbing in accordance with standards of SMACNA.
  - 2. Unless noted otherwise, all isolators shall be from single manufacturer.
  - 3. Select isolation devices for uniform static deflections according to distribution of weight.
  - 4. Select isolators to ensure against vibration and noise transmission from equipment to building structure through mounts and hangers. Coordinate weights and locations as required.
  - 5. Isolators shall be OSHPD pre-approved. Non-approved isolators will not be considered.



D. Reference Standards:

1. SMACNA: "Sheet Metal and Air Conditioning Contractors National Association, Inc." Reference shall be to the latest material available, and to all SMACNA manuals which apply.

1.04 SUBMITTALS

A. Product Data:

1. Provide materials lists, catalog data sheets, manufacturer's drawings and technical literature covering details of all items specified or shown on drawings.
2. Spring isolators:
  - a. Spring diameter.
  - b. Static deflection.
  - c. Compressed spring height.
  - d. Solid spring height.
  - e. Number of active coils.
  - f. Ratio of horizontal to vertical stiffness.
  - g. Operating height.
  - h. Spring constant.
  - i. Vertical load for each spring.
  - j. Location and designation of each isolator.
  - k. Calculate horizontal and vertical loading and bending moment due to horizontal force applied at the center of gravity of the equipment. Calculate bolt requirements.
  - l. Indicate all bases and rail clearance of 1 IN.

B. Shop Drawings:

1. Submit plans, elevations and sections and details showing installation, operating heights and spring constants.

C. Project information:

1. Static seismic calculations for all equipment, piping and miscellaneous structural steel connections to building frame.
  - a. Calculations performed by a licensed Civil or Structural Engineer employed by isolation manufacturer for a minimum of five years.
2. Dynamic seismic calculations:
  - a. Provide in the form of a computer report.
  - b. Performed by a licensed Civil or Structural Engineer employed by isolation manufacturer for a minimum of five years.
  - c. List six natural frequencies of the system, with and without restraints.
  - d. List most probable maximum displacements at restraint locations.

- e. List maximum acceleration at center of gravity of each piece of equipment.
  - f. List most probable force at each restraint.
3. Certification of seismic restraints.
- a. Substantiated by calculations or test reports verified by a licensed Civil or Structural Engineer.

## PART 2 – PRODUCTS

### 2.01 GENERAL

- A. Provide piping and equipment isolation systems as specified or as indicated on drawings.
- B. Manufacturer shall be responsible for the proper selection of isolators to accomplish the specified minimum static deflection, based on weight distribution of equipment to be isolated.
  - 1. Select vibration isolators in accordance with weight distribution to produce reasonably uniform deflection.
  - 2. The vibration isolators selected shall have no less than 80 percent of the deflections given in the vibration isolation schedule.
  - 3. Furnish a complete set of shop drawings of all plumbing and electrical equipment to receive vibration isolation devices to the vibration isolation materials manufacturer. The shop drawings to be furnished shall include operating weights of the equipment to be isolated and the distribution of weight at support points.
- C. Manufacturer shall be responsible for selection of isolators to meet seismic codes.
- D. Provide vibration isolation equipment including mountings and miscellaneous structural steel connections to building frame, hangers, structural steel bases, welded concrete pouring forms and flexible pipe connectors from a single manufacturer of vibration isolation equipment. The isolation materials manufacturer shall be responsible for the structural design of steel beam bases and concrete inertia bases to support plumbing equipment scheduled to receive such supplementary base.
- E. The Contractor shall furnish a complete layout of piping, including vertical risers, to be isolated to the vibration isolation materials manufacturer. Layout shall show size or weight and support points of the piping system.
- F. If vibration isolators with a deflection greater than the minimum specified are required to meet sound criteria or because of system dynamics, suitable isolation systems shall be submitted for review prior to any installation work.
- G. Coat all vibration isolation systems exposed to moisture or an outdoor environment as follows:
  - 1. All steel parts to be hot dipped galvanized.
  - 2. All bolts to be cadmium plated.
  - 3. All springs to be cadmium plated and neoprene coated.
- H. Manufacturer: Subject to compliance with requirements, provide vibration isolation products of

one of the following:

1. Kinetics Noise Control, Inc.
2. Korfund Dynamics Corp.
3. Mason Industries, Inc.
4. Vibration Eliminator Co., Inc.
5. Vibration Mountings and Controls, Inc.

## 2.02 VIBRATION ISOLATION SCHEDULE

A. The minimum static deflection and type of vibration isolation system shall be as follows:

B. Vibration Isolator Types and Minimum Static Deflection for Equipment and Components

| Type of Machinery             | Isolator Type (*) | Suggested Min static Deflection, inches. Shall Meet Job Conditions |
|-------------------------------|-------------------|--------------------------------------------------------------------|
| Pumps                         | N-B-2             | 0.10                                                               |
| Mechanical Room Piping        | H-3               | 0.50                                                               |
| Piping Over 3"                | PNR-3             | ---                                                                |
| Miscellaneous Suspended Pumps | H-3               | 1.5                                                                |
| Pump Flexible Connections     | PFC               | ---                                                                |
| Pipe Flexible Hoses           | PFH               | ---                                                                |

(\*) Equipment Vibration Isolation Schedule designations as follows. Hyphenated designations are combinations of the following:

1. H – Hanger-type spring isolator
2. B - Structural steel base, Type B
3. 2 - Seismic snubber, Type 2
4. 3 - Seismic cables, Type 3
5. N - Neoprene rubber
6. CRI - Composite rubber isolator
7. PNR - Neoprene/rubber isolators for pipe hangers
8. MF - Stainless steel flexible connectors
9. PFC - Twin Sphere Type flexible connectors
10. PFH - Rubber/cloth pipe flexible hoses
11. RVIR-CR – Restrained vibration isolation roof – curb rails.

## 2.03 DESCRIPTION OF ISOLATORS

A. Hanger Type Isolators:

1. Provide combination metal spring and rubber isolator in series.
2. Spring isolators shall be adjustable, free-standing and laterally stable without the housing. Mount spring in a neoprene cup between the spring and the bottom of the hanger. The neoprene/rubber cup shall include a bushing that projects into the bottom opening.
3. Provide springs with horizontal stiffness equal to at least 0.75 times the vertical stiffness and a minimum additional travel to solid equal to 50 percent of the rated deflection.
4. A double deflection neoprene or rubber spring shall be in series with the metal spring. The spring shall have a minimum thickness of 2 IN.
5. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30-degree arc before contacting the hole.
6. Metal and neoprene spring shall be encased in a steel bracket.
7. Pipes and equipment that must not move during installation shall use pre-compressed springs. Deflection shall be clearly indicated by means of a permanent scale.
8. Acceptable Suppliers: The following or equal:
  - a. Mason Industries, Inc.;
    - 1) Model: 30N or W30N, standard or equal.
    - 2) Model: PC30N or W30N, pre-compressed or equal.

B. Composite Rubber Isolators:

1. Provide pads to fit under frame of equipment to be isolated plus a combined washer and bushing that fits through bolt holes to prevent contact between fastener and frame. Washer and bushing may be single piece or two separate pieces.
2. Synthetic rubber isolator shall be manufactured of all new materials and composed of multiple layers of pre-stressed duct, 8 ounce per net square yard impregnated and bound with a high quality rubber compound. Pads shall be of uniform thickness.
3. The rubber shall contain rot and mildew inhibitors and anti-oxidants.
4. Material shall withstand moderate exposure to moisture, oils and chemicals.
5. The dynamic spring rate properties shall resist more than five percent permanent compression set.
6. Shore Durometer shall not be less than 80 nor more than 95.
7. Acceptable Suppliers: Fabreeka Products Company, Inc.

C. Neoprene Isolators:

1. Rubber pads shall be at least 5/16 inch thick with cross-ribbed or waffle design. Provide optional pad thickness to suit application.
2. Material shall be resistant to water and to chemicals and oils to be encountered in the pumping station.
3. For concentrated loads, provide steel bearing plates bonded or cold cemented to the pads.
4. Size pads for not more than 50 psi or as recommended by the pad manufacturer. Select durometer to suit application.
5. Acceptable Suppliers: Mason Industries, Inc.; Model: Super W or equal.

D. Rubber Neoprene Pipe Isolators:

1. Pipe isolators shall comprise an internal rubber or neoprene material that isolates pipe from hanger and structure.
2. Isolation material shall be either a rubber or neoprene material that prevents contact between the pipe and the structure. The rubber shall have between a 45 to 55 durometer rating and a minimum thickness of 1/2 inch.
3. Acceptable Suppliers:
  - a. Vertical runs to fixture: Acousto-Plumb or equal.
  - b. Horizontal runs: B-Line Systems, Inc.; Kin-Line, Inc.; Acousto-Plumb or equal.

E. Wall Penetration Isolators:

1. Either a split seal isolator or loose fill isolator shall be used.
2. The split seal shall comprise of two bolted pipe halves with at least 0.25 inches thick neoprene sponge bonded to the inner faces.
  - a. The seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping.
  - b. Seals shall project a minimum of 1 inch past either face of the wall.
  - c. Where temperatures exceed 240°F, 6 lb./cu. it. or greater density fiberglass may be used in place of the neoprene sponge.
3. The loose fill isolator shall comprise a combination of fiberglass insulating and non-hardening caulking.
  - a. A 1/4 inch to 3/4 inch gap shall be left around the object penetrating the wall of floor.
  - b. Objects penetrating a wall shall be supported on either side of the wall. Objects penetrating the floor shall be support on the top of the floor.
  - c. The opening around the penetration shall be filled loosely with the fiberglass insulation.
  - d. The opening is then to be sealed air tight with the non- hardening caulking compound.
  - e. A rubber or metal escutcheon may be used over this to cover the mastic.

2.04 DESCRIPTION OF BASES AND RAILS

A. Restrained Vibration Isolation Roof-Curb Rails:

1. Manufacturers:
  - a. Kinetics Noise Control, Inc.
  - b. Mason Industries, Inc.
  - c. Vibration Mountings & Controls/Korfund.
  - d. M. A. Sausse
2. Curb mounted rooftop equipment shall be mounted on spring isolation curbs. The lower

member shall consist of a sheet metal Z section containing adjustable and removable steel springs that support the upper floating section. The upper frame must provide continuous support for the equipment and must be captive so as to resiliently resist wind and seismic forces. Limit stops shall be located below the upper spring attachment to limit horizontal displacement due to angular misalignment. All directional neoprene snubber bushings shall be a minimum of 1/4" thick.

3. Steel springs shall be laterally stable and rest on 1/4" thick neoprene acoustical pads and have a minimum deflection of 3" with an additional 1-1/2" deflection to solid. Spring diameter must be a minimum of 4". Spring adjustment shall utilize a level lift mechanism to reduce side-sway and limit short circuits.
4. Hardware must be plated and the springs provided with a rust resistant finish.
5. The curbs waterproofing shall consist of a continuous galvanized flexible counter flashing nailed over the lower curbs waterproofing and joined at the corners by EPDM bellows.
6. All spring locations shall have access ports with removable waterproof covers. Lower curbs shall have provision for 2" of insulation.
7. The roof curbs shall be built to seismically contain the rooftop unit. The unit must be solidly fastened to the top floating rail, and the lower Z section anchored to the roof structure. Curb shall have anchorage preapproval "R" from OSHPD in the state of California attesting to the maximum certified horizontal and vertical load ratings. Anchorage of the isolation system shall be certified by a licensed engineer, employed by the isolation manufacturer for a minimum of 5 years with documented experience in the design of flexibly mounted systems.

B. Type B:

1. Structural steel base:
  - a. Rectangular structural beam frames shall be furnished.
  - b. The frame will be specifically designed for rigidity without concrete fill.
  - c. All perimeter beam members shall have a minimum depth of 1/10 of the longest dimension. The beam depth need not exceed 14 inches.
  - d. Height saving brackets will be employed where possible to provide a base clearance of 1 inch.
  - e. Acceptable Suppliers: Mason Industries; Type W or equal.

## 2.05 DESCRIPTION OF SEISMIC RESTRAINT

A. Type 2: Snubber.

1. The snubber shall be capable of handling shock or seismic loads in all directions.
2. The unit shall comprise interlocking steel members restrained by a bridge bearing neoprene bushing.
3. The bushing shall be replaceable and shall be a minimum of 1/4 inch thick.
4. Provide a 1/8 inch minimum air gap in the snubber design in all direction before contact is made between the rigid and resilient surfaces.
5. Snubber end shall be removable to allow inspection of internal clearance. Neoprene bushing shall be rotated to insure no short circuit exists.

6. Acceptable Suppliers: Mason Industries; Model: Z-1225 or equal.

B. Type 3: Cables

1. Steel cables shall be capable of handling supported load plus seismic load.
2. Cables shall be arranged to achieve all directional restraint.
3. Cables shall have sufficient slack to avoid short circuiting the vibration isolators.
4. Submittal drawings shall indicate proposed method of achieving vertical restraint.
5. Acceptable Suppliers: Mason Industries; Model: SSC or equal.

2.06 DESCRIPTION OF FLEXIBLE CONNECTORS

A. Metal Flexible Connectors:

1. An 18-inch long metal flexible connector shall be used at the connection of the turbocharger outlet to the exhaust pipe.
2. A minimum 6-inch long flexible connection shall be used at the connection of the exhaust pipe to the first silencer inlet.
3. Connections shall be all stainless steel.
4. Acceptable Products: Hyspan Precision Products; Model: Exhaust Flexible Connectors or equal.

B. Pipe Flexible Connectors: Neoprene type.

1. All pump inlet and discharges shall be joined to the pipes using flexible neoprene connectors.
2. Flexible connectors shall be manufactured of multiple ply of tire cord fabric and neoprene for uses on all lines except refrigerant lines.
3. No steel wire or rings shall be used as pressure reinforcement.
4. Double sphere flexible connectors shall be used at all locations. Single sphere flexible elbows shall not be used.
5. Control cables or rods shall only be used where pipe sizes exceed 12 inches and pressures are at or above 100 psi. If control cables or rods are used, the end fittings shall be isolated from the cable or rod by means of 1/2 inch thick bridge bearing neoprene washer bushings designed for a maximum of 1000 psi.
6. Connectors 2 inches diameter or less shall use threaded or flanged ends.
7. Connectors greater than 2 inches diameter shall use floating galvanized steel flanges.
8. The minimum pressure rating shall be 150 psi at 220°F.
9. Acceptable suppliers: Mason Industries, Inc.; Model: MFTNC, or equal.

C. Flexible pipe hoses: Stainless steel type.

1. Flexible connections in refrigerant and other high temperature lines shall be stainless steel braid and carbon steel fittings.
2. Connectors 2 inch diameter or less shall use male threaded nipples.
3. Connectors greater than 2 inch diameter shall be flanged flanges.
4. Hoses for thermal fluid must be suitable for 500°F operating temperature and flanged.
5. Acceptable Suppliers: Mason Industries, Inc.; Model: BSS, or equal.

D. Flexible pipe hoses: Stainless steel type.

1. Provide an inner tube of a non-toxic synthetic polymer, suitable for water temperatures from 5 to 230 degrees F., and an outer covering of braided stainless steel.
2. Provide swivel end connections, female or male pipe thread as required.
3. Hoses shall be 24 inches long, full pipe size of the branch feeding the heat pump, with pressure ratings as follows:
 

|    |                  |         |
|----|------------------|---------|
| a. | 3/4 inch size:   | 300 psi |
| b. | 1 inch size:     | 225 psi |
| c. | 1-1/4 inch size: | 200 psi |
4. Hoses shall meet flame retardant testing standards similar to UL No. 723, MFPA No. 255, ANSI No. 2.5, UBC No. 42-1, and ASTM No. E34. Manufacturer shall provide independent laboratory tests verifying compliance with these standards.
5. Testing for 10 minutes with 72 to 80 degree water flowing through the hose and a flame exposure temperature of 1400 to 1500 degrees F. shall be equal to the following:
 

|    |                   |   |
|----|-------------------|---|
| a. | Flame Spread      | 0 |
| b. | Fuel Contribution | 0 |
| c. | Smoke Density     | 5 |

### PART 3 – EXECUTION

#### 3.01 PREPARATION

A. Structural Bases:

1. The cooling tower shall be supported on a structural steel base designed and supplied by the vibration isolator manufacturer.
2. Pumps shall be supported on a structural steel base designed and supplied by the vibration isolator manufacturer.

#### 3.02 ISOLATORS, BASES AND SEISMIC INSTALLATION

A. General:

1. Isolators shall be installed per the requirements of the manufacturer.
2. All vibration isolators for a single piece of equipment shall be installed to provide equal deflection and load.
3. All connections to vibration isolated equipment shall be through flexible connections. This shall include all piping, electrical connections, fuel lines, structural elements, etc.
4. Equipment installed on metal spring isolators shall rock freely or move freely within limits of stop or seismic snubber restraints.

B. Hanger Spring Isolators:

1. All pipes supported from the ceiling within the mechanical equipment room shall be provided with hanger isolators. Provide hanger isolators for three supports after the



mechanical equipment room. Provide seismic cables at each isolator.

2. Provide hanger type isolators and Type 3 seismic cables on all ceiling supported fans and pumps.
3. Hanger isolators shall be used on the engine exhaust pipes. Seismic cables shall be used at isolator, Type 3.
4. Hanger spring isolators shall be hung plumb to reduce chance of rod contacting spring housing.
5. After installation, confirm that unit can move or rock freely on spring.
6. Confirm the operating height is per manufacturer's submittal and that minimum static deflection is per Specifications.
7. Insure that all seismic cables are slack and that equipment can move freely.

C. Composite Rubber Isolator:

1. Install isolator at bearing points around both geared and gearless elevator equipment. This shall include the bearing points for the bedplate of the gearless drive, the frame of the motor generator and hoisting machine of the gearless machine.
2. Install isolator material under bolts and through bolt-hole when securing equipment to structure. The isolator shall be separated from the bolt by a heavy flat washer that will not deform under the load.
3. The bolts shall be torqued per isolator manufacturer's guidelines and as required by the elevator equipment manufacturer.
4. Inspect that rubber isolator is not deflected to the point of excess deformation. Insure that equipment does not contact the building structure.

D. Neoprene Isolators:

1. Neoprene pads shall be installed under the boilers, chillers, domestic water booster system, filter bank and coil bank.
2. Install pads so that maximum stress level is not exceeded.
3. Insure that no part of isolated equipment is in contact with the structure or any un-isolated component.

E. Neoprene/Rubber Isolators for Pipe Hangers:

1. All horizontal pipes not supported on a hanger isolator shall be supported using a neoprene/rubber isolator.
2. The isolators shall be installed per the manufacturer's recommendations if commercial product is used.
3. Contractor will insure that after pipe is secured that there is discontinuity between pipe and hanger and between pipe and structure.
4. Insure that clamp around rubber/ neoprene pad is not excessively tightened as this increases the stiffness of the isolator and short circuits the intended isolation quality of the hanger.

### 3.03 FLEXIBLE CONNECTOR INSTALLATION

A. Metal Flexible Connector:

1. The flexible connectors shall be installed to permit lateral and longitudinal motion of the piping.
  2. Inspect installation, insuring that small motion is possible in radial and axial directions.
- B. Where necessary, thrust restraint springs shall be used to prevent excessive motion.
- C. Pipe Flexible Connectors:
1. All pump suction and discharges shall be joined to the pipes using flexible neoprene connectors.
  2. Employ flexible connector at juncture with vibration isolated equipment.
  3. Install flexible connectors per manufacturer's instructions.
  4. Flexible connections are to be used within one to three pipe diameters of the prime mover.
  5. Provide flexible pipe connections hose to suit the application. Shop drawings shall indicate specific applications.
  6. Flexible connectors shall be installed on the equipment side of the shut-off valves.
- D. Pipe Flexible Hoses:
1. Install metal flexible hoses at the following locations:
    - a. Air compressor discharge piping.
    - b. At condensate drain connections to heat pumps and air handlers.
  2. Provide flexible pipe hose to suit the application. Shop drawings shall indicate specific applications.
  3. Flexible connectors shall be installed on the equipment side of the shut-off valves.

### 3.04 INSTALLATION

- A. Install in accordance with manufactures instructions.
- B. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
- C. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- D. Provide seismic snubbers for all equipment and piping mounted on isolators. Each inertia base shall have minimum of four seismic snubbers located close to isolators. Snub equipment designated for post-disaster use to 0.05 inch maximum clearance. Other snubbers shall have clearance between 0.15 inch and 0.25 inch.
- E. Support piping connections to equipment mounted on isolators using isolators or resilient hangers as follows:
1. Up to 4 inches pipe size: First three points of support.
  2. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0

inch static deflection or ½ static deflection of isolated equipment.

### 3.05 FIELD QUALITY CONTROL

- A. Inspect isolated equipment after installation and submit report. Include static deflections.

### 3.06 VIBRATION AND DYNAMIC BALANCING

- A. All equipment submitted and installed by Division 22 shall not exceed maximum tolerances as specified by the "International Research and Development Corporation", Worthington, Ohio, measured by the displacement, peak to peak, in the horizontal, vertical and axial axis as follows:
  - 1. Pump and Electric Motors: Below severity chart labeled "SLIGHTLY ROUGH", maximum vibration velocity of 0.157 in/sec, peak and corresponding displacement (mils), peak-to-peak.
- B. Where installed equipment noise or vibration is objectionable to the Owner's Representative, it shall be responsibility of the contractor to conduct testing to confirm that the equipment does not exceed the standard.
- C. Correction shall be made to all equipment, which exceeds vibration tolerances specified above. Final vibration levels shall be reported as described above.

### 3.07 TESTING

- A. Provide all tests specified hereinafter and as otherwise required. Provide all test equipment, including test pumps, gauges, instruments, and other equipment required. Test all rotational equipment for proper direction of rotation. Upon completion of testing, certify to the Owner's Representative, in writing, that the specified tests have been performed and that the installation complies with the specified requirements and provide a report of the test observations signed by qualified inspector.
- B. Temperature Control: Test all control functions to assure that all systems are controlling as specified or as otherwise necessary and that all controls are adjusted to maintain proper room temperatures. The manufacturer's representative shall perform all tests.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 09/30/2022 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

SECTION 22 05 53  
PLUMBING IDENTIFICATION

**PART 1 - GENERAL**

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe Markers.

1.02 RELATED REQUIREMENTS

- A. Refer to the General Conditions, Special Conditions and Division 1 General Requirements. The requirements of these sections apply to this section.
- B. Section 09 90 00 - Paints and Coatings: Identification painting.

1.03 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers; 2007.

1.04 SUBMITTALS

- A. See Section 00 72 00 - Submittals, for submittal procedures.
- B. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- E. Project Record Documents: Record actual locations of tagged valves.

**PART 2 - PRODUCTS**

2.01 MANUFACTURERS

- A. Brady Corporation: [www.bradycorp.com](http://www.bradycorp.com).
- B. Seton Identification Products: [www.seton.com/aec](http://www.seton.com/aec).

## 2.02 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved letters.
  - 1. Letter Color: White.
  - 2. Letter Height: Equipment, control panels 1 inch.
  - 3. Letter Height: Thermostats and small control components, 1/4 inch.
  - 4. Background Color: Black.

## 2.03 TAGS

- A. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- B. Chart: Typewritten letter size list in anodized aluminum frame.

## 2.04 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
  - 1. Access Doors and Similar Operational Instructions: Minimum 3/4" high letters.
- B. Stencil Paint: As specified in Section 09 90 00, semi-gloss enamel, colors conforming to ASME A13.1.

## 2.05 PIPE MARKERS

- A. Comply with ASME A13.1.
- B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.
- D. Service Markers: Identify buried plugged or capped pipe with concrete marker, 4 inch diameter by 30 inches long, set flush with grade. Provide engraved brass nameplate identifying pipe stub.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

### 3.02 INSTALLATION

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.

- C. Apply stencil painting in accordance with Section 09 90 00.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- F. Identify domestic hot water heating equipment, including water heaters, pumps, expansion tanks, etc. with plastic nameplates.
- G. Identify control panels and major control components outside panels with plastic nameplates.
- H. Identify valves in main and branch piping with tags.
- I. Tag automatic controls, instruments, and relays. Key to control schematic.
- J. Identify piping, concealed or exposed, with plastic pipe markers. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- K. Provide red ceiling dots to locate valves above T-bar type panel ceilings. Locate in corner of T-bar panel closest to equipment.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 09/30/2022 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 01/31/2025 – Added 1.02, paragraphs C thru E.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- 4-band Husky clamps are approved for underground piping. 2-band is approved for above ground piping, no exceptions.



## SECTION 22 10 00

## PLUMBING PIPING SYSTEMS

**PART 1 - GENERAL****1.01 SUMMARY****A. Section Includes:**

1. Pipe and fittings.
2. Valves.
3. Domestic water piping specialties.
4. Gas piping specialties.
5. Drain and waste piping specialties.

**1.02 RELATED REQUIREMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 22 00 50 Basic Plumbing Materials and Methods.
- C. Section 22 05 29 Plumbing Pipe Supports and Anchors.
- D. Section 22 05 48 Plumbing Vibration and Seismic Control.
- E. Section 22 05 53 Plumbing Identification.

**1.03 ACTION SUBMITTALS**

- A. For additional requirements, refer to Section 22 00 50, Basic Plumbing Materials and Methods.
- B. Product Data: Submit manufacturer's technical product data and installation instructions for plumbing piping systems materials and products.

**1.04 INFORMATIONAL SUBMITTALS**

- A. For additional requirements, refer to Section 22 00 50, Basic Plumbing Materials and Methods.
- B. Provide welding certificate for all gas pipe welders.
- C. Gas Pipe Installer Qualifications: Provide evidence of current qualifications for individuals performing work requiring qualifications.

**1.05 CLOSEOUT SUBMITTALS**

- A. For additional requirements, refer to Section 22 00 50, Basic Plumbing Materials and Methods.
- B. Maintenance Data: Submit maintenance data and parts lists for plumbing piping systems materials and products. Include this data in Operation and Maintenance Manual.

**1.06 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish to Owner, with receipt, one valve key for each key operated hydrant, bibb, or faucet installed.

**1.07 QUALITY ASSURANCE**

- A. For additional requirements, refer to Section 22 00 50, Basic Plumbing Materials and Methods.
- B. Gas Pipe Installer Qualifications: Individuals performing tasks requiring qualifications under Federal and State regulations shall be qualified by the gas utility supplying Project site. The qualifications shall be current at the time of performing the Work.
- C. NFPA/ANSI Compliance: Fabricate and install natural gas systems in accordance with latest edition of NFPA 54/ANSI Z223.1 "National Fuel Gas Code."
- D. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- E. Fabricate and install natural gas systems in accordance with California Plumbing Code.
- F. Utility Compliance: Fabricate and install natural gas systems in accordance with local gas utility company requirements.

**PART 2 - PRODUCTS****2.01 MATERIALS AND PRODUCTS**

- A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Provide materials and products complying with California Plumbing Code. Where more than one type of material or product is indicated, selection from materials or products specified is Contractor's option.
- B. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372. Plastic piping components shall be marked with "NSF-pw."

**2.02 PIPE AND FITTINGS ATTACHED TO AND BELOW BUILDINGS INCLUDING 5 FEET FROM BUILDINGS**

- A. Piping and fittings attached to covered walkways and corridors shall comply with the requirements of this article.
- B. Drain and Waste Pipe Above Grade: Cast iron soil pipe and fittings, asphaltic coated, conforming to ASTM A888 and Cast Iron Soil Pipe Institute Standard (CISPI) 301 and so marked. Pipe and fittings shall be as manufactured by AB&I, Charlotte, Tyler Pipe, or equal. Pipe and fittings shall be the products of a single manufacturer. At Contractor's option, vertical piping above floor from lavatories, sinks, and drinking fountains may be Schedule 40 galvanized steel pipe with black cast iron drainage fittings, or DWV weld pipe and fittings.
  - 1. Joints above grade: No-Hub pipe conforming to ASTM A888 and CISPI 301. Couplings conforming to ASTM 1277 and CISPI 310, with stainless steel bands. Provide products by ANACO-Husky, Tyler, Ideal or equal. Provide sway brace at 20'-0" maximum spacing for suspended pipe with

No-Hub joints. Provide a brace on each side of a change in direction of 90 degrees or more. Brace riser joints at each floor and at 15 foot maximum intervals (also see Specification Section 22 00 50).

- C. Drain and Waste Pipe Below Grade: Cast iron soil pipe and fittings, asphaltic coated, conforming to ASTM A888 and CISPI 301 and so marked. Pipe and fittings shall be as manufactured by AB&I, Charlotte, Tyler Pipe, or equal. Pipe and fittings shall be the products of a single manufacturer. At Contractor's option, hub and spigot cast iron soil pipe and fittings, asphaltic coated, conforming to ASTM A-74 and so marked, may be used.
  - 1. Joints below grade: ANACO-Husky SD 4000, Clamp-All 125, or equal couplings and No-Hub fittings, meeting the requirements of FM 1680, SD Class I and ASTM C1540.
  - 2. Joints below grade (hub and spigot option): Neoprene gaskets conforming to ASTM C564, as manufactured by Ty-Seal, Dual-Tite, or equal.
- D. Vent Pipe:
  - 1. 3 inch and larger: Cast iron soil pipe and fittings conforming to ASTM A888 and Cast Iron Soil Pipe Institute Standard 301 and so marked. Joints in cast iron vent pipe shall be the same as specified for cast iron waste pipe above grade.
  - 2. 2-1/2 inch and smaller: Cast iron soil pipe and fittings as specified for sizes 3 inch and larger, Schedule 40 galvanized steel pipe with black cast iron drainage fittings, or DWV copper pipe and fittings.
  - 3. Vent pipe buried in ground and to 6 inches above ground: Cast iron soil pipe and fittings conforming to ASTM A888 and Cast Iron Soil Pipe Institute Standard 301 and so marked. Joints in cast iron vent pipe shall be the same as specified for cast iron waste pipe below ground.
- E. Type DWV copper tubing or No-Hub cast iron pipe and fittings may be used for concealed rainwater leaders. Where no-hub piping is used, the fittings and couplings shall match those used for waste piping.
- F. Grease Waste (GW) and Vent (GV) Pipe Underground to 6 Inches Aboveground: George Fisher Sloane, Inc., "Fuseal PP," Orion Fittings, Inc., "Rionfuse CF," IPEX, Inc., "Enfield," or equal, Schedule 40 polypropylene pipe and fittings assembled with electrofusion joints. Piping shall comply with ASTM F1412.
- G. Grease Waste (GW) and Vent (GV) Pipe Aboveground:
  - 1. In inaccessible spaces or within walls, George Fisher Sloane, Inc., "Fuseal PP," Orion Fittings, Inc., "Rionfuse CF," IPEX, Inc., "Enfield," or equal, flame-retardant schedule 40 polypropylene pipe and fittings assembled with electrofusion joints. Piping shall comply with ASTM F1412.
  - 2. In accessible areas: George Fisher Sloan, Inc. "Fuseal PP," Orion Fittings, Inc. "Blueline," IPEX, Inc. "Labline," or equal, flame retardant Schedule 40 polypropylene drainage pipe and fittings, with mechanical joints. Piping shall comply with ASTM F1412.
  - 3. Vent pipe aboveground: 3 Inches and Larger: Service weight cast iron soil pipe and fittings; 2-1/2 inches and smaller: Schedule 40 galvanized steel pipe with black cast iron drainage fittings.
- H. Acid Waste (AW) and Vent (AV) Pipe Underground to 6 Inches Aboveground: George Fisher Sloane, Inc., "Fuseal PP," Orion Fittings, Inc., "Rionfuse CF," IPEX, Inc., "Enfield," or equal, Schedule 40

polypropylene pipe and fittings assembled with electrofusion joints. Piping shall comply with ASTM F1412.

- I. Acid Waste (AW) and Vent (AV) Pipe Aboveground:
  1. In inaccessible spaces or within walls, George Fisher Sloane, Inc., "Fuseal PP," Orion Fittings, Inc., "Rionfuse CF," IPEX, Inc., "Enfield," or equal, flame-retardant Schedule 40 polypropylene pipe and fittings assembled with electrofusion joints. Piping shall comply with ASTM F1412.
  2. In accessible areas: George Fisher Sloan, Inc. "Fuseal PP," Orion Fittings, Inc. "Blueline," IPEX, Inc. "Labline," or equal, flame retardant Schedule 40 polypropylene drainage pipe and fittings, with mechanical joints. Piping shall comply with ASTM F1412.
- J. Water Pipe (Tempered Water, Tempered Water Return, Hot Water, Hot Water Return and Cold Water): ASTM B88, Type L copper tubing, hard-temper, with wrought copper fittings. Provide full solder cup for all fittings. Capped or plugged outlets shall be Schedule 40 screwed brass. Water piping below slab: ASTM B88, Type K copper tubing, hard temper, with wrought copper fittings. At Contractor's option, pipe runs below slab having no branches may be ASTM B88, Type K annealed copper tubing without joints. See Section 22 00 50 for pipe protection requirements for below slab copper piping.
- K. Temperature and Pressure Relief Valve Piping: ASTM B88, Type L copper tubing, hard-temper, with wrought copper fittings. Provide full solder cup for all fittings. Capped or plugged outlets shall be Schedule 40 screwed brass.
- L. Gas Pipe: Schedule 40 black steel conforming to ASTM A53, with malleable iron threaded fittings above grade for piping 2 inch and smaller; welded piping below grade and for above grade piping larger than 2 inches, with Class 150 welding fittings.
  1. Appliance Flexible Connectors for Indoor Equipment Without External Spring Isolation:
    - a. Contractor may choose one of the following:
      - 1) Direct gas pipe connection.
      - 2) Appliance flexible connector:
        - a) Comply with ANSI Z21.24.
        - b) Polymer or hot-dipped PVC coated corrugated 304 stainless steel.
        - c) Operating-Pressure Rating: 0.5 psig.
        - d) End Fittings: Zinc-coated steel.
        - e) Maximum Length: 30 inches.
        - f) Manufacturers: Dormont, Series 30C, 31, 40C, 41, and 51, Brasscraft model ProCoat, or equal.
    - b. Provide with end connections compatible with equipment and piping system.
    - c. Equipment located in spaces normally accessible to building occupants, other than maintenance personnel, shall utilize direct gas pipe connection.
    - d. Provide anti-microbial PVC coating for use with appliances located in kitchen areas.
  2. Flexible Gas Connector for Outdoor Equipment Without External Spring Isolation:

- a. Contractor may choose one of the following:
  - 1) Direct gas pipe connection.
  - 2) Corrugated stainless steel hose with 304 stainless steel braid covering, CSA certified. Metraflex model GASCT, Unisource Manufacturing series 400, or equal. Provide with end connections compatible with equipment and piping system.
- 3. Flexible Gas Connector for Equipment with External Spring Isolation, Indoors and Outdoors:
  - a. Where Drawings indicate installation of mechanical equipment on spring isolation rails spring mounted curbs, or spring hangers, provide metal flexible connectors, Metraflex Metraloop, or equal by Unisource Mfg. Co., or Flexicraft Industries, CSA certified for 4 inches of movement in all directions.
- 4. Flexible Gas Connection System for Movable Gas-Fired Cooking Equipment:
  - a. System shall include flexible PVC coated braided stainless steel hose, quick disconnect fitting, full port CSA certified ball valve, 2 swivel elbows, coiled steel restraining cable and mounting hardware. Assembly shall be certified per ANSI Z21.69/CSA 6.16, "Connectors for Movable Gas Appliances." Size as required for appliance connection, 48" minimum hose length. Install per manufacturer's instructions. Connectors shall be Dormont Safety System, T&S Safe-T-Link, or equal.
- M. Compressed Air Pipe: Type K copper tubing, hard temper, with wrought copper fittings. Capped or plugged outlets shall be screwed brass.
- N. Condensate Drain Piping:
  - 1. Inside buildings provide ASTM B88, Type L copper tubing and fittings. Provide Wye fittings with capped cleanout plug for tubing up to 1 inch size. Provide wrought or cast DWV fittings for sizes 1-1/4 inch and larger.
  - 2. Outside buildings provide ASTM B88, Type L copper pipe and fittings, cast iron drain pipe and fittings or Schedule 40 galvanized steel pipe and cast iron drain or vent fittings.
  - 3. Connect condensate drains to mechanical equipment per equipment manufacturer's recommendations; provide P-trap where required. Slope piping to drain, with 1 inch in 10 foot minimum pitch. Provide di-electric couplings or unions at connections to dissimilar materials.
  - 4. Where Drawings indicate installation of mechanical equipment on spring isolation rails spring mounted curbs, or spring hangers, provide threaded metal connector at mechanical equipment, Metraflex Model SST, or equal by Unisource Mfg. Co., or Flexicraft Industries. Arrange flexible connection to ensure drainage of condensate, and support flexible connection at each end of connector, to ensure proper alignment.
  - 5. Where condensate drain P-traps are required, install trap using Wye fitting on inlet and outlet of trap. Provide cap on top of each Wye, made removable for cleaning and inspection. Drill 1/8 inch diameter hole in cap at outlet of the trap to allow venting of the system. Minimum depth of trap should be 4 inches, or as recommended by the manufacturer in printed literature.
  - 6. Provide cleanout tees or "Y" at each change in direction.
- O. Condensing-Type Equipment Condensate Drain Pipe: CPVC pipe and fittings conforming to ASTM D-2846.

1. Provide CPVC condensate drain pipe for condensing water heaters, furnaces, and where shown on Drawings.
2. Piping and fittings shall be as manufactured by Spears Manufacturing, Charlotte Pipe and foundry Co., or equal.

P. Deionized Water Piping:

1. Polyvinylidene Fluoride (PVDF) Pressure Rated Pipe and Fittings: Schedule 80 PVDF pressure rated pipe and fittings. Pipe and fittings shall meet ASTM D-1785. Threaded fittings shall comply with ASTM D-2464. The pipe and fittings shall be sterilized and capped or packaged immediately after production and all seals shall be intact when the material is delivered to the jobsite.
2. Provide continuous channel support under all horizontal piping, B-line, Grinnell, or equal PVC coated channel systems, series B11 through B72 with matching pipe clamps as appropriate, or equal.

2.03 SITE PIPING AND FITTINGS TO 5 FEET FROM BUILDINGS

A. Buried Drain, Waste, and Vent Piping:

1. Install piping from street connection to the property line in accordance with local requirements.
2. 4 inches and larger: PVC, ASTM D3034 - SDR 35; use matching Ring Tite fittings.
3. 3 inches and smaller: Cast iron soil pipe and fittings, asphaltic coated, conforming to ASTM A888 and Cast Iron Soil Pipe Institute Standard 301 and so marked. Pipe and fittings shall be as manufactured by AB&I, Charlotte, Tyler pipe, or equal. Provide ANACO-Husky SD 4000, Clamp-All 125, or equal couplings and No-Hub fittings, meeting the requirements of FM 1680, SD Class I and ASTM C1540. Pipe and fittings shall be the product of a single manufacturer.

B. Grease Waste (GW) and Vent (GV) Pipe: George Fisher Sloane, Inc., "Fuseal PP," Orion Fittings, Inc., "Rionfuse CF," IPEX, Inc., "Enfield," or equal, polypropylene pipe and fittings assembled with electrofusion joints. Piping shall comply with ASTM F1412.

C. Acid Waste (AW) and Vent (AV) Pipe: George Fisher Sloane, Inc., "Fuseal," Orion Fittings, Inc., "Rionfuse CF," IPEX, Inc., "Enfield," or equal, polypropylene pipe and fittings assembled with electrofusion joints. Piping shall comply with ASTM F1412.

D. Water Service Piping:

1. Sizes 2 inches and larger (not under building): Gasket style PVC conforming to ASTM D2241-SDR21, Class 200 with gasket type fittings or ductile iron mechanical joint couplings. Gasket fittings shall be one piece injection molded PVC fittings, equal to Flo-Seal water main fittings for PVC pressure pipe, 200 psi, ASTM D-3139.
2. Sizes less than 2 inches: Type K copper tubing, hard temper, with wrought copper fittings. See Section 22 00 50 for pipe protection requirements for below grade copper piping.
3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
  - a. J.M. Eagle.
  - b. P.W. Pipe.
  - c. Ipex Series Pipe.

E. Water Service Piping Above Grade:

1. Sizes 3 inches and larger: Class 150 flanged ductile cast iron water pipe conforming to AWWA/ANSI C150/A21.50 and manufactured in accordance with AWWA/ANSI C151/A21.51. Fittings shall conform to AWWA/ANSI C110/A21.10, Class 250 pattern. Pipe and fittings shall have factory applied cement-mortar lining in accordance with AWWA/ANSI C104/A21.4. Flanges shall conform to ASME/ANSI B16.1.
2. Piping 2-1/2 inches and smaller: Type K copper tubing, hard temper, with brazed wrought copper fittings.

F. Gas Piping Underground: Performance Pipe, "DriscoPlex" 6500 PE 2708 (yellow), Polypipe, Inc., "Polypipe", or equal, polyethylene gas distribution pipe, ASTM D2513, ASTM D3261, and ASTM D2683 fittings with fusion welded joints. Provide piping labeled for natural gas in accordance with CPC.

1. Electrically isolate underground ferrous gas piping from the rest of the gas system with listed or approved isolation fittings installed a minimum of six inches above grade.
2. Provide Central Plastics Corp., Perfection, or equal, anodeless, single seal riser for transition from below grade polyethylene to schedule 40 steel piping above grade. Minimum horizontal length shall be 30 inches. Minimum vertical length shall be 30 inches, or greater as required. Provide fusion connection to polyethylene pipe below grade, and screwed connection to steel pipe above grade.

G. Gas Piping Aboveground to 30 inches Belowground: Schedule 40 black steel with beveled ends for welding, with Class 150 welding fittings. Mitering to form elbows or tees will not be permitted; where branch tee connections of welded piping are required, Bonney "Weldolet" Allied Pipe Fittings, or equal fittings may be used if the branch is one-half of the diameter of the main or less.

H. Drainage Pipe, Perforated or Un-perforated: J-M PVC, P.W. Pipe, or equal drainage pipe and fittings or non-reinforced concrete sewer pipe ASTM C14.

2.04 FIRE PROTECTION PIPING

A. Refer to specification Section 21 10 00 "Fire Protection."

2.05 PIPE JOINING MATERIALS

A. Refer to piping Articles in this Section for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated
  - a. Full-Face Type: For flat-face, Class 125, cast iron and cast bronze flanges.
  - b. Narrow-Face Type: For raised-face, Class 250, cast iron and steel flanges.
2. AWWA C111, rubber, flat face, 1/8-inch (3.2mm) thick, unless otherwise indicated; and full-face or ring type, unless other indicated.

3. Flange Bolts and Nuts: AWWA C111, carbon steel, unless otherwise indicated.
  4. Plastic, Pipe-Flange Gasket, Bolts and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, 100 percent lead free alloys. Include water-flushable flux according to ASTM B813.
- D. Brazing Filler Metals: AWS A5.8, BCup-5 Series, copper-phosphorus unless otherwise indicated. Sil-Fos 15, or equal.
- E. Welding Filler Metals: Comply with ASME B31.1 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- F. Solvent Cements for Joining CPVC Piping: ASTM F 493.
1. CPVC solvent cement shall have VOC content of 490 g/L or less.
  2. Adhesive primer shall have VOC content of 550 g/L or less.
  3. Solvent cement and adhesive primer shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
- G. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
1. PVC solvent cement shall have VOC content of 510 g/L or less.
  2. Adhesive primer shall have VOC content of 550 g/L or less.
  3. Solvent cement and adhesive primer shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.

## 2.06 VALVES AND FITTINGS FOR POTABLE WATER SYSTEMS

### A. General:

1. Provide valves and fittings conforming to lead-free requirements of California Health and Safety Code Section 11 68 75.
  - a. Provide valves listed to NSF/ANSI 61-G or NSF/ANSI 372 for valve materials for potable-water service.
    - 1) Exception: Main distribution gate valves above 1-1/2 inches located underground outside building are not required to conform lead-free requirements of California Health and Safety Code Section 11 68 75.

### B. Gate Valves:

1. General: Furnish valves in copper lines with adapters to suit valve/line requirements.
2. 1-1/2 inches and smaller: Minimum 200 psi CWP, bronze body, threaded bonnet, rising or non-rising stem, solid wedge, threaded or solder ends, conforming to MSS SP-80. Milwaukee UP148, UP149, Nibco T-113-LF, S-113-LF, or equal.
3. 2 inches through 3 inches: Minimum 200 psi CWP, bronze body, threaded bonnet, non-rising stem, solid wedge, threaded or solder ends, conforming to MSS SP-80. Nibco T-113-LF, S-113-LF, or equal.



4. Main distribution gate valves underground outside building above 1-1/2 inches:
  - a. Underground valves 2 inches thru 12 inches: 250 psi, iron body, Non-rising stem, bolted bonnet, resilient wedge valves, conforming to AWWA C509, equipped with operating nuts, Mueller Series 2360, Nibco F-619-RW-SON, or equal.
    - 1) Underground valves 3 inches and smaller may be furnished with operating nuts or hand-wheels, and with Ring-Tite joint ends.
    - 2) Furnish and deliver to Owner one wrench of each size required for operating underground valves.
- C. Ball Valves:
  1. 2 inches and smaller: 600 psi CWP, cast bronze or brass body, full port, two piece, threaded ends, and reinforced PTFE seal, conforming to MSS SP-110. Nibco T-685-80-LF, Milwaukee UPBA400, Apollo 77C-LF10, Kitz 868, or equal.
  2. 2-1/2 inches: Apollo 77C-LF10, or equal.
- D. Swing Check Valves:
  1. Minimum 200 psi CWP, bronze or brass body, suitable for regrinding, threaded ends, conforming to MSS SP-80. Milwaukee UP509, Nibco T-413LF, Kitz 822T, or equal.
- E. Butterfly Valves:
  1. General: Tight closing, full lug type, with resilient seat suitable for minimum working pressure of 200 psig, conforming to MSS SP-67. Bi-direction dead end service with downstream flange removed.
  2. Provide valves with the following:
    - a. Seats: suitable for 40 degrees F for cold water service and 250 degrees F for hot water service. Seats shall cover inside surface of body and extend over body ends.
    - b. Bodies: ductile iron or cast iron.
    - c. Discs: Bronze or stainless steel.
    - d. Stems or Shafts: Stainless steel. Install valves with stems horizontal.
    - e. Control Handles: Suitable for locking in any position or with 10 degree or 15 degree notched throttling plates to hold valve in selected position. Provide extended necks to compensate for insulation thickness. Provide gear operator for valves 5 inches and larger.
  3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. 2 through 12 inches: Watts Regulator Co., model DBF-03.
- F. Silent Check Valves (for use on pump discharge):
  1. General: Provide spring loaded check valves at pump discharge of all pumps.
    - a. 2 inches and smaller: Minimum 300 psi CWP, bronze body, Apollo 61LF, Milwaukee UP548-T, or equal.

- b. 2-1/2 inches and larger: Class 250, cast iron body, suitable for regrinding, Mueller 103MAP, or equal.

G. Calibrated Balancing Valves:

1. General: Calibrated orifice ball type rated for 400 psig maximum operating pressure and 250 degrees F. maximum operating temperature.
  - a. Body: Brass.
  - b. Ball: 304 Stainless Steel.
  - c. Seat: Glass and Carbon filled TFE.
  - d. End Connections: Threaded.
  - e. Pressure Gage connections: Integral capped readout valves with internal check valves and drain port, for use with portable pressure differential meter.
  - f. Handle Style: Dial, with memory stops to retain set position.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
  - a. 3 Inch and Smaller: Bell & Gossett model CB, "LF" series.

2.07 VALVES AND FITTINGS FOR NON-POTABLE WATER, COMPRESSED AIR, AND GAS SYSTEMS

A. Gate Valves:

1. 2-1/2 inches and smaller: Class 150, bronze body, union bonnet, rising stem, solid wedge, threaded or solder ends, conforming to MSS SP-80. Hammond IB641, IB648, Nibco T-134, S-134, Milwaukee 1151, 1169, or equal.
2. 3 inches and larger: Class 125, iron body, bronze mounted, bolted bonnet, non-rising stem, solid wedge, flanged ends, conforming to MSS SP-70. Hammond IR-1138, Nibco F619, Milwaukee F2882A, Stockham G-612, or equal.
3. Underground valves 2 inches thru 12 inches: 250 psi, iron body, Non-rising stem, bolted bonnet, resilient wedge valves, conforming to AWWA C509, equipped with operating nuts, Mueller Series 2360, Nibco F-619-RW-SON, or equal.
  - a. Underground valves 3 inches and smaller may be furnished with operating nuts or hand-wheels, and with Ring-Tite joint ends.
  - b. Furnish and deliver to Owner one wrench of each size required for operating underground valves.

B. Ball Valves:

1. 2 inches and smaller: 600 psi CWP, 150 psi SWP, cast bronze body, full port, two piece, threaded ends, and reinforced PTFE seal, conforming to MSS SP-110. Nibco T585-70, Milwaukee BA-400, Stockham T-285, or equal.
2. 2-1/2 inches and larger: Class 150, carbon steel body, full port, two piece, stainless steel vented ball, flanged ends, and reinforced PTFE seal, conforming to MSS SP-72. Nibco F-515-CS-F-66-FS, Milwaukee F20-CS-15-F-02-GO-VB, or equal.

3. Compressed Air Services: 600 psi CWP, 150 psi SWP, bronze body, full port, three piece, threaded ends, and reinforced PTFE seal, conforming to MSS SP-110. Nibco Model T-595-Y, Milwaukee BA-300, or equal.
- C. Swing Check Valves: Class 125 or 150, bronze body, suitable for regrinding, threaded ends, conforming to MSS SP-80. Stockham B-321, Milwaukee 509, Nibco T-433, or equal.
- D. Butterfly Valves:
1. General: Tight closing, full lug type, with resilient seat suitable for minimum working pressure of 200 psig, conforming to MSS SP-67. Bi-direction dead end service with downstream flange removed.
  2. Provide valves with the following:
    - a. Seats: Suitable for 40 degrees F for cold water service and 250 degrees F for hot water service. Seats shall cover inside surface of body and extend over body ends.
    - b. Bodies: Ductile iron or cast iron.
    - c. Discs: Bronze or stainless steel.
    - d. Stems or Shafts: Stainless steel.
    - e. Control Handles: Suitable for locking in any position or with 10 degree or 15 degree notched throttling plates to hold valve in selected position. Provide extended necks to compensate for insulation thickness. Provide gear operator for valves 5 inches and larger.
  3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. 2 through 12 inches: Milwaukee Valve, CL series, Nibco, Inc., Model LD2000-3, or equal.
- E. Silent Check Valves (for use on pump discharge):
1. General: Provide spring loaded check valves at pump discharge of all pumps.
  2. 2 inches and smaller: 250 psi CWP, bronze body, Nibco Model T-480, Milwaukee 548-T, or equal.
  3. 2-1/2 inches and larger: Class 250, cast iron body, wafer style, suitable for regrinding. Nibco Model F960, Milwaukee 1400, Mueller 103MAP, or equal.
- F. Calibrated Balance Valves (Symbol CBV): Provide globe style valves for precision regulation and control rated 175 psi for sizes 2-1/2 inches through 12 inches and rated 240 psi for bronze sizes 2 inches and below. Each valve shall have two metering/test ports with internal check valves and protective caps. All valves must be equipped with visual position readout and concealed memory stops for repeatable regulation and control.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. Bell & Gossett Circuit Setter Plus.
    - b. Armstrong CBV.
    - c. Flow Design Inc. Accusetter.
    - d. Tour & Andersson.
    - e. Circuit Sensor with butterfly valve above 3 inches.

- f. Illinois Series 5000 through 2 inches.
- G. Flow Control Valves: Automatic pressure compensating flow control valves shall be Griswold, Flow Design, Inc., or equal.
- H. Building Gas Shut-Off Valves:
  - 1. 2 inches and smaller: Provide 175 psi SWP ball valve, CSA listed, full port, lockwing type, with AGA painted grey finish. Jomar 175-LWN, or equal.
  - 2. Above 2 inches: Provide ReSun D-126, Key Port, or equal, lubricated plug cock, CSA listed, rectangular port, full pipe area, 125 psi SWP, flanged ends. Provide T-Handle socket wrench and adapter fittings as required for operation of valves. Provide one package of spare lubricant sticks, sizes as required for valve sizes. Lubricant shall be the product recommended by valve manufacturer for use with type of gas conveyed by the piping system.
  - 3. Provide valves same size as upstream piping. Make any reduction in size of gas piping downstream of shutoff valves.
- I. Gas Shut-off Valve Above Grade:
  - 1. 2 inches and smaller: Provide Milwaukee BB2-100, Jomar T-100NE, or equal, ball valve, CSA listed, full port.
  - 2. Above 2 inches: Provide ReSun D-126, Key Port, or equal, CSA listed, rectangular port, full pipe area, 125 psi SWP, flanged ends. Provide T-Handle socket wrench and adapter fittings as required for operation of valves. Provide one package of spare lubricant sticks, sizes as required for valve sizes. Lubricant shall be the product recommended by valve manufacturer for use with type of gas conveyed by the piping system.
  - 3. Provide valves same size as upstream piping. Make any reduction in size of gas piping downstream of shutoff valves.
- J. For Gas Service Below Grade:
  - 1. Lubricated plug cocks: ReSun Model D-126, Key Port, or equal, lubricated plug cock, CSA listed, rectangular port, full pipe area, 125 psi SWP, flanged ends. Provide extended lubrication stem, arranged to allow for lubrication of the valve from grade. The extension must be constructed to allow for lubrication of the valve and for operation of the valve from grade. Provide T-Handle socket wrench and adapter fittings as required for operation of valves. Provide one package of spare lubricant sticks, sizes as required for valve sizes. Lubricant shall be the product recommended by valve manufacturer for use with type of gas conveyed by the piping system.
    - a. Provide flanged ends on valves installed below grade. Connect to polyethylene piping with flanges and stainless steel bolts.
    - b. Anchor each valve flange to valve box with welded angle iron, or provide vertical stiff leg, minimum 18 inches into earth.
    - c. Provide Central Double O Seal Transition Fittings, or equal, flanged style for connection between valve and piping system.
    - d. Wrap valve, flanges and exposed pipe with PASCO Specialty & Mfg., Inc., or equal tape wrap, installed in accordance with requirements listed under "Pipe Protection".

2. Molded polyethylene body ball valves: Nordstrom Valves - Polyvalve II for sizes 1-1/4 inches to 2 inches, and Polyvalve for sizes 2 inches and larger, or equal. Valves 1 inch and smaller shall be listed lubricated plug cocks, with transition fittings..
  - a. Provide stub ends to match SDR of the piping, arranged for butt fusion welding. Provide valve body material to suit the adjacent piping system.
  - b. Provide wrench to suit the valve operator.
- K. Seismic Gas Shut-Off Valves: Certified by State of California and compliant with ASCE 25. Provide standard or high pressure model as required to match site gas pressure. Provide unit arrangement per Drawings schedule and details.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Little Firefighter Corporation, models NAGV, VAGV, and AGV.
    - b. Seismic Safety Products, LLC, Northridge series.

## 2.08 DOMESTIC WATER PIPING SPECIALTIES

### A. Hose Bibbs:

1. Manufacturers: Drawing schedules indicate Basis of Design products. Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following, or equal:
  - a. Acorn Engineering Co.
  - b. Woodford Manufacturing Co.
2. Hose Station: Leonard THS-25-VB-CW, Symmons, or equal.

### B. Wall Hydrants:

1. Manufacturers: Drawing schedules indicate Basis of Design products. Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following, or equal:
  - a. Acorn Engineering Co.
  - b. Woodford Manufacturing Co.
  - c. Mifab, Inc.

### C. Water Hammer Arrestors:

1. Provide water hammer arrestors conforming to lead-free requirements of California Health and Safety Code Section 11 68 75, with nesting type bellows contained within a casing having sufficient displacement volume to dissipate the calculated kinetic energy generated in the piping system. Water hammer arrestors shall be sized for type and number of fixtures served. Provide all stainless steel shell construction with stainless steel bellows and threaded connection to water system.

2. Water hammer arrestors shall be certified under P.D.I. Standard WH201 and by ASSE Standard 1010.
  3. Select units in accordance with the requirements of Plumbing and Drainage Institute Standard P.D.I. WH201. Install above ceilings or behind wall access door at each plumbing fixture, or where plumbing fixtures are installed in groups, at each group of fixtures.
  4. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. Josam Company, series 75000.
    - b. Smith (Jay R.) Mfg. Co., Hydrotrol 5005-5050.
    - c. Mifab, series WHB.
- D. Water Filters:
1. Provide Cuno Incorporated, Aqua Pure model AP510, or equal, point of use water filters, conforming to lead-free requirements of California Health and Safety Code Section 11 68 75, in locations indicated on Drawings.
    - a. Provide model AP517 filter cartridge at each location, with 5 micron rating and 2,000 gallon rating, to remove sediment, rust, scale and chlorine taste and odor from incoming water. 2 gallon per minute capacity.
    - b. Provide one spare cartridge for each unit provided.
- E. Reduced Pressure Backflow Preventers for Potable Water Systems:
1. Provide reduced pressure principle backflow preventer conforming to lead free requirements of California Health and Safety Code Section 11 68 75.
    - a. Reduced-pressure principle backflow preventer assembly, consisting of shutoff valves on inlet and outlet, and strainer on inlet., Backflow preventer shall include test cocks, and pressure differential relief valve located between two positive seating check valves. Construct in accordance with ASSE Standard 1013.
    - b. Manufacturers: Subject to compliance with requirements and local water authorities having jurisdiction, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
      - 1) 2 inches and smaller: Wilkins 975XL2, Febco LF825YRP, Watts LF919.
      - 2) 2-1/2 thru 10 inches: Wilkins 475AXL, Febco LF860RP.
      - 3) 2-1/2 and 3 inches: Watts LF009.
  2. Provide LeMeur, Hot-Box, WattsBox, or equal, two piece reinforced aluminum, fiberglass, welded angle with expanded metal, backflow preventer enclosure, sized to suit the size of backflow preventer. Install on concrete pad, in accordance with manufacturer's written installation instructions.
  3. Provide substantial padlock and chain to lock valves in open position, and turn key over to Project Inspector.
    - a. Padlocks shall be as specified under Section 08 70 00.

- b. Chain shall be of carbon steel, 3/8 inch wire diameter, fully welded links and weight of 140 pounds per 100 lineal feet. Chain shall be hot galvanized.
  4. Provide capped connections at each test cock. Install in accordance with requirements of Authority Having Jurisdiction.
  5. For units installed within buildings, provide drain, connected to unit, to collect spillage from atmospheric vent. Run drain to nearest floor sink or drain.
  6. Provide two concrete filled, 6-inch diameter pipe bollards to protect all exposed piping from motor vehicle damage.
- F. Reduced Pressure Backflow Preventers for Non-Potable Water Systems:
1. Refer to Section 21 10 00 for backflow preventers for fire protection service.
  2. Provide reduced-pressure principle backflow preventer consisting of assembly, including shutoff valves on inlet and outlet, and strainer on inlet, equal to Febco 825Y or 880, as required Wilkins, Aames, or equal. Backflow preventer shall include test cocks, and pressure differential relief valve located between two positive seating check valves. Construct in accordance with ASSE Standard 1013.
  3. Provide LeMeur, Hot-Box, or equal, two piece backflow preventer enclosure, sized to suit the size of backflow preventer. Install on concrete pad, in accordance with manufacturer's written installation instructions.
  4. Provide substantial padlock and chain to lock valves in open position, and turn key over to Project Inspector.
    - a. Padlocks shall be as specified under Section 08 70 00.
    - b. Chain shall be of carbon steel, 3/8 inch wire diameter, fully welded links and weight of 140 pounds per 100 lineal feet. Chain shall be hot galvanized.
  5. Provide capped connections at each test cock. Install in accordance with requirements of Authority Having Jurisdiction.
  6. For units installed within buildings, provide drain, connected to unit, to collect spillage from atmospheric vent. Run drain to nearest floor sink or drain.
  7. Provide two concrete filled, 6-inch diameter pipe bollards to protect all exposed piping from motor vehicle damage.
  8. Manufacturers: Subject to compliance with requirements and local water authorities having jurisdiction, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. Ames.
    - b. Febco Sales, Inc.
    - c. Watts Regulator Company.
    - d. Clow.
- G. Double Check Valve Backflow Preventers:
1. Refer to Section 21 10 00 for backflow preventers for fire protection service.
  2. Provide double detector check valve assembly consisting of two spring loaded brass check valves, two cast iron bronze fitted gate valves and four test cocks, equal to Febco Model 856 or 876 as required. Construct in accordance with ASSE Standard 1048.

3. Provide LeMeur, Hot-Box, or equal, two piece backflow preventer enclosure, sized to suit the size of backflow preventer. Install on concrete pad, in accordance with manufacturer's written installation instructions.
  4. Provide substantial padlock and chain to lock valves in open position and turn key over to Project Inspector.
    - a. Padlocks shall be as specified under Section 08 70 00.
    - b. Chain shall be of carbon steel, 3/8 inch wire diameter, fully welded links and weight of 140 pounds per 100 lineal feet. Chain shall be hot galvanized.
  5. Provide capped connections at each test cock. Install in accordance with requirements of Authority Having Jurisdiction.
  6. Provide two concrete filled, 6 inch diameter pipe bollards to protect all exposed piping from motor vehicle damage.
  7. Provide Christy, or equal, utility box sized as required to suit backflow assembly, complete with two piece reinforced concrete lid, concrete extensions, insulation and other construction details shown on the drawings.
  8. Manufacturers: Subject to compliance with requirements and local water authorities having jurisdiction, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. Ames.
    - b. Febco Sales, Inc.
    - c. Watts Regulator Company.
    - d. Clow.
- H. Potable Water Pressure-Regulating Valve:
1. Provide pressure-regulating valves, single-seated, direct-operated type, bronze body, integral strainer, complying with requirements of ASSE Standard 1003, and the lead-free requirements of California Health and Safety Code Section 11 68 75. Size for maximum flow rate and inlet and outlet pressure indicated on Drawings.
  2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. Cla-Val Company.
    - b. Watts Regulator Company.
- I. Thermostatic Water Temperature Control Valve:
1. Provide thermostatic water temperature control valve conforming to lead free requirements of California Health and Safety Code Section 11 68 75, with size as noted on Drawings, complete with union angle strainer checkstops. Valves shall be thermostatic type, with a maximum temperature setting as follows:
  2. Provide surface recessed semi-recessed mounted, white enameled or stainless steel cabinet with locking door for control valves. Including:



- a. Control valve cabinet and valve shall be provided as a package, and include thermostatic water mixing valve, thermometer, safety checkstops, volume control valve and internal piping.
  3. Where indicated on drawings, provide a temperature alarm system, utilizing a micro-processor based controller and solid state temperature controller. Provide audible and visual indication of high and low temperature set points. Provide required hardware and wiring for a complete operating system.
    - a. Provide isolation transformer for control of the alarm system.
    - b. Provide solenoid valve and shock absorber, installed and wired to the alarm module.
  4. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. Leonard Valve Company.
    - b. Lawler Manufacturing Co., Inc.
    - c. Powers.
- J. Relief Valves:
1. Provide relief valves as indicated, of size and capacity as selected by Contractor for proper relieving capacity, in accordance with ASME Boiler and Pressure Vessel Code.
  2. Combined Pressure-Temperature Relief Valves: Bronze body, test lever, thermostat, complying with ANSI A21.22 listing requirements for temperature discharge capacity. Provide temperature relief at 210 degrees F, and pressure relief at 150 psi.
  3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. Watts Regulator Company.
    - b. Cash (A.W.) Valve Manufacturing Corporation.
    - c. Zurn Industries, Inc.; Wilkins-Regulator Division.
- K. Trap Primers:
1. Manufacturers: Drawing schedules indicate Basis of Design products. Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following, or equal:
    - a. MiFab, Inc.
    - b. Precision Plumbing Products.
    - c. Sioux Chief Manufacturing Company.
- L. Water Meter:
1. Provide and install prefabricated water meter and bypass assembly, sized as indicated on the Drawings, complete with strainer, adapter, couplings, spool piece and test nipple. The meter shall be compound type, with two measuring chambers and a single billing register. Pipe

materials used in construction of the assembly shall be ductile iron, and the meter shall be bronze with stainless steel trim.

2. Install the meter and accessories in a Christy, Brooks, or equal, series "R" pit Model R37, 4 feet by 7 feet by 3 feet deep; complete with 4 piece checker plate parkway lid (screw down type), and 8 inch round meter reading lid. Install meter in accordance with the requirements of the Authority Having Jurisdiction.
3. Manufacturers: Subject to compliance with requirements and local water authorities having jurisdiction, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
  - a. Badger Meter, Inc.
  - b. Sensus North America Water.
  - c. Neptune Technology Group.
  - d. Hershey Meters.

## 2.09 GAS PIPING SPECIALTIES

### A. Gas Pressure Regulating Valves:

1. Provide single-stage, spring-loaded, corrosion-resistant gas pressure regulators, with die-cast aluminum or cast iron body, complying with ANSI Z21.80. Unit shall be with atmospheric vent, internal relief overpressure protection, threaded ends for 2 inches and smaller, flanged ends for 2-1/2 inches and larger. For inlet and outlet gas pressures, specific gravity, and volume flow refer to Drawings schedule.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

| <u>Size</u>           | <u>Manufacturer/Model</u>                                                                                                                                        |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1/2 inch              | Elster (American, Singer) model 1213B<br>Itron (Actaris, Slumberger, Sprague) model B42R.                                                                        |
| 3/4 thru 1-1/4 inches | Elster (American, Singer) model 1813C<br>Sensus (Ivensys, Equimeter, Rockwell) model 143-80-12<br>Itron (Actaris, Slumberger, Sprague) models B42R, B57R, B58R   |
| 1-1/2 thru 2 inches   | Elster (American, Singer) models 1813, 1813B<br>Sensus (Ivensys, Equimeter, Rockwell) model 243<br>Itron (Actaris, Slumberger, Sprague) models B43SR, B34R, B38R |

### B. Gas and Air Outlets:

1. Gas Outlets: Deck mounted Chicago 982-907BC duplex, T&S Brass, or equal; deck mounted Chicago 980-907BC single, or equal, deck-mounted Chicago 984-907BC, four outlets, or equal. Provide integral check valve, and single lever handle in compliance with ADA requirements.
2. Air Outlets: Panel mounted Chicago 986-937CH; deck-mounted Chicago 980-937CH, T&S Brass, or equal. Provide integral check valve, and single lever handle in compliance with ADA requirements.
3. Air Hose Valve: Lincoln 815 coupler and 11659 nipple, Grover, or equal, with ball valve on inlet. Refer to drawing details for additional requirements. Provide Wilkerson Model CB6-04-000 air pressure regulator, or equal.
4. Hose Reels: Lincoln Model 85062, Grover or equal. Provide heavy-duty type with delivery hose, universal swivel, ball stop, shut-off valve, control valve and filter as required. Connect services to reels with ball valve.

## 2.10 DRAIN AND WASTE PIPING SPECIALTIES

### A. Cleanouts:

1. General: Install cleanouts of same diameter as pipe (4 inch maximum) in all horizontal soil and waste lines where indicated and at all points of change in direction. Cleanouts shall be located not less than 18 inches from building construction so as to provide sufficient space for rodding. No horizontal run over 50 feet inside buildings or 100 feet outside buildings shall be without cleanout, whether shown on Drawings or not. Provide two-way cleanouts where indicated on drawings, and whenever sanitary sewer exits building. All two-way cleanouts shall have (2) risers, each in opposing directions.
  - a. Provide cleanouts in waste drop from each sink and urinal.
  - b. Provide one wrench for each size and type of cleanout used. Turn over to Owner at completion of the project, and obtain receipt. Place receipt in Operation and Maintenance Manuals.
2. Cleanouts in floor and in concrete sidewalks: Ducco Cast Iron with nickel bronze top, clamping collar and ABS plastic plug: Zurn ZN-1400-KC, or equal, with square or round top to suit floor construction.
3. Cleanouts in composition floors: Zurn ZN-1400-X-DX, or equal (nickel bronze top).
4. Cleanouts in concealed, aboveground cast-iron soil or waste lines: Zurn Z-1440A, or equal, with ABS plastic plug.
5. Cleanouts in walls: Zurn Z-1441 or Z-1443, or equal, with stainless steel cover. Provide long sweep elbow or combination wye at connection to riser and install with surface of cleanout within ½ inch of front face of finished wall.
  - a. Where space does not permit the above installation, provide Zurn Z-1446, or equal, with stainless steel access cover, and vandal resistant screw.
  - b. Install face of cleanout plug within 1/2 inch of front face of finished wall.
6. Cleanouts exterior to building in landscaped areas: Zurn Z-1449-BP, or equal, cleanout ferrule with tapered bronze plug. Where located at grade, provide 18 by 18 by 6 inch concrete pad; Trowel concrete smooth and edge; set flush with finished grade.
7. Cleanouts in drive areas: Zurn -1400-HD-KC, or equal, with heavy-duty top and ABS plastic plug.

8. Cleanouts in acid waste systems: Zurn ZN-1404, or equal, cleanout access housing, with ductile cast iron body and nickel bronze top. Extend acid waste piping within the cleanout, and terminate with threaded cap. Secure acid waste pipe inside cleanout access housing with setscrews provided.
- B. Floor Drains:
1. Manufacturers: Drawing schedules indicate Basis of Design products. Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following, or equal:
    - a. J.R. Smith.
    - b. MIFAB.
    - c. Watts.
    - d. Zurn.
- C. Floor Sinks:
1. Floor Sinks: Provide anchoring flange (seepage pan) at all floor sinks, and provide flashing clamp in locations where floor membrane is used. Provide cast iron "P" trap and trap primer connection at P-Trap.
  2. Manufacturers: Drawing schedules indicate Basis of Design products. Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following, or equal:
    - a. J.R. Smith.
    - b. MIFAB.
    - c. Watts.
    - d. Zurn.
- D. Hopper Drains:
1. Manufacturers: Drawing schedules indicate Basis of Design products. Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following, or equal:
    - a. Zurn.
    - b. J.R. Smith.
- E. Catch Basin:
1. Manufacturers: Drawing schedules indicate Basis of Design products. Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following, or equal:
    - a. Brooks.
    - b. J.R. Smith.
    - c. Old Castle Precast.
    - d. Watts.

e. Zurn.

F. Backwater Valves:

1. Provide Zurn Model Z-1090 J. R. Smith 7012, or equal flapper type backwater valve where indicated on drawings. Install in accordance with manufacturer's recommendations.
2. Provide Christy Model B16, Brooks, or equal utility box, 12 inches by 22 inches size, for installation of backwater valve.
3. Provide Zurn Model Z-1091, J.R. Smith 7070, or equal terminal type backwater valve, and install in catch basin piping at the outlet of the catch basin.

G. Roof Drains and Overflow Drains:

1. See Architectural Drawings for drain style to be used.
2. Provide offset downspout boots where required for connection of exposed sheet metal downspouts to underground cast iron or PVC piping.
3. Provide rainwater leader nozzles on overflow piping. Nozzle body shall be bronze with threaded inlet and bronze wall flange with mounting holes. Size nozzle to match connected rainwater leader.
4. Manufacturers: Drawing schedules indicate Basis of Design products. Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following, or equal:
  - a. J.R. Smith.
  - b. Mifab.
  - c. Zurn.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Examine areas and conditions under which plumbing piping systems are to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected in manner acceptable to Contractor.
- B. Make all arrangements for the utilities required. Pay all costs involved in obtaining the services including gas service and meter, water meter, pressure reducing valve, access boxes, street work. Connect to site utilities. Verify the location of all services. No extra cost will be allowed if services are not as shown.
- C. Determine sanitary sewer and storm drain location and elevation at all points of connection before installing any piping. Notify Architect immediately if indicated grades cannot be maintained.
- D. At time of final connection, and prior to opening valve to allow pressurization of water and gas piping from existing systems, on site or off site, perform a pressure test to indicate static pressure of existing systems. If pressure on water piping is greater than 80 psi, or gas pressure is not as indicated on Contract Documents, inform Architect immediately. Do not allow piping systems to be pressurized without written consent of the Architect.

### 3.02 INSTALLATION OF WATER PIPING

- A. Run all water piping generally level, free of traps or unnecessary bends, arranged to conform to the building requirements, and to suit clearance for other mechanical work such as ducts, flues, conduits, and other work. No piping shall be installed so as to cause unusual noise from the flow of water therein under normal conditions.
- B. Provide manufactured water hammer arrestors, sized and installed in accordance with Plumbing and Drainage Institute Standard PDI WH201.
  - 1. Locate water hammer arrestors at every plumbing fixture, or, where fixtures are located in groups, at every group of fixtures, and as indicated on Drawings.
  - 2. Install water hammer arrestors above accessible ceilings, or install access doors for service.
- C. In freezing locations arrange water piping to drain as shown.
- D. Install piping on room side of building insulation.
- E. Check final location of rubber rings within couplings on PVC water piping with gauge or as recommended by manufacturer. Make connection to valves with cast iron adapters connected to water pipe with cast iron couplings. Furnish and install anchors or thrust blocks.
- F. For all faucets, hose bibbs, or other water outlets delivering industrial hot and/or cold water, provide a sign, permanently mounted, indicating "CAUTION: NON-POTABLE WATER, DO NOT DRINK". Each sign shall be permanently engraved with black uppercase letters on a yellow background. Letters shall be minimum 1-1/4 inch high.

### 3.03 INSTALLATION OF SANITARY AND STORM DRAINAGE SYSTEMS

- A. Make joints in PVC sewer pipe with PVC-type couplings and rubber rings.
- B. Check final location of rubber rings within the couplings with gauge or as recommended by the manufacturer. Make joints between PVC pipe and cast iron pipe or fittings using cast iron adapter fittings, installed as recommended by the manufacturer.
  - 1. Ring-Tite cast iron pipe fittings may be used in lieu of standard fittings. Make connection to valves with cast iron adapters connected to the pipe with PVC couplings.
- C. Sewer Piping: Run all horizontal sanitary drain piping inside of building on a uniform grade of not less than 1/4 inch per foot unless otherwise noted or later approved. Unless otherwise noted on the plans, piping shall have invert elevations as shown and slope uniformly between given elevations.
- D. Storm Drain Piping: Run all horizontal storm drain piping inside of building on a uniform grade of not less than 1/4 inch per foot. Unless otherwise noted on the plans, piping shall have invert elevations as shown and slope uniformly between given elevations.
- E. Install rainwater leader nozzles at exposed bottom of leaders where they spill onto grade.
- F. Run all drainage piping as straight as possible and provide easy bends with long turns; make all offsets at an angle of 45 degrees or less.

- G. Grade all vent piping so as to free itself quickly of any water condensation.
- H. Where possible, join groups of vent risers together with one enlarged outlet through roof. Maintain minimum of 10 foot horizontal or 3 foot vertical clearance from air intakes.
- I. Install drip pan under storm drain piping, sanitary drain piping, and vent piping that must be run over kitchen areas.
- J. Hubless Cast Iron Joints: Comply with coupling manufacturer's installation instructions.

#### 3.04 INSTALLATION OF GREASE WASTE PIPING SYSTEMS

- A. Install to comply with all manufacturers' recommendations.
- B. All buried pipe shall be bedded in and backfilled with 4 inches of sand, and installed as recommended by manufacturer.
- C. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Maintain continuous pressure test on piping installed below grade, until all work has progressed to above grade.
- D. Electrofusion joints: Make polypropylene drainage piping joints according to ASTM F 1290.

#### 3.05 INSTALLATION OF ACID WASTE PIPING SYSTEMS

- A. Install to comply with all manufacturers' recommendations.
- B. All buried pipe shall be bedded in and backfilled with 4 inches of sand, and installed as recommended by manufacturer.
- C. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Maintain continuous pressure test on piping installed below grade, until all work has progressed to above grade.
- D. Electrofusion joints: Make polypropylene drainage piping joints according to ASTM F 1290.
- E. Connection to Building Sewer: At point of connection of acid waste piping to building sewer, provide fitting of same material as acid waste piping.

#### 3.06 INSTALLATION OF NATURAL GAS PIPING

- A. Install natural gas piping in accordance with Division 22 Basic Plumbing Materials and Methods sections.
- B. Use sealants on metal gas piping threads that are chemically resistant to natural gas. Use sealants sparingly, and apply to only male threads of metal joints.
- C. Remove cutting and threading burrs before assembling piping.
- D. Do not install defective piping or fittings. Do not use pipe with threads that are chipped, stripped, or damaged.

- E. Plug each gas outlet, including valves, with threaded plug or cap immediately after installation and retain until continuing piping or equipment connections are completed.
- F. Ground gas piping electrically and continuously within project, and bond tightly to grounding connection.
- G. Install drip-legs in gas piping where indicated and where required by code or regulation.
  - 1. Install "Tee" fitting with bottom outlet plugged or capped at bottom of pipe risers.
  - 2. Where gas supply is connected to equipment with flexible connectors, install drip-leg in piping on downstream side of flexible connector, and install shut off valve on piping on upstream side of flexible connector.
- H. Install piping with 1/64 inch per foot (1/8 percent) downward slope in direction of flow.
- I. Install piping parallel to other piping.
- J. Paint all gas piping installed in exposed exterior locations. For additional requirements, refer to Section 22 00 50, Basic Plumbing Materials and Methods, article, Painting.
- K. Provide shutoff valve downstream of meter.
- L. Provide exterior shutoff valve at each building. Provide sign affixed to wall at valve location reading: "Gas Shut-Off." Size and location of the sign shall be as required by the Authority Having Jurisdiction. Where gas piping enters a building in more than one location, exterior shutoff valves shall have a permanently attached metal tag identifying the area served by that valve, in addition to sign on wall.
- M. Provide watertight Schedule 40 PVC conduit to protect gas piping installed below covered walk, covered driveways, and where noted on Drawings. Extend sleeve at least 12 inches beyond any area where it is required to be installed, and terminate with valve box extended to grade, and marked "GAS".
- N. Maintain minimum of 12 inch clearance between gas piping and steam piping above 200 degrees F.

### 3.07 PIPE JOINTS AND CONNECTIONS

- A. General:
  - 1. Cutting: Cut pipe and tubing square, remove rough edges or burrs. Bevel plain ends of steel pipe.
  - 2. Remove scale, slag, dirt and debris from inside and outside of pipe before assembly.
  - 3. Boss or saddle type fittings or mechanically extracted tube joints will not be allowed.
- B. Threaded Pipe: 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 thread compound to external pipe threads: Rectorseal No. 5, Permatex No. 1, or equal.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.



- C. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- D. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
  - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
  - 3. PVC Piping: Join according to ASTM D 2855.
- E. Copper Pipe and Tubing (Except pneumatic control piping): All joints shall be brazed according to ASME Section IX, Welding and Brazing Qualifications, except domestic water piping 1-1/4 inches and smaller when not buried in the ground or concrete and type DWV plumbing piping may be soldered.
  - 1. Soldered joints: Apply water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828.
- F. Cast Iron Soil Pipe:
  - 1. No-Hub fittings shall be made with a torque wrench.
  - 2. Hub joints shall be with Ty-Seal couplings.
  - 3. Wrought iron, steel, or copper pipe shall have a ring or part of a coupling screwed on to form a spigot end if caulked into a joint.
  - 4. Connect cast iron sewer piping to outside service pipe with cast iron or vitrified LOP reducers or increasers as required. Caulking of smaller pipe into the larger without a reducer or increaser will not be permitted.
- G. Welded Pipe:
  - 1. Make up with oxyacetylene or electric arc process.
  - 2. All line welds shall be of the single "V" butt type. Welds for flanges shall be of the fillet type.
  - 3. Where the branch is two pipe sizes smaller than the main or smaller, Bonney Weldolets, Thredolets, Nibco, or equal, may be used in lieu of welding tees.
- H. PVC Sewer and Drainage Pipe (outside building as allowed only): Four inches and larger shall be bell and spigot, assembled in accordance with manufacturer's recommendations. Joint shall be tested in accordance with ASTM D3212. Solvent weld joints below 4 inches in size, schedule 40 PVC with matching fittings, assembled per manufacturer's instructions.
- I. Polyethylene and Polypropylene Pipe: Assemble with fusion joints in strict accordance with manufacturer's instructions.
- J. Make joints in PVC water pipe with PVC couplings and rubber rings, Manville Ring-Tite, PW Pipe, or equal. Check final location of rubber rings with the couplings with gauge or as recommended by the manufacturer. Make joints between PVC pipe and cast iron pipe or fittings using cast iron or PVC adapter fittings, installed as recommended by the manufacturer. Ring-Tite PVC or cast iron pipe

fittings may be used in lieu of standard fittings. Make connection to valves with cast iron adapters connected to the water pipe with PVC couplings.

K. Flexible Connections:

1. Furnish and install Thermo Tech., Inc. F/J/R, Metraflex, or equal, flexible couplings with limiter bolts on piping connections to all equipment mounted on anti-vibration bases, on each connection to each base mounted pump and where shown. Couplings shall be suitable for pressure and type of service.
2. Anchor piping securely on the system side of each flexible connection.

3.08 INSTALLATION OF VALVES

A. Install valves as indicated on Drawings and in the following locations:

1. Shutoff Valves: Install on inlet of each plumbing equipment item, and on inlet of each plumbing fixture, and elsewhere as indicated.
2. Drain Valves: Install on each plumbing equipment item located to completely drain equipment for service or repair. Install at base of each riser, at base of each rise or drop in piping system, and elsewhere indicated or required to completely drain potable water system.
3. Provide gate or globe valves on inlet and outlet of each water heater or pump.

B. General:

1. Valves shall be full line size unless indicated otherwise on Drawings.
2. Install horizontal valves with valve stem above horizontal, except butterfly valves.
3. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
4. Locate valves for easy access and provide separate support where necessary.
5. Install valves in position to allow full stem movement.
6. Install exposed polished or enameled connections with special care showing no tool marks or exposed threads.
7. Butterfly valves conforming to the paragraph "Butterfly Valves" may be used in lieu of gate or globe valves for locations above grade.
8. Ball valves conforming to the paragraph "Ball Valves" may be used in lieu of gate valves for locations above grade for services 2-1/2 inches and smaller.
9. Valves 2-1/2 inches and smaller (except ball valves) in nonferrous water piping systems may be solder joint type with bronze body and trim.
10. Rigidly fasten hose bibbs, hydrants, fixture stops, compressed air outlets, and similar items to the building construction.

C. Gate Valves:

1. Furnish valves in copper lines with adapters to suit valve / line requirements.
2. Underground gate valves:
  - a. Underground valves 3 inches and smaller may be furnished with operating nuts or hand-wheels, and with Ring-Tite joint ends.

- b. Furnish and deliver to Owner one wrench of each size required for operating underground valves.
- D. Swing Check Valves: Install in horizontal position with hinge pin level.
- E. Butterfly Valves: Install with stems horizontal.
- F. Silent Check Valves: Install in horizontal or vertical position between flanges.
- G. Calibrated Balancing Valves: Install calibrated balancing valves per manufacturers' recommendations, including requirements for straight pipe lengths at valve inlet and outlet.
- H. Gas Shut-Off Valves:
  - 1. Provide line size ball valve in gas line to each appliance.
  - 2. Provide line size ball valve in gas line, to be used as emergency shut-off for science classrooms. Install valve in locking box where indicated on the drawings.
  - 3. Provide line size electric solenoid gas valve in gas line to kitchen equipment (if not supplied with appliance) under Type 1 hood. Interlock with hood fire alarm system.
- I. Valve Adjustment: Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

### 3.09 INSTALLATION OF CLEANOUTS

- A. Cleanouts: Install in piping as indicated, as required by California Plumbing Code, at each change in direction of piping greater than 45 degrees. Install at maximum intervals of 50 feet for piping 4 inches and smaller and 100 feet for larger piping inside buildings, and at base of each conductor.
- B. Flashing Flanges: Install flashing flange and clamping device with each cleanout passing through water resistant membrane.

### 3.10 INSTALLATION OF FLOOR DRAINS AND FLOOR SINKS

- A. Install drains in accordance with manufacturer's written instructions and in locations indicated. Install floor drains with lip of drain slightly below finished floor to ensure drainage. Install floor sinks flush with finished floor. Coordinate with other trades to ensure that floor slopes to drain. Provide flashing flange and clamping device with each drain passing through water resistant membrane.
- B. Install vented P-trap below each drain. Where trap primers are indicated, install trap primer connection in the P-trap.

### 3.11 INSTALLATION OF ROOF DRAINS AND OVERFLOW DRAINS

- A. Install roof drains and overflow roof drains in accordance with manufacturer's written instructions and in locations indicated.
- B. Coordinate with roofing as necessary to interface roof drains with roofing work.

### 3.12 INSTALLATION OF HOPPER DRAINS

- A. Install hopper drain in wall, in sheet metal box, with access door.
  - 1. Size access door and box to suit the size required for hopper drain and trap primer, and solder all seams of box. Seal all penetrations to box with non-hardening waterproof sealant. Provide locking door in occupied spaces.
- B. Grind top and sides of funnel, if required, to suit wall thickness.

### 3.13 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers where indicated on Drawings. Provide drain connection available from the manufacturer at drain connection, pipe drain outlet to the nearest floor drain.
  - 1. Where drain pans are shown on the Drawings, pipe drain pan outlet to nearest floor drain.

### 3.14 TRAP PRIMER INSTALLATION

- A. Install as indicated in manufacturers printed literature, with 1/2 inch, Type L, hard copper piping to trap primer connection on floor drains and floor sinks where indicated on Drawings. At Contractor's option, Type K annealed copper tubing without joints may be used below slab only. See Section 22 00 50 for pipe protection requirements for below slab copper piping/tubing.
- B. Install trap primer piping with 1/4 inch per foot slope, to insure that the line will drain fully to the floor drain or floor sink.
  - 1. Provide ball valve to the inlet at each trap primer location.
- C. Install trap primer and distribution unit exactly as called for in manufacturers printed installation instructions. Connect to domestic water piping from the top of the water line, in order to prevent foreign material from entering directly into primer assembly.
- D. Mount trap primer in wall, in sheet metal box, with Karp or equal access door. Size access door and box to suit valve operation, and solder all seams of box. Seal all penetrations to box with non-hardening waterproof sealant. Provide locking door where installed in occupied spaces.
- E. Where one trap primer will be used for more than one trap, provide a distribution unit with feeder piping for a maximum of four traps sized for equal pressure drop to each trap.

### 3.15 INSTALLATION OF GAS PRESSURE REGULATING VALVES

- A. Install as indicated; comply with utility requirements. In locations where regulators are installed in confined spaces, pipe atmospheric vent to outdoors, full size of outlet. Install gas shutoff valve upstream and downstream of each pressure-regulating valve.

### 3.16 GAS PIPING EQUIPMENT CONNECTIONS

- A. Connect gas piping to each gas-fired equipment item, with union, drip leg and shutoff gas cock full size of supply line shown. Reduce only at connection to equipment. Comply with equipment manufacturer's instructions.
  - 1. Route gas vent and gas relief to outside.
  - 2. Gas shutoff valve shall be placed as close as possible to equipment in a location where it can be serviced. Distance from equipment to valve shall not exceed 6 feet.

### 3.17 EQUIPMENT CONNECTIONS

- A. Piping Runouts to Fixtures: Provide hot and cold water piping runouts to fixtures of sizes indicated.
- B. Mechanical Equipment Connections: Connect hot and cold water piping system and gas piping system to mechanical equipment as indicated, and provide with shutoff valve and union for each connection.

### 3.18 KITCHEN EQUIPMENT INSTALLATION

- A. Coordinate all work with Specification Section for kitchen equipment.
- B. All equipment shall be fully connected.
- C. Furnish and install all required "P" traps.
- D. Provide stops on all hot and cold water lines at equipment, in an accessible position. Include lines to kettle and range swing faucets.
- E. Water pressure for dishwasher and glass-washer to be 25 pound maximum. Provide pressure reducing valves on water line to washers.
- F. All floor openings are to be sealed watertight.
- G. Indirect waste lines required for standard or fabricated items of kitchen equipment, except sinks, shall be furnished and installed by the kitchen equipment contractor.
- H. Provide all sink drains. All indirect drains shall terminate above floor sinks at least 1-1/2 times ID of drain line and shall be so set that flare will not spill on floor area.
- I. Provide approved vacuum breaker or anti siphon device on water lines to equipment wherever required.
- J. Provide gas pressure regulators for modular front manifold cooking equipment assemblies. Pressure regulators shall be adjustable from 2 inch to 7 inch water column and shall be set for approximately 6 inches W.C. at manifold connection.
- K. All gas pressure regulators shipped loose with gas fired equipment shall be installed by plumbing contractor.

- L. The kitchen equipment contractor will provide all equipment trim including faucets and sink wastes and swing faucets at kettles all to be installed by Plumbing contractor.
- M. All horizontal piping lines connected to equipment shall be run at the highest possible elevation not less than 6 inches above floor. Piping rough-in shall be stubbed in walls wherever possible.
- N. Vent piping for waste lines shall be concealed wherever possible and vertical vents for island or free-standing equipment shall be avoided. Any required exposed vents shall be submitted to the Architect for approval.
- O. Kitchen equipment contractor to furnish coffee maker. Plumbing contractor shall provide a cold water connection terminating in a 3'-0" length of 1/4 inch OD soft copper tubing with a 1/4 inch female flare fitting on the end.
- P. Fire protection systems for ventilators and cooking equipment are furnished and installed by kitchen equipment contractor unless shown otherwise on the drawings. Gas valves which are a part of the fire protection systems are furnished only. Plumbing Contractor shall install gas valves.
- Q. Connect movable gas-fired cooking equipment utilizing flexible gas connection system.

### 3.19 LABORATORY EQUIPMENT AND CASEWORK INSTALLATION

- A. Coordinate all work with Specification Section for Laboratory Equipment and Casework.
- B. Furnish and install all required P-traps. Traps shall be Enfield, Fuseal, or equal.
- C. Provide stops on all hot and cold water lines at equipment in an accessible position.
- D. Seal floor openings watertight.
- E. Provide approved vacuum breaker or anti-siphon device on water lines to equipment wherever required.
- F. All horizontal piping lines connected to equipment shall be run at the highest possible elevation not less than 6 inches above floor. Piping rough-in shall be stubbed in walls wherever possible.
- G. Vent piping for waste lines shall be concealed and vents for island or freestanding equipment shall be looped.

### 3.20 DOMESTIC WATER SYSTEM STERILIZATION

- A. Clean and disinfect new or altered hot and cold water piping connected to domestic water systems using methods prescribed by the Health Authority. If the Health Authority does not prescribe methods, clean and disinfect new or altered hot and cold water piping using methods given in the California Plumbing Code.
  - 1. A water treatment company that has a current state EPA license to apply disinfectant chlorine in potable water shall perform the procedure.

### 3.21 CARE AND CLEANING

- A. Repair or replace broken, damaged, or otherwise defective parts, materials, and work. Leave entire work in condition satisfactory to Architect. At completion, carefully clean and adjust equipment, fixtures, and trim that are installed as part of this work. Remove labels from stainless steel sinks, except 316 stainless steel sink labels should be retained to confirm that the correct material has been provided. Leave systems and equipment in satisfactory operating condition.

### 3.22 OPERATIONAL TESTS

- A. Test each piece of equipment to show that it will operate in accordance with indicated requirements.

### 3.23 TESTING AND BALANCING

- A. See Section 23 05 93 of Specifications for testing and balancing requirements.

### 3.24 CLEANING UP

- A. Upon completion of Work remove materials, equipment, apparatus, tools, and the like, and leave premises clean, neat, and orderly.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 09/30/2022 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Schedule 80 pipe from rigid to pvc.
- No electric faucets, provide metered valves.
- No automatic flush valves.
- Wants Sloan flush valves. Pfister is second choice. No Moen.
- Basis of Design shall be Chicago faucets.
- Wall hung fixtures desired over floor mounted.
- Provide isolation valves at each building, minimum. At all new toilet rooms, provide shut off for all fixtures.
- Murdock Model A172.8-VR-BF12-WF1 Series, or Haws hi-low drinking fountain plus hydration stations. All non-refrigerated. All with Cartridge Filers.
- Plastic pipe is acceptable above and below ground with cast iron option.
- Schedule 10 downspouts/rain water leaders to 8' to 10' feet above grade. Fully welded.



- Provide a cleanout tee at all new downspouts/rain water leaders.
- Galvanized pipe condensate drain lines.
- Do not use gas fired tankless water heaters. Okay with limited insta-hots.
- AO Smith or Bradford White water heaters.
- All copper joints shall be soldered. No ProPress.
- Provide flush valve diaphragm extra stock requirement.
- Provide faucet cartridge extra stock requirement. (minimum 4 sets per project).
- Use only bellows-type water hammer arrestors.

SECTION 22 40 00

PLUMBING FIXTURES

**PART 1 - GENERAL**

1.01 SUMMARY

A. Section Includes:

1. Water supplies and stops.
2. Plumbing fixture hangers and supports.
3. Refrigerator ice maker outlet boxes.
4. Dishwasher air gap fittings.
5. Solids interceptors.
6. Washing machine hose/supply boxes.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 22 00 50 Basic Plumbing Materials and Methods.

1.03 ACTION SUBMITTALS

- A. For additional requirements, refer to Section 22 00 50, Basic Plumbing Materials and Methods.
- B. Product Data: Submit manufacturer's specifications for plumbing fixtures and trim, including catalog cut of each fixture type and trim item furnished.

1.04 INFORMATIONAL SUBMITTALS

- A. Refer to Section 22 00 50, Basic Plumbing Materials and Methods.

1.05 CLOSEOUT SUBMITTALS

- A. For additional requirements, refer to Section 22 00 50, Basic Plumbing Materials and Methods.
- B. Maintenance Data: Submit maintenance data and parts lists for each fixture type and trim item, including instructions for care of finishes. Include this data in Operation and Maintenance Manual.

1.06 QUALITY ASSURANCE

- A. For additional requirements, refer to Section 22 00 50, Basic Plumbing Materials and Methods.
- B. Plumbing Fixture Standards: Comply with applicable portions of the following codes and requirements for all work in this Section:
1. 2022 California Building Code – CBC
  2. 2022 California Plumbing Code – CPC

3. 2022 California Health and Safety Code
  4. American National Standards Institute - ANSI
  5. Federal Standards - F.S.
  6. National Sanitary Foundation – NSF International
- C. ANSI Standards: Comply with ANSI/NSF 61, “Drinking Water System Components – Health Effects.”
- D. PDI Compliance: Comply with standards established by Plumbing and Drainage Institute pertaining to plumbing fixture supports.
- E. UL Labels: Provide water coolers that have been listed and labeled by Underwriters' Laboratories.
- F. ARI Labels: Provide water coolers that are rated and certified in accordance with applicable Air-Conditioning and Refrigeration Institute Standards.
- G. Americans with Disabilities Act (ADA).
- H. California Green Building Standards Code Requirements:
1. Tank-type water closets shall be certified to the performance criteria of the U.S. EPA WaterSense Specification for Tank-Type Toilets.
  2. Single Showerheads shall be certified to the performance criteria of the U.S. EPA WaterSense Specification for Showerheads.

## **PART 2 - PRODUCTS**

### **2.01 PLUMBING FIXTURES**

- A. General: Provide factory fabricated fixtures of type, style and material indicated. For each type fixture, provide fixture manufacturer's standard trim, carrier, seats, and valves as indicated by their published product information; either as designed and constructed, or as recommended by the manufacturer, and as required for a complete, installation. Where more than one type is dedicated, selection is Contractor's option; but, all fixtures of same type must be furnished by single manufacturer.
1. Take special care with the roughing-in and finished plumbing where batteries of fixtures occur.
  2. Take location and mounting heights for roughing-in from Architectural Drawings.
  3. Follow schedule on Plumbing Drawings for roughing-in connections. Set roughing-in for all fixtures exactly as per measurements furnished by the manufacturers of the fixtures used.
  4. Roughing-in for lavatories and sinks shall be brought in through the wall under the centerline of the drain from the fixture wherever possible and as close to the fixture as possible.

### **2.02 MATERIALS**

- A. Provide materials that have been selected for their surface flatness and smoothness. Exposed surfaces that exhibit pitting, seam marks, roller marks, foundry sand holes, stains, discoloration, or other surface imperfections on finished units are not acceptable.

- B. Where fittings, trim and accessories are exposed or semi-exposed, provide, chromium plated 17 gauge seamless brass and match faucets and fittings. Provide 17 gauge seamless copper or brass where not exposed.
- C. Handles on all faucets and stops shall be all metal chromium plated.
- D. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.

## 2.03 PLUMBING FITTINGS, TRIM AND ACCESSORIES

- A. Water Outlets: At locations where water is supplied (by manual, automatic or remote control), provide commercial quality faucets, valves, or dispensing devices, of type and size indicated, and as required to operate as indicated.
  - 1. Include manual shutoff valves and connecting stem pipes to permit outlet servicing without shut-down of water supply piping systems.
- B. P-Traps: Include IAPMO approved removable P-traps where drains are indicated for direct connection to drainage system. P-Traps shall be less trap screw cleanout, and incorporate a chrome plated cast brass body, brass connection nuts, 17 gauge seamless brass wall return and chrome plated wall escutcheon to match trap finish.
- C. Carriers: Provide cast iron supports for fixtures of graphitic gray iron, ductile iron, or malleable iron as indicated. Where the carrier for wall mounted water closets are installed more than 6 inches behind the finished wall, provide water closet support for wide pipe chase.
- D. Fixture Bolt Caps: Provide manufacturer's standard exposed fixture bolt caps finished to match fixture finish.
- E. Escutcheons: Where fixture supplies and drains penetrate walls in exposed location, provide chrome-plated cast brass escutcheons with setscrews.
- F. Aerators: Provide aerators of types approved by Health Departments having jurisdiction. Delete aerators where not allowed by CPC for health care occupancies.
- G. Comply with additional fixture requirements contained in Fixture Schedule shown on the drawings.

## 2.04 MANUFACTURERS

- A. In accordance with California Plumbing Code, provide indelibly marked or embossed manufacturers name or logo, arranged so as to be visible after installation.
- B. Manufacturers: Drawing schedules indicate Basis of Design products. Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following:
  - 1. Vitrified China Plumbing Fixtures:
    - a. American Standard, U.S. Plumbing Products.

- b. Eljer Plumbingware Div., Wallace-Murray Corp.
  - c. Kohler Co.
  - d. Vitra.
- 2. Modular Lavatories:
  - a. Bradley.
  - b. Acorn.
  - c. Willoughby Industries, Inc.
- 3. Plumbing Trim:
  - a. McGuire Manufacturing Co., Inc.
  - b. Delta Commercial.
  - c. Chicago Faucet Co.
  - d. T&S Brass and Bronze Works, Inc.
- 4. Flush Valves:
  - a. Sloan Valve Co.
  - b. Zurn Industries, Hydromechanics Div.
  - c. Toto USA, Inc.
- 5. Faucets:
  - a. Chicago Faucet Co.
  - b. Symmons Scott.
  - c. T&S Brass and Bronze Works, Inc.
  - d. Delta Commercial.
- 6. Fixture Seats:
  - a. Church Seat Co.
  - b. Bemis Mfg. Co.
  - c. Beneke Corp.
- 7. Water Coolers and Drinking Fountains:
  - a. Murdock
  - b. Haws Corporation.
- 8. Service Sinks:
  - a. American Standard.
  - b. Kohler Co.
  - c. Williams Serviceceptor.
  - d. Florestone.
  - e. Acorn.
- 9. Stainless Steel Sinks:

- a. Elkay Mfg. Co.
- b. Just Mfg. Co.
- c. Haws Corporation.

10. Showers:

- a. Acorn.
- b. Bradley.
- c. Symmons.
- d. Powers.

11. Emergency Equipment:

- a. Haws Corporation.
- b. Gardian.
- c. Symmons.
- d. Bradley.
- e. Encon.

12. Fixture Carriers:

- a. Josam Mfg. Co.
- b. J. R. Smith.
- c. Tyler Pipe; Wade Div.
- d. Zurn Industries; Hydromechanics Div.
- e. Mifab, Inc.

2.05 FLUSH VALVE REQUIREMENTS

- A. Metering flush valves where required and specified shall be non-hold open type with exposed parts chrome plated. Conform to all codes and manufacturers' recommendations. All diaphragms are to have multiple filtered bypass and be chloramine resistant synthetic rubber with internal components suitable for 180 degree hot water to 150 pounds pressure, plastic or leather diaphragm not acceptable.
- B. Electronic flush valves where required and specified shall be non-hold open type with exposed parts chrome plated. Conform to all codes and manufacturers' recommendations. All diaphragms are to have multiple filtered by pass and be chloramine and resistant synthetic rubber with rubber and internal components suitable for 180 degree hot water to 150 pounds pressure, plastic or leather diaphragm not acceptable. All flush valve solenoids and sensors shall be UL listed.

2.06 FIXTURE CONNECTIONS

- A. Make connection between fixtures and flanges on soil pipe absolutely gastight and watertight with neoprene type gaskets (wall hung fixtures) or bowl wax (floor outlet fixtures). Rubber gaskets or putty will not be permitted.

- B. Provide fixtures not having integral traps with P-traps of chromium-plated 17 gauge cast brass, with 17 gauge seamless brass wall return, connected to concealed waste in wall and sanitary fittings. Provide IAPMO approval for trap, and provide less trap screw cleanout.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. Dearborn Brass, Commercial series with brass nuts.
    - b. Delta Commercial.
    - c. McGuire Manufacturing Co., Inc.
- C. Connections from stacks or horizontal wastes to wall or floor finish for wastes from lavatories, urinals, sinks, and drinking fountains and connection between floor drains and traps shall be IPS 85 percent red brass pipe.
- D. Plumbing fixture traps connected to special waste systems shall be constructed of materials to suit the waste system.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. Orion.
    - b. Enfield
- E. Unions on waste pipes on fixture side of traps may be slip or flange joints with soft rubber or lead gaskets. Traps shall rough in full size to waste and vent connection, using deep escutcheon plate to cover wall penetration. Compression adaptor extensions or sweat adaptors are not acceptable.

## 2.07 WATER SUPPLIES AND STOPS

- A. Provide 85 percent IPS threaded red brass nipple, conforming to the lead-free requirements of California Health and Safety Code Section 11 68 75, securely anchored to building construction, for each connection to stops, hose bibbs, etc. Each fixture, except hose bibbs, shall have stop valves installed on water supply lines.
- B. Provide water supplies to fixtures with compression shut-off stops with threaded inlets and lock shield-loose key handles. Provide combination fixtures with compression stop and threaded inlet on each water supply fitting. Provide lock shield-loose key handle for each stop.
- C. Provide 1/2 inch riser tubes with reducing coupling for fixtures, unless otherwise noted.
- D. Provide cast brass escutcheon.
- E. Furnish shut-off valves on hose bibbs where directly connected to mains with no intervening valves.
- F. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
  - 1. McGuire Manufacturing Company, Inc., model LFH2167LK.
  - 2. T & S Brass and Bronze Works, Inc., model B-1305.

## 2.08 PLUMBING FIXTURE HANGERS AND SUPPORTS

- A. Floor-affixed supports for off-the-floor plumbing fixtures shall comply with ASME A112.6.1M.
- B. Residential type fixture supports are not acceptable.
- C. Install wall mounted water closets with combination support and waste fittings, with feet of support securely anchored to floor.
- D. Install floor mounted water closets with J.R. Smith, Zurn, or equal government pattern cast iron closet flanges with brass bolts, nuts, washers, and porcelain caps secured with Spackle.
- E. Install the following fixtures on concealed support with feet of support securely anchored to floor. Anchor top of support to wall construction in an approved manner.
  - 1. Wall hung lavatories.
  - 2. Wall mounted urinals.
  - 3. Drinking fountains.
  - 4. Electric water coolers.

## 2.09 PLUMBING FIXTURES

- A. Install all plumbing fixtures at height indicated on Architectural Drawings. Where mounting height is not indicated, install at height required by Code.
- B. Special Requirements For Accessible Fixtures:
  - 1. Operating handle or valve for accessible water closets, urinals, lavatories, and sinks shall operate with less than 5 pounds force. Metering faucets shall be adjusted to operate between 10 and 15 seconds.
  - 2. Insulate exposed waste piping and domestic water supplies below accessible fixtures with CBC access code compliant molded "closed-cell" vinyl covers. Covers shall be installed using vandal resistant fasteners and must be removable. Covers shall meet flame spread rating not to exceed 25 and smoke density not to exceed 50 when tested in accordance with ASTM E-84, and shall comply with the requirements of California Code of Regulations, Title 24. Plumberex – Handy Shield, Johns Manville – Zeston 2000, or equal.
- C. Refrigerator Ice Maker Outlet Boxes:
  - 1. Manufacturers: Drawing schedules indicate Basis of Design products. Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following, or equal:
    - a. Guy Gray.
    - b. Water-Tite.
- D. Dishwasher Air Gap Fittings:



1. Manufacturers: Drawing schedules indicate Basis of Design products. Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following, or equal:
  - a. Zurn Industries, LLC.
  - b. Dearborn Brass.
- E. Solids Interceptors:
  1. Manufacturers: Drawing schedules indicate Basis of Design products. Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following, or equal:
    - a. J.R. Smith Mfg. Co.
- F. Washing Machine Hose/Supply Boxes:
  1. Manufacturers: Drawing schedules indicate Basis of Design products. Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following, or equal:
    - a. Acorn Engineering Co.

### **PART 3 - EXECUTION**

#### **3.01 PRODUCT HANDLING AND PROTECTION**

- A. Deliver packaged materials in their original, unopened wrapping with labels intact. Protect materials from water, the elements and other damage during delivery, storage and handling.

#### **3.02 PREPARATORY PROVISIONS**

- A. The Contractor is responsible for the examination and acceptance of all conditions affecting the proper construction and/or installation of the Work of this Section. Do not proceed until all unsatisfactory conditions have been corrected. Commencing work will be construed as acceptance of all conditions by the Contractor as satisfactory for the construction and/or installation of the Work.

#### **3.03 INSPECTION AND PREPARATION**

- A. Examine roughing-in work of domestic water and waste piping systems to verify actual locations of piping connections prior to installing fixtures. Also examine floors and substrates, and conditions under which fixture work is to be accomplished. Correct any incorrect locations of piping, and other unsatisfactory conditions for installation of plumbing fixtures. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Install plumbing fixtures of types indicated where shown and at indicated heights; in accordance with fixture manufacturer's written instructions, roughing-in drawings. Ensure that plumbing fixtures comply with requirements and serve intended purposes. Comply with applicable

requirements of the National Standard Plumbing Code pertaining to installation of plumbing fixtures.

- C. Fasten plumbing fixtures securely to supports or building structure; and ensure that fixtures are level and plumb. Secure plumbing supplies to blocking behind or within wall construction so as to be rigid, and not subject to pull or push movement.
- D. Install CBC accessible fixtures in accordance with Chapter 4 California Plumbing Code, and Chapters 11A and 11B California Building Code.
- E. Refer to Division 26 for wiring for electronic flush valves.

#### 3.04 FAUCET INSTALLATION

- A. Provide 85 percent IPS red brass pipe, conforming to lead-free requirements of California Health and Safety Code Section 11 68 75, securely anchored to building construction, for each connection to faucets, stops, hose bibbs, etc. Each fixture, except hose bibbs, shall have a stop valve installed on water supply lines to permit repairs without shutting off water mains.
- B. Adjust metering faucets to run for 10 to 15 seconds.

#### 3.05 CLEAN AND PROTECT

- A. Clean plumbing fixtures of dirt and debris upon completion of installation.
- B. Protect installed fixtures from damage during the remainder of the construction period.
- C. Grout voids between all fixtures and adjacent surfaces with white Dow Silicone Sealant, arranged to shed water.

#### 3.06 FIELD QUALITY CONTROL

- A. Upon completion of installation of plumbing fixtures and after units are water pressurized, test fixtures to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

#### 3.07 EXTRA STOCK

- A. General: Furnish special wrenches and other devices necessary for servicing plumbing fixtures and trim to Owner with receipt. Furnish one device for every ten units.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 09/30/2022 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 01/31/2025 – Added 1.02, paragraphs C & D.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Instantaneous Gas-Fired Water Heaters are only to be used when storage tank type water heaters will not fit. Storage type Water Heaters shall be the Basis of Design.

SECTION 22 50 00  
PLUMBING EQUIPMENT

**PART 1 - GENERAL**

1.01 SUMMARY

A. SECTION INCLUDES

1. Commercial electric water heaters.
2. Instantaneous electric water heaters.
3. Booster Heaters.
4. Gas fired water heaters.
5. Expansion tanks.
6. In-line domestic hot water recirculation pumps.
7. Neutralizing basin.
8. Concrete grease interceptors.
9. Plaster interceptors.
10. Oil interceptor.
11. Air compressors.
12. Air dryer.
13. Manholes.
14. Catch basin.
15. Liquefied petroleum tanks.
16. Insulation.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 22 00 50 Basic Plumbing Materials and Methods.
- C. Section 22 05 48 Plumbing Vibration and Seismic Control.
- D. Section 22 05 53 Plumbing Identification.

1.03 ACTION SUBMITTALS

- A. For additional requirements, refer to Section 22 00 50, Basic Plumbing Materials and Methods.
- B. Product Data: Submit manufacturer's plumbing equipment specifications, installation and start-up instructions, capacity and ratings, with selection points clearly indicated.

1.04 INFORMATIONAL SUBMITTALS

- A. For additional requirements, refer to Section 22 00 50, Basic Plumbing Materials and Methods.

### 1.05 CLOSEOUT SUBMITTALS

- A. For additional requirements, refer to Section 22 00 50, Basic Plumbing Materials and Methods.
- B. Maintenance Data: Submit maintenance data and parts lists for each item of plumbing equipment. Include "trouble-shooting" maintenance guides. Include this data in Operation and Maintenance Manual.

### 1.06 QUALITY ASSURANCE

- A. For additional requirements, refer to Section 22 00 50, Basic Plumbing Materials and Methods.
- B. Trade names or catalog numbers stated herein indicates grade or quality of materials desired.
- C. Dimensions, sizes, and capacities shown are minimum and shall not be changed without permission of Architect.
- D. UL and NEMA Compliance: Provide electric motors and electrical components required as part of plumbing equipment, which have been listed and labeled by Underwriters Laboratories and comply with NEMA standards.
- E. Pump types and sizes regulated by the US Department of Energy's "Energy Conservation Standards for Pumps" 10 CRF Parts 429 and 431 shall be marked with a compliant  $PEI_{CL}$  or  $PEI_{VL}$  (Pump Energy Index, constant or variable load) value, basic model number, and RPM on the nameplate. Regulated pumps shall be listed in the Hydraulic Institute (HI) Energy Rating database ([er.pumps.org](http://er.pumps.org)) and be assigned an Energy Rating as defined in the HI 40.5 program guide.
- F. CEC Compliance: Comply with California Electrical Code (Title 24, Part 3) as applicable to installation and electrical connections of ancillary electrical components of plumbing equipment.
- G. ANSI Compliance: Comply with ANSI Z223.1 (NFPA 54) "National Fuel Gas Code", as applicable to installation of gas-fired water heaters.
- H. CSA/UL Labels:
  - 1. Provide gas-fired water heaters that have been listed and labeled by CSA International or Underwriters Laboratories, certifying design according to ANSI Z21.10.1-CSA 4.1 standards governing storage-type water heaters with input ratings of 75,000 BTU/hr. or less.
  - 2. Provide gas-fired water heaters that have been listed and labeled by CSA International or Underwriters Laboratories, certifying design according to ANSI Z21.10.3-CSA 4.3 standards governing storage-type water heaters with input ratings of greater than 75,000 BTU/hr.
- I. ASME Relief Valve Stamps: Provide water heaters with safety relief valves bearing ASME valve markings.
- J. ASME Code Symbol Stamps: For the following equipment, comply with ASME Boiler and Pressure Vessel Code for construction, and stamp with ASME Code symbol:
  - 1. Water Heaters 200 MBH and greater.

- K. California Energy Commission Compliance: Provide written confirmation of listing of all water heaters in the "Appliance Efficiency Database."

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver packaged materials in their original, unopened wrapping with labels intact. Protect materials from water, the elements and other damage during delivery, storage and handling.

#### 1.08 WARRANTY

1. Commercial Electric Water Heaters: Three-year minimum limited warranty on tank leakage.
2. Atmospheric Gas Fired Water Heaters: Three-year minimum limited warranty on tank.
3. Power Gas Fired Water Heaters: Three-year minimum limited warranty on tank.
4. Direct Vented Sealed Combustion Condensing Gas-Fired Water Heater: Three-year minimum limited warranty on tank.
5. Instantaneous Gas-Fired Water Heater: three-year minimum limited warranty on heat exchanger and parts.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS

- A. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.
- B. Insulation products, including insulation, insulation facings, jackets, adhesives, sealants and coatings shall not contain polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations in amounts greater than 0.1 percent (by mass).

#### 2.02 COMMERCIAL ELECTRIC WATER HEATERS

- A. General: Provide commercial electric water heaters of size, capacity, and electrical characteristics indicated on Drawings. Comply with ASHRAE 90.1 for energy efficiency. Provide UL listing. Relief valve dip tube shall extend to within 3 inches of tank.
- B. Heater: Working pressure of 150 psi, magnesium anode rod; glass lining on internal surfaces exposed to water.
- C. Heating Elements: Heavy-duty, medium watt density, with incoloy sheath or zinc plated copper, thermostat stepped through magnetic contactor.
- D. Safety Controls: Double-pole, manual-reset, high-limit, probe type electric water low water cutoff; both factory wired.
- E. Jacket: Equip with full size control compartments with front panel opening. Insulate tank with vermin resistant polyurethane or glass fiber insulation. Provide outer steel jacket with bonderized undercoat and baked enamel finish.
- F. Provide the following accessories:

1. Brass drain valve.
  2. 3/4 inch temperature and pressure relief valve.
  3. Thermometer.
- G. Provide equal flow manifold for piping entering and leaving the water heaters. Manifold shall be provided as a standard option for the heaters proposed.
- H. Controls: Adjustable immersion thermostat or surface mounted therm-o-disc; power circuit fusing.
- I. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
1. Bradford White Corporation.
  2. Lochinvar Corporation.
  3. PVI Industries, LLC.
  4. Rheem Manufacturing Company.
  5. Smith, A.O. Water Products Co.; a division of A.O. Smith Corporation.

## 2.03 INSTANTANEOUS ELECTRIC WATER HEATERS

- A. General: Wall mounted, microprocessor-controlled, electric heating style.
- B. Standard: UL 499 for electric, tankless, (domestic-water heater) heating appliance.
- C. Construction: Copper piping or tubing complying with NSF 61 and NSF 372 barrier materials for potable water, without storage capacity.
1. Connections: ASME B1.20.1 pipe thread.
  2. Pressure Rating: 150 psig.
  3. Heating Element: Resistance heating system.
  4. Temperature Control: Flow-control fitting.
  5. Safety Control: High-temperature-limit cutoff device or system.
  6. Jacket: Aluminum or steel with enameled finish or plastic.
- D. Support: Bracket for wall mounting.
- E. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
1. Chronomite Laboratories, Inc.
  2. Eemax, Inc.

## 2.04 BOOSTER HEATERS

- A. General: Booster water heater shall be of the size and type shown on Drawings with stainless steel or glass lined tank, incoloy sheath or stainless steel element and all stainless steel jacket and casing, 100 psi working pressure, pressure reducing valve, check valve and strainer, magnetic contactors, temperature and pressure relief valve, temperature and pressure gauge all factory-mounted and wired, UL-approved, baked enamel stand or stainless steel stand, with control panel.

## 2.05 GAS FIRED WATER HEATERS

- A. General: All units shall comply with the emissions requirements of the Air Quality Management District (AQMD) in which they are to be installed.
- B. Atmospheric Gas Fired Water Heaters:
  - 1. General: Provide commercial atmospheric gas-fired water heater of size, capacity, and electrical characteristics indicated on Drawings. Comply with ASHRAE 90.1 for energy efficiency. Provide UL or CSA International listing.
  - 2. Heater: Working pressure of 150 psi, rigidly supported magnesium anode rod, glass lining on internal surfaces exposed to water. Provide gas pressure regulator, adjusted for operation on natural gas, with pressure rating to suit heater listing. Provide hand-hole cleanout through tank and jacket.
  - 3. Jacket: Insulate tank with rigid polyurethane foam or fiberglass insulation. Provide heavy-gauge steel jacket and baked enamel finish.
  - 4. Accessories: Provide brass drain valve and 3/4 inch temperature and pressure relief valve. Provide thermometer, installed in the top 1/3 of the tank or at hot water discharge at the tank.
  - 5. Controls: Adjustable immersion thermostat with safety shutoff.
  - 6. Vent: Furnish and install "Metalbestos", Selkirk, or equal, Type B vent, UL listed. Furnish complete with roof support, flashing, Briedert Type L, Metalbestos, or equal stainless stack cap, and all supports and accessories required for a complete installation.
  - 7. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. Bradford White Corporation.
    - b. Lochinvar Corporation.
    - c. PVI Industries, LLC.
    - d. Rheem Manufacturing Company.
    - e. Smith, A.O. Water Products Co.; a division of A.O. Smith Corporation.
- C. Power Gas Fired Water Heaters:
  - 1. General: Provide commercial power gas-fired water heater of size, capacity, and electrical characteristics as noted on Drawings. Comply with ASHRAE 90.1 for energy efficiency. Provide UL or CSA International listing. Units with gas input above 200 MBH shall be ASME constructed and listed, stamped for 125 PSIG.
  - 2. Heater: Working pressure of 150 psi, magnesium anode rod, glass lining on internal surfaces exposed to water.
  - 3. Jacket: Insulate tank with vermin-proof glass fiber or polyurethane foam insulation. Provide heavy-gauge steel jacket and baked enamel finish.
  - 4. Accessories: Provide brass drain valve and 3/4 inch temperature and pressure relief valve. Provide thermometer, installed in the top 1/3 of the tank or at hot water discharge at the tank.
  - 5. Provide equal flow manifold for piping entering and leaving the water heaters. Manifold shall be provided as a standard option for the heaters proposed.
  - 6. Controls: Adjustable immersion thermostat with safety shutoff.
  - 7. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:



- a. Bradford White Corporation.
  - b. Lochinvar Corporation.
  - c. PVI Industries, LLC.
  - d. Rheem Manufacturing Company.
  - e. Smith, A.O. Water Products Co.; a division of A.O. Smith Corporation.
8. Vent: Furnish and install "Metalbestos", Selkirk, or equal, Model PS, all-steel vent, UL listed. Furnish complete with roof support, flashing, Briedert, Metalbestos, or equal, Type L stainless stack cap, .035" stainless steel inner pipe, and all supports and accessories required for a complete installation. All joints shall be sealed with silicone sealant as recommended by the manufacturer for pressure-tight joints.
- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - 1) American Metal Products
    - 2) Selkirk
    - 3) Metalbestos
- D. Direct Vented Sealed Combustion Condensing Gas-Fired Water Heater:
1. General: Provide commercial direct vented sealed combustion condensing gas-fired water heater of size, capacity, and electrical characteristics as noted on Drawings. Provide UL or CSA International listing. Design unit to conform to the following:
    - a. ASHRAE/IESNA 90.1.
    - b. California NOx emission requirements.
    - c. Units with gas input above 200 MBH shall be ASME constructed and listed, stamped for 150 PSIG.
    - d. Minimum efficiency of 95 percent.
  2. Storage Tank Construction: Seamless steel with 150 psig working-pressure rating, glass lining on internal surfaces exposed to water.
  3. Factory-Installed Storage Tank Appurtenances:
    - a. Anode Rods: Magnesium.
    - b. Jacket: Heavy-gauge steel with enameled finish.
    - c. Cleanout: Hand-hole cleanout through tank and jacket.
    - d. Burner: Low NOx, pre-mix powered type, down-fired configuration.
    - e. Insulation: Non-CFC foam.
    - f. Drain Valve: Brass construction.
    - g. Heat Exchanger Coil: Located within submerged combustion chamber.
    - h. Combination Temperature and Pressure Relief Valve.
    - i. Dielectric Fittings.
  4. Accessories: Provide thermometer, installed in the top 1/3 of the tank or at hot water discharge at the tank.
  5. Controls: Adjustable electronic immersion thermostat with safety shutoff.
  6. Condensate Drain Piping: CPVC piping as defined in Section 22 10 00.

7. Vent and Exhaust Piping: CPVC piping as defined in Section 22 10 00
  8. See equipment Schedule and details on Drawings for additional accessories and requirements.
  9. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. Bradford White Corporation.
    - b. Lochinvar Corporation.
    - c. PVI Industries, LLC.
    - d. Rheem Manufacturing Company.
    - e. Smith, A.O. Water Products Co.; a division of A.O. Smith Corporation.
- E. Instantaneous Gas-Fired Water Heater:
1. General: Provide instantaneous gas-fired water heater of size, capacity, and electrical characteristics as noted on Drawings. Unit shall be suitable for interior or exterior installation and multiple-unit battery configuration as shown on Drawings, and shall be design certified and listed by CSA International. Design unit to conform to the following:
    - a. ASHRAE/IESNA 90.1.
    - b. California NOx emission requirements.
    - c. Minimum efficiency of 82 percent.
    - d. 150 PSI maximum water pressure.
  2. Factory-Installed Appurtenances:
    - a. Jacket: Heavy-gauge steel with enameled finish.
    - b. Burner: Low NOx, horizontal stainless steel, direct electronic ignition.
    - c. Gas Valve: Automatic modulating type.
    - d. Gas Pressure Regulator.
    - e. Heat Exchanger Coil: Copper, integral fin and tube type.
  3. Accessories: Provide with the following:
    - a. Thermometer, as described in Section 22 00 50.
    - b. Wall mounting bracket.
    - c. ASME pressure relief valve.
  4. Controls and Safeties: Shall provide the following features:
    - a. Flame proof sensor.
    - b. High temperature shut-off.
    - c. Over-current protection.
    - d. Freeze protection.
  5. Vent and Exhaust Piping: Provide field-fabricated or factory furnished piping as required by unit manufacturer for exterior or interior installations. Piping material shall be per unit manufacturers' requirements. Provide factory furnished vent termination cap for exterior installations.
  6. See equipment Schedule and details on Drawings for additional accessories and requirements.

7. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
  - a. Bradford White Corporation.
  - b. Rinnai Corporation.
  - c. Takagi Industrial Corporation.

## 2.06 EXPANSION TANKS

- A. Provide thermal expansion tanks of size and number as indicated on Drawings, conforming to lead-free requirements of California Health and Safety Code Section 11 68 75. Construct tank of welded steel for working pressure of 125 psi. Provide specially compounded flexible diaphragm securely sealed into tank to permanently separate air charge from system water, to maintain design expansion capacity.
  1. Tanks shall be IAPMO approved and listed for use with domestic water systems.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
  1. Amtrol, Inc.
  2. A.O. Smith Water Products Company.
  3. Watts Water Technologies, Inc.

## 2.07 IN-LINE DOMESTIC HOT WATER RECIRCULATION PUMPS

- A. Provide lead-free in-line domestic water recirculation pumps where indicated on Drawings and of capacities as scheduled on Drawings. Pumps shall be third-party certified by an approved laboratory as complying with California Health and Safety Code Section 11 68 75.
- B. Pumps shall be of the centrifugal type with non-overloading characteristics and shall not overload the motor above its nameplate horsepower rating under any operating condition. No allowance for service factor shall be used in pump selection. Motor horsepower shown is minimum; furnish larger motors if necessary to meet the non-overloading requirements.
- C. Type: Horizontal, designed for 125 thru 150 psi maximum working pressure and 225 degrees F continuous water temperature.
- D. Construction: Bronze casing, non-metallic impeller.
- E. Shaft: Ceramic, supported by carbon bearings. Bearings shall be lubricated by the pumped water.
- F. Motors shall have permanently lubricated ball bearings. Motors shall meet NEMA specifications. Motors shall have built-in thermal overload or impedance protection.
- G. Provide control wiring between field-installed controls, indicating devices, and pump control panels as work of this section, complying with requirements of Division 26 sections:
  1. Control wiring specified as work of Division 23 for Automatic Temperature Controls is work of that section.

- H. Wire pumps to mechanical control circuits to shut down pump when building is not occupied. Where no control system is installed, furnish pump manufacturers standard timer to automatically turn off circulating pump when hot water is not required.
- I. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
  - 1. Grundfos Pumps Corporation.
  - 2. Bell & Gossett, ITT Corporation.
  - 3. Taco Incorporated.
  - 4. Armstrong Pumps, Inc.

## 2.08 NEUTRALIZING TANKS

### A. Plastic-Tank Neutralization Systems

- 1. Description: System for neutralizing chemical waste.
- 2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
  - a. Orion Fittings; a Watts Water Technologies company.
  - b. Town & Country Plastics, Inc.
- 3. Controls: Factory wired and tested, 120 V ac, to operate probes, and to monitor pH of effluent; with wiring and electrical-power cord and plug.
- 4. Panel: NEMA 250, Type 4X enclosure unless otherwise indicated; with manufacturer's standard features, control devices, and indicators, but not less than the following:
  - a. Power light and on/off switch.
  - b. pH analyzer with programmable meter and high- and low-pH indicators, factory calibrated.
  - c. Analyser and sensor fault detection.
  - d. NEMA 5-15R audible and visual alarm with reset switch, with 4-20 mA output for remote indication.
  - e. Provide with contacts for connection to building energy management system.
- 5. Piping between Tanks: Polypropylene. Refer to Section 22 10 00, Plumbing Piping Systems.
- 6. Neutralization Tank: Polyethylene; with removable, gastight cover, heat-fused threaded sidewall inlet, outlet, and vent piping connections
  - a. Limestone: Chips or lumps, with more than 90 percent calcium carbonate content and 1- to 3-inch diameter.
- 7. Sampling Tank: Polyethylene; with removable, gastight cover, heat-fused threaded sidewall inlet, outlet, and vent piping connections, and opening in top for probe.
  - a. pH probe: Type and length suitable for sampling-tank size.

## 2.09 CONCRETE GREASE INTERCEPTORS

- A. Furnish and install a concrete grease interceptor with minimum capacity as indicated on the drawings, complete as cataloged. Provide manholes to grade for access to each section. Provide gastight cast-iron ring and cover at grade for each manhole.
- B. Provide concrete with an approved coating inside and outside.
- C. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
  - 1. M.C. Nottingham Company.
  - 2. Jensen Precast.

## 2.10 PLASTER INTERCEPTORS

- A. Furnish and install plaster interceptor with minimum capacity indicated on Drawings, complete as cataloged. Interceptor shall be all cast iron with acid-resistant coating on interior and exterior.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
  - 1. Jay R Smith 8710-ABS.
  - 2. Zurn Model Z-1180.

## 2.11 OIL INTERCEPTOR – COMPRESSOR LOCATIONS

- A. Furnish and install Oil/Sediment interceptor with minimum capacity of 12 pounds of sludge, complete as cataloged. Interceptor shall be coated fabricated steel with acid-resistant coating on interior and exterior. Provide fabricated extension, anchor flange, and single grate.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
  - 1. J.R. Smith 8925-F-ARC.
  - 2. Zurn Model Z-1189.

## 2.12 AIR COMPRESSORS

- A. Provide single package unit featuring belt driven rotary screw compressor. Compressor shall be driven by TEFC electric motor. Provide enclosed weatherproof casing and include factory wired starter, control panel with stop-start push buttons, indicator lights, gauges, run time meter and reset button.
  - 1. Provide control panel with, discharge air pressure and lubricant discharge temperature, operating hours, start/stop switch, power on light, emergency stop button, and control safety system with compressor ON light.
  - 2. Provide high air pressure shutdown switch, 3-phase motor overload protection, safety valve and oil sight glass. Compressor control shall be by a fully adjustable dual operating control providing idle time and time delay controls. Main air and oil piping shall be rigid steel with flexible

connections. The unit shall be delivered with full operating charge of oil and shall be ready for full operation.

- B. Provide ASME stamped receiver, pressure gauge. ASME Code pressure relief valve, tank drain, manual valve on main air line, intake filter and muffler, belt guards, and pressure reducing valve. Provide pipe line filter and refrigerated after-cooler.
- C. Provide soundproof enclosure around compressor unit, complete with filter media on air intake, and locking access doors. Where installed in locations exposed to weather conditions, provide rain hood.
- D. Furnish permit by State Division of Industrial Safety prior to project completion.
- E. Manufacturer shall be Powerex, Kaeser, Quincey, or equal.

#### 2.13 AIR DRYER

- A. Air dryer shall be a single package refrigerated compressed air dryer with built in controls and push button graphic control panel. Unit shall be contained in a weatherproof cabinet.
- B. Manufacturer shall be Kaeser, Quincy, or equal.

#### 2.14 AIR COMPRESSOR CONDENSATE DRAIN SYSTEM

- A. Provide high efficiency condensate drain system to automatically remove oil from compressed air condensate line. Install in accordance with manufacturer's recommendations.
- B. Manufacturer shall be Kaeser, Quincy, or equal.

#### 2.15 MANHOLES

- A. Provide standard precast concrete as shown on the plans and specified herein. Where special details are shown on Drawings or vary from requirements stated herein, follow Drawings.
  - 1. Provide manholes that comply with local utility company standards.
- B. Manholes shall be 48 inch diameter base section size with a minimum wall thickness of 4 inches. Taper manhole to 24 inch diameter. All dimensions given above are inside diameters.
- C. Install a minimum of two 6 inch and one 3 inch adjusting or grade rings on the top of manhole taper.
- D. Manhole frames and cover shall be Teichert Precast, Pinkerton, Alhambra Foundry Company, or equal, 24 inch diameter clear opening, unless otherwise specified on the plans, in which case numbers given on plans shall be used. Indicate weight on the bottom outside of rim of cover, and machine seat of the frame sufficiently so that the cover will set evenly and firmly in place without rocking. Letter cover as required to identify service. Information as to finish grade elevations must be adhered to when setting manhole frame and cover.
- E. Seal joints between base, manhole barrel, grade rings, taper section, and manhole frame to grade ring with Portland cement-sand-water grout or with resilient gasket material specifically formulated for such use. Make joints with care for watertight installation.

- F. Extend sewer pipe through the concrete manhole walls at the invert elevations given on the Drawings. Provide PVC manhole adapter connections at the manhole wall. Adapters shall be arranged to eliminate leaks around the pipe entrance.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. Indiana Seal.
    - b. CPK Products, Inc.
- G. Accurately shape inverts of all manholes to a "U" section as shown on the Drawings, using Portland cement concrete of suitable mix to assure a smooth, dense surface. Align inverts through manholes to provide good hydraulic transitions, including changes in direction as required. Make joints between manhole walls and sewer pipe neat and watertight.
- H. Provide manhole with polypropylene coated steel safety type manhole steps of the Edison type manufactured by the Alhambra Foundry Company, Alhambra, California, or equal. Manhole steps shall be installed with a maximum spacing of 15 inches.
- I. Where indicated on the drawings and where required by site conditions provide Santa Rosa Precast shallow manhole, or equal. Provide field poured base section, 48 inch diameter manhole section and 48 inch eccentric reducer slab for manhole. All other material and work, including cast iron frame and cover, grade rings, joints and gaskets, and formation of manhole base shall be in accordance with other manhole requirements.

## 2.16 CATCH BASIN

- A. Shall be as detailed on the drawings. Santa Rosa Precast, Model BK, Brooks, or equal, with cast iron grate and locking device, depth as required, Provide 6 inch thick concrete base, 6" minimum width each side, grout drain line into box a minimum of 6 inches above bottom.
- B. Fill bottom with cobbles for a minimum of 6 inches deep. Joints between sections shall be sealed with Ram-Nek, or equal, flexible plastic gaskets.

## 2.17 LIQUEFIED PETROLEUM TANKS

- A. Furnish and install liquefied petroleum tanks with size as indicated on Drawings. Each tank, system, system component and all of the installation shall conform to NFPA Pamphlet #58 and applicable local regulations.
- B. Design, construct and test tanks for 250 psi gauge working pressure, in accordance with ASME Code for Unfired Pressure Vessels, and provide code stamp or marking with indication of water capacity and working pressure.
- C. Provide system nameplate stating whether system is designed for underground or above ground installation and name and address of supplier of system, and any other markings required by NFPA #58.
- D. Support tanks on substantial concrete saddles or steel skids in such manner as to permit expansion and contraction and to prevent concentration of excessive loads on supporting portion of shell.

- E. Paint tanks with reflective aluminum paint.
- F. Design all components for LP gas service. Provide test and listing by Underwriters Laboratories, Inc., or other nationally recognized Testing Laboratory. Provide approval of other authority having jurisdiction.
- G. Provide the following for each tank:
  - 1. Tank liquid level gauging device of approved design.
  - 2. Safety relief valve for tank.
  - 3. Shut-off valves on all tank connections except safety valve. Shut-off valves shall be conspicuously marked.
  - 4. Approved pressure reducing valve (capacity 650 GPH) on outlet of interconnecting tank manifold to reduce pressure in outgoing line to 15 psi gauge, and approved safety relief valve on low pressure side. Provide high pressure manifold of material, arrangement, etc., as recommended by Regulator Manufacturer.
- H. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
  - 1. Roy E. Hanson Jr. Manufacturing.
  - 2. American Welding and Tank.

## 2.18 INSULATION MATERIALS

- A. General:
  - 1. Insulation products, including insulation, insulation facings, jackets, adhesives, sealants and coatings shall not contain polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations in amounts greater than 0.1 percent (by mass).
  - 2. Products shall not contain asbestos, lead, mercury, or mercury compounds.
  - 3. 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.
  - 4. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
  - 5. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
  - 6. Adhesives and sealants shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
- B. Insulation Materials:
  - 1. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB.
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
      - 1) CertainTeed Corporation.



- 2) Johns Manville.
- 3) Knauf Insulation.
- 4) Owens Corning.

C. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
  - a. Design Polymerics.
  - b. Foster Brand; H. B. Fuller Construction Products.
  - c. Knauf Insulation.
2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

D. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
  - a. Design Polymerics.
  - b. Childers Brand; H. B. Fuller Construction Products.
  - c. Foster Brand; H. B. Fuller Construction Products.
  - d. Knauf Insulation.
2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. The Contractor shall be responsible for the examination and acceptance of all conditions affecting the proper construction and/or installation of the Work of this Section and shall not proceed until all unsatisfactory conditions have been corrected. Commencing work shall be construed as acceptance of all conditions by the Contractor as satisfactory for the construction and/or installation of the Work.

#### **3.02 ELECTRIC WATER HEATER INSTALLATION**

- A. Install electric water heaters as indicated, in accordance with manufacturer's installation instructions and in compliance with applicable codes.
- B. Furnish wiring diagram to Electrical Installer. Refer to Division 26 for wiring of units, not work of this section.

- C. Connect to hot and cold water lines with shutoff valve, check valve, and dielectric union in the cold water line, and ASME standard pressure and temperature relief valve and dielectric union in the hot water line. Connect drain and relief piping as noted on Drawings.
- D. Start-up, test, and adjust electric water heaters in accordance with manufacturer's start-up instructions. Check and calibrate controls.
- E. After installation has been completed, seal bottom of heaters without feet to floor with silicone sealer.

### 3.03 GAS-FIRED WATER HEATER INSTALLATION

- A. Install gas-fired water heaters as indicated, in accordance with manufacturer's installation instructions and in compliance with applicable codes.
- B. Furnish wiring diagram to Electrical Installer. Refer to Division 26 for wiring of units, not work of this section.
- C. Connect to hot and cold water lines with shutoff valves and dielectric unions. Install ASME standard pressure and temperature relief valve. Connect drain and relief piping as noted on Drawings.
- D. Start-up, test, and adjust water heaters in accordance with manufacturer's start-up instructions. Check and calibrate controls.
- E. Install thermometer, in the top 1/3 of the tank or at hot water discharge at the tank.
- F. Confirm that water heater proposed is suitably equipped to be brought into the building through building openings provided, and that heater may be installed and removed through building openings provided.
- G. Additional requirements for direct vented sealed combustion condensing water heaters:
  - 1. Install vent and exhaust piping for direct vented sealed combustion condensing gas-fired water heaters strictly in accordance with unit manufacturers' recommendations.
  - 2. Trap condensate drain line per manufacturers' recommendations and run to nearest code-compliant point of disposal.
- H. Additional requirements for gas fired instantaneous water heaters:
  - 1. Install pressure relief valve at the hot water discharge of the unit.
  - 2. Install vent and exhaust piping for instantaneous gas-fired water heaters strictly in accordance with unit manufacturers' recommendations.

### 3.04 PUMP INSTALLATION

- A. Install pumps where indicated, in accordance with manufacturer's published instructions, complying with recognized industry practices to ensure that pumps comply with requirements and serve intended purposes.

- B. Provide floor-mounted pumps with a 6 inch high concrete base and anchor bolts as recommended by the pump manufacturer. Pumps shall be carefully shimmed level.
- C. Provide access space around pumps for service as indicated, but in no case less than that recommended by manufacturer.
- D. Install in-line pumps with support from overhead structure on each side of pump, or as indicated on Drawings.
- E. Support piping from the building structure so as to prevent any strain on the pump casings. Provide a final check for perfect alignment of the piping connections after pump has been secured to its base. Provide valves, accessories, gauges, flexible connections, and supports as indicated.
- F. Install electrical devices furnished by manufacturer but not specified to be factory mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.
- G. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 sections. Do not proceed with equipment start-up until wiring installation is complete and correct.
- H. Check alignment, and where necessary, realign shafts of motors and pumps within recommended tolerances by manufacturer.
- I. Lubricate pumps before start-up. Start-up in accordance with manufacturer's instructions.
- J. Increase piping immediately at pump suction and discharge; flexible couplings and all valves shall be full line size.
- K. Trim pump impeller to obtain the desired water flow after installation, without cost to Owner.
- L. Pumps shall not be connected to piping before piping is thoroughly flushed and cleaned of all dirt and grit. After piping connections have been made, systems shall be filled before starting pumps. Pumps shall not be run dry under any circumstances.

### 3.05 NEUTRALIZATION SYSTEM INSTALLATION

- A. Install neutralization systems as detailed on Drawings. Include full initial charge of limestone.

### 3.06 INTERCEPTOR INSTALLATION

- A. Install interceptors as indicated, in accordance with manufacturer's installation instructions and in compliance with applicable codes.
- B. Support: Anchor interceptors securely to substrate. Locate interceptors so that adequate clearance is provided to remove covers and sediment baskets. Set recessed units so top of cover is flush with finished grade.
- C. Piping: Connect inlet and outlet piping to interceptors.
- D. Refer to local standards for special installation requirements.

### 3.07 AIR COMPRESSOR INSTALLATION

- A. Install air compressors as indicated, in accordance with manufacturer's installation instructions and in compliance with applicable codes.
- B. Prior to initial test run of air compressor, provide lubrication, confirm satisfactory operation of water cooled after cooler, and post operating instructions in a prominent location near the unit.

### 3.08 MANHOLE INSTALLATION

- A. Install manholes as indicated on Drawings, in accordance with manufacturer's installation instructions and in compliance with applicable codes.

### 3.09 INSULATION INSTALLATION

#### 1. Insulation Installation on Pumps:

- a. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch- diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism. Do not enclose or insulate pump motor.
- b. Fabricate boxes from G90 galvanized steel, at least 0.050 inch thick.
- c. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

### 3.10 DEMONSTRATION AND TRAINING

- A. Provide a minimum of 16 hours of training and orientation of Owners staff in proper care and operation of Plumbing Equipment.

### 3.11 CARE AND CLEANING

- A. Repair or replace broken, damaged, or otherwise defective parts, materials, and work. Leave entire work in condition satisfactory to Architect. At completion, carefully clean and adjust equipment, fixtures, and trim that are installed as part of this work. Leave systems and equipment in satisfactory operating condition.

### 3.12 OPERATIONAL TESTS

- A. Test each piece of equipment to show that it will operate in accordance with indicated requirements.

### 3.13 CLEANING UP

- A. Upon completion of Work remove materials, equipment, apparatus, tools, and the like, and leave premises clean, neat, and orderly.

3.14 EQUIPMENT INSULATION SCHEDULE

A. Domestic hot water recirculation pump insulation shall be the following:

1. Mineral-Fiber Board: Thickness equal to insulation thickness for connected pipes and 3-lb/cu. ft. nominal density.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 09/30/2022 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 01/31/2025 – Revised 2.11, paragraph A to reference Section 23 05 53 – Mechanical Identification. Revised 2.12, paragraph A to reference Section 23 05 53 – Mechanical Identification. Deleted 2.12, paragraph B. Added article 3.03 in its entirety. Revised 3.13, paragraph A to reference Section 23 05 53 – Mechanical Identification. Deleted 3.13, paragraphs B thru E.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

## SECTION 23 00 50

## BASIC HVAC MATERIALS AND METHODS

**PART 1 - GENERAL****1.01 SUMMARY****A. Section Includes:**

1. Electric motors.
2. Motor starters.
3. Strainers.
4. Gauges.
5. Thermometers.
6. Access Doors.
7. Flexible joints.

**1.02 RELATED REQUIREMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. This Section is a part of each Division 23 Section.
- C. Refer to Section 23 08 00. T-24 Commissioning of HVAC for Title 24 commissioning and acceptance testing requirements.

**1.03 ADDITIONAL REQUIREMENTS**

- A. Furnish and install incidental work not shown or specified necessary to provide a complete and workable system.
- B. Make all temporary connections required to maintain services, including adequate heat and cooling, during the course of the Contract without additional cost to Owner. Notify Owner seven days in advance before disrupting services.
- C. Provide for adjustments or modifications to fan and motor sheaves, belts, damper linkages, and other components as required to achieve specified air balance at no additional cost to Owner.

**1.04 REFERENCES AND STANDARDS**

- A. Where material or equipment is specified to conform to referenced standards, it shall be assumed that the most recent edition of the standard in effect at the time of bid shall be used.
  1. AABC - Associated Air Balance Council
  2. AFBMA - Anti Friction Bearing Manufacturer's Association
  3. AMCA - Air Moving and Control Association Inc.
    - a. Standard 210 - Laboratory Methods of Testing Fans

4. ANSI - American National Standards Institute
5. ARI - Air-Conditioning and Refrigeration Institute
6. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
7. ASME - American Society of Mechanical Engineers
8. ASTM - American Society for Testing and Materials
9. CCR - California Code of Regulations

- a. Title 8 - Division of Industrial Safety, Subchapter 7; General Industry Safety Orders, Articles 31 through 36

10. CSA – Canadian Standards Association International
11. CSFM - California State Fire Marshal
12. NCPWB - National Certified Pipe Welding Bureau
13. NIST - National Institute of Standards and Technology
14. NEMA - National Electrical Manufacturers' Association
15. NFPA - National Fire Protection Association
16. OSHA - Occupational Safety and Health Act
17. SMACNA - Duct Manuals
18. UL - Underwriters' Laboratories, Inc.

B. Requirements of Regulatory Agencies:

1. The publications listed below form part of this specification; comply with provisions of these publications except as otherwise shown or specified.
  - a. California Building Code, 2022.
  - b. California Electrical Code, 2022.
  - c. California Energy Code, 2022.
  - d. California Fire Code, 2022.
  - e. California Green Building Standards Code, 2022.
  - f. California Mechanical Code, 2022.
  - g. California Plumbing Code, 2022.
  - h. California Code of Regulations, Title 24.
  - i. California Health and Safety Code.
  - j. CAL-OSHA.
  - k. California State Fire Marshal, Title 19 CCR.
  - l. National Fire Protection Association.
  - m. Occupational Safety and Health Administration.
  - n. Other applicable state laws.
2. Nothing in Drawings or specifications shall be construed to permit work not conforming to these codes, or to requirements of authorities having jurisdiction. It is not the intent of Drawings or specifications to repeat requirements of codes except where necessary for clarity.

1.05 DRAWINGS

- A. Examine Drawings prior to bidding of work and report discrepancies in writing to Architect.



- B. Drawings showing location of equipment and materials are diagrammatic and job conditions will not always permit installation in location shown. The HVAC Drawings show general arrangement of equipment and materials, etc., and shall be followed as closely as existing conditions, actual building construction, and work of other trades permit.
1. Architectural and Structural Drawings shall be considered part of the Work. These Drawings furnish Contractor with information relating to design and construction of the Project. Architectural Drawings take precedence over HVAC Drawings.
  2. Because of the small scale of HVAC Drawings, not all offsets, fittings, and accessories required are shown. Investigate structural and finish conditions affecting the Work and arrange Work accordingly. Provide offsets, fittings, and accessories required to meet conditions. Inform Architect immediately when job conditions do not permit installation of equipment and materials in the locations shown. Obtain the Architects approval prior to relocation of equipment and materials.
  3. Relocate equipment and materials installed without prior approval of the Architect. Remove and relocate equipment and materials at Contractors' expense upon Architects' direction.
  4. Minor changes in locations of equipment, piping, ducts, etc., from locations shown shall be made when directed by the Architect at no additional cost to the Owner providing such change is ordered before such items of work, or work directly connected to same are installed and providing no additional material is required.
- C. Execute work mentioned in the Specifications and not shown on the Drawings, or vice versa, the same as if specifically mentioned or shown in both.

#### 1.06 FEES AND PERMITS

- A. Obtain and pay for permits and service required in installation of the Work. Arrange for required inspections and secure approvals from authorities having jurisdiction. Comply with requirements of Division 01.
- B. Arrange for utility connections and pay charges incurred, including excess service charges.
- C. Coordination:
1. General:
    - a. Coordinate HVAC Work with trades covered in other Specifications Sections to provide a complete, operable and sanitary installation of the highest quality workmanship.
  2. Have fire damper and fire smoke damper installation instructions available at Project site during construction for use by Project Inspector.
  3. Electrical Coordination:
    - a. Refer to the Electrical Drawings and Specifications, Division 26, for service voltage and power feed wiring for equipment specified under this section. Contractor has full responsibility for the following items of work:
      - 1) Review the Electrical Drawings and Division 26 Specifications to verify that electrical services provided are adequate and compatible with equipment requirements.

- 2) If additional electrical services are required above that indicated on Electrical Drawings and in Division 26, such as more control interlock conductors, larger feeder, or separate 120 volt control power source, include cost to furnish and install additional electrical services as part of the bid.
- 3) Prior to proceeding with installation of additional electrical work, submit detailed drawings indicating exact scope of additional electrical work.

4. Mechanical Coordination:

- a. Arrange for pipe spaces, chases, slots and openings in building structure during progress of construction, to accommodate mechanical system installation.
- b. Coordinate installation of supporting devices. Set sleeves in poured-in-place concrete and other structural components during construction.
- c. Coordinate requirements for access panels and doors for mechanical items requiring access where concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
- d. Coordinate with other trades equipment locations, pipe, duct and conduit runs, electrical outlets and fixtures, air inlets and outlets, and structural and architectural features. Provide information on location of piping and seismic bracing to other trades as required for a completely coordinated project.

1.07 SUBMITTALS - GENERAL

- A. Refer to Division 01 Submittals Section(s) for additional requirements.
- B. Submittal packages may be submitted via email as PDF electronic files, or as printed packages. PDFs shall be legible at actual size (100 percent). Provide seven copies of printed submittal packages.
- C. Provide submittal of materials proposed for use as part of this Project. Product names in Specifications and on Drawings are used as standards of quality. Furnish standard items on specified equipment at no extra cost to the Contract regardless of disposition of submittal data. Other materials or methods shall not be used unless approved in writing by Architect. Architect's review will be required even though "or equal" or synonymous terms are used.
  1. Partial or incomplete submittals will not be considered.
  2. Quantities are Contractor's responsibility and will not be reviewed.
  3. Provide materials of the same brand or manufacturer for each class of equipment or material.
  4. Identify each item by manufacturer, brand, trade name, number, size, rating, or other data necessary to properly identify and review materials and equipment. Words "as specified" are not sufficient identification.
  5. Identify each submittal item by reference to items' Specification Section number and paragraph, by Drawing and detail number, and by unit tag number.
  6. Organize submittals in same sequence as in Specification Sections.
  7. Show physical arrangement, construction details, finishes, materials used in fabrications, provisions for piping entrance, access requirements for installation and maintenance, physical size, mechanical characteristics, foundation and support details, and weight.
    - a. Submit Shop Drawings, performance curves, and other pertinent data, showing size and capacity of proposed materials.

- b. Specifically indicate, by drawn detail or note, that equipment complies with each specifically stated requirement of Contract Documents.
  - c. Drawings shall be drawn to scale and dimensioned (except schematic diagrams). Drawings may be prepared by vendor but must be submitted as instruments of Contractor, thoroughly checked and signed by Contractor before submission to Architect for review.
  - d. Catalog cuts and published material may be included with supplemental scaled drawings.
- D. Review of submittals will be only for general conformance with design concept and general compliance with information given in Contract Documents. Review will not include quantities, dimensions, weights or gauges, fabrication processes, construction methods, coordination with work of other trades, or construction safety precautions, which are sole responsibility of Contractor. Review of a component of an assembly does not indicate acceptance of an assembly. Deviations from Contract Documents not clearly identified by Contractor are Contractor's responsibility and will not be reviewed by Architect.
- E. Within reasonable time after award of contract and in ample time to avoid delay of construction, submit to Architect shop drawings or submittals on all items of equipment and materials provided. Provide submittal as a complete package.
  - 1. Shop drawings and submittals shall include Specification Section, Paragraph number, and Drawing unit symbol or detail number for reference. Organize submittals into booklets for each Specification section and submit in loose-leaf binders with index. Deviations from the Contract Documents shall be prominently displayed in the front of the submittal package and referenced to the applicable Contract requirement.
- F. Furnish to the Project Inspector complete installation instructions on material and equipment before starting installation.

#### 1.08 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for plumbing systems materials and products.
- B. Shop Drawings.
- C. Sustainable Design Submittals:
  - 1. Product Data: For adhesives and sealants, documentation of compliance including printed statement of VOC content and chemical components.
  - 2. Laboratory Test Reports: For adhesives and sealants, indicating compliance with requirements for low-emitting materials.
- D. Delegated-Design Submittals: For seismic supports, anchorages, restraints, and vibration isolators indicated to comply with performance requirements and design criteria.
  - 1. Calculations performed for use in selection of seismic supports, anchorages, restraints, and vibration isolators shall utilize criteria indicated in Structural Contract Documents.

2. Include design calculations and details for selecting vibration isolators and vibration isolation bases complying with performance requirements, design criteria, and analysis data signed and sealed by the California registered structural engineer responsible for their preparation.
3. Supports, anchorage and restraints for piping, ductwork, and equipment shall be an HCAI pre-approved system such as TOLCO, ISAT, Mason, or equal. Pipes, ducts and equipment shall be seismically restrained in accordance with requirements of current edition of California Building Code. System shall have current OPM number and shall meet additional requirements of authority having jurisdiction. Provide supporting documentation required by the reviewing authority and the Architect and Engineer. Provide layout drawings showing piping, ductwork and restraint locations.
  - a. Bracing of Piping, Ductwork, and Equipment: Specifically state how bracing attachment to structure is accomplished. Provide shop drawings indicating seismic restraints, including details of anchorage to building. In-line equipment must be braced independently of piping and ductwork, and in conformance with applicable building codes. Provide calculations to show that pre-approval numbers have been correctly applied in accordance with general information notes of pre-approval documentation.
  - b. In lieu of the above or for non-standard installations not covered in the above pre-approved systems, Contractor shall provide layout drawings showing piping, ductwork, and restraint locations, and detail supports, attachments and restraints, and furnish supporting calculations and legible details sealed by a California registered structural engineer, in accordance with 2016 California Building Code
4. Additional Requirements: In addition to the above, conform to all state and local requirements.

#### 1.09 INFORMATIONAL SUBMITTALS

- A. Provide coordinated layouts for HVAC Ductwork systems, in accordance with Specification Section 23 80 00.
- B. Provide evidence of equipment certification to California Energy Code Section 110.1 or 110.2, if not providing Electrically Commutated motors for HVAC fans sized below 1 hp and above 1/12 hp. Refer to specific equipment articles requiring electrically commutated motors.
- C. Check, Test, and Start forms, from equipment manufacturers.
- D. Check, Test and Start reports.

#### 1.10 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:
  1. Furnish three complete sets of Operation and Maintenance Manual bound in hardboard binder, and one compact disc containing complete Operation and Maintenance Manual in searchable PDF format. Provide Table of Contents. Provide index tabs for each piece of equipment in binder and disc. Begin compiling data upon approval of submittals.
    - a. Sets shall incorporate the following:

- 1) Product Data.
  - 2) Shop Drawings.
  - 3) Record Drawings.
  - 4) Service telephone number, address and contact person for each category of equipment or system.
  - 5) Complete operating instructions for each item of heating, ventilating and air conditioning equipment.
  - 6) Copies of guarantees/warranties for each item of equipment or systems.
  - 7) Test data and system balancing reports.
  - 8) Typewritten maintenance instructions for each item of equipment listing lubricants to be used, frequency of lubrication, inspections required, adjustment, etc.
  - 9) Manufacturers' bulletins with parts numbers, instructions, etc., for each item of equipment.
  - 10) Temperature control diagrams and literature.
  - 11) Check test and start reports for each piece of mechanical equipment provided as part of the Work.
  - 12) Commissioning and Preliminary Operation Tests required as part of the Work.
2. Post service telephone numbers and addresses in an appropriate place designated by Architect.
- B. Record Drawings:
1. Refer to Division 01 for additional requirements.
  2. Upon completion of the Work, deliver to Architect the following:
    - a. Originals of drawings showing the Work exactly as installed.
    - b. One complete set of reproducible drawings showing the Work exactly as installed.
    - c. One compact disc with complete set of drawings in PDF format showing the Work exactly as installed.
    - d. Provide Contractor's signature, verifying accuracy of record drawings.
    - e. Obtain the signature of the Inspector of Record for Record Drawings.

#### 1.11 SUBSTITUTIONS

- A. Refer to Division 01 for complete instructions. Requirements given below are in addition to or are intended to amplify Division 01 requirements. In case of conflict between requirements given herein and those of Division 01, Division 01 requirements shall apply.
- B. It is the responsibility of Contractor to assume costs incurred because of additional work and or changes required to incorporate proposed substitute into the Project. Refer to Division 01 for complete instructions.
- C. Substitutions will be interpreted to be manufacturers other than those specifically listed in the Contract Documents by brand name, model, or catalog number.
- D. Only one request for substitution will be considered for each item of equipment or material.
- E. Substitution requests shall include the following:

1. Reason for substitution request.
  2. Complete submittal information as described herein; see "Submittals."
  3. Coordinated scale layout drawings depicting position of substituted equipment in relation to other work, with required clearances for operation, maintenance and replacement.
  4. List optional features required for substituted equipment to meet functional requirements of the system as indicated in Contract Documents.
  5. Explanation of impact on connected utilities.
  6. Explanation of impact on structural supports.
- F. Installation of reviewed substitution is Contractors' responsibility. Any mechanical, electrical, structural, or other changes required for installation of substituted equipment or material must be made by Contractor without additional cost to Owner. Review by Architect of substituted equipment or material, will not waive these requirements.
- G. Contractor may be required to compensate Architect for costs related to substituted equipment or material.

#### 1.12 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of HVAC systems products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Contractor's Qualifications: Firm with at least 5 years of successful installation experience on projects with HVAC systems work similar to that required for this Project.
- C. Comply with applicable portions of California Mechanical Code pertaining to selection and installation of HVAC materials and products.
- D. All materials and products shall be new.

#### 1.13 DELIVERY, STORAGE, AND HANDLING

- A. Protect equipment and materials delivered to Project site from weather, humidity and temperature variations, dirt, dust and other contaminants.

#### 1.14 FIELD CONDITIONS

- A. Contractor shall visit Project site and examine existing conditions in order to become familiar with Project scope. Verify dimensions shown on Drawings at Project site. Bring discrepancies to the attention of Architect. Failure to examine Project site shall not constitute basis for claims for additional work because of lack of knowledge or location of hidden conditions that affect Project scope.
- B. Information on Drawings relative to existing conditions is approximate. Deviations from Drawings necessary during progress of construction to conform to actual conditions shall be approved by the Architect and shall be made without additional cost to the Owner. The Contractor shall be held responsible for damage caused to existing services. Promptly notify the Architect if services are found which are not shown on Drawings.

**1.15 WARRANTY**

- A. Refer to Division 01 for warranty requirements, and duration and effective date of Contractor's Standard Guarantee.
- B. Repair or replace defective work, material, or part that appears within the warranty period, including damage caused by leaks.
- C. On failure to comply with warranty requirements within a reasonable length of time after notification is given, Architect/Owner shall have repairs made at Contractor's expense.

**PART 2 - PRODUCTS****2.01 GENERAL**

- A. Materials or equipment of the same type shall be of the same brand wherever possible. All materials shall be new and in first class condition.
- B. All sizes, capacities, and efficiency ratings shown are minimum, except that gas capacity is maximum available.
- C. Refer to Division 22 10 00 and 23 80 00 for specific system piping materials.

**2.02 MATERIALS**

- A. No material installed as part of this Work shall contain asbestos.
- B. California Green Building Code Compliance:
  - 1. HVAC and refrigeration equipment shall not contain CFCs.
  - 2. HVAC and refrigeration equipment shall not contain Halons.

**2.03 ELECTRIC MOTORS**

- A. General Motor Requirements: Comply with NEMA MG 1 unless otherwise indicated. Comply with IEEE 841 for severe-duty motors.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. U.S. Motors.
    - b. Century Electric.
    - c. General Electric.
    - d. Lincoln.
    - e. Gould.
- B. Motor Characteristics: Designed for continuous duty at ambient temperature of 40 deg. C and at altitude of 3300 feet above sea level. Capacity and torque shall be 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.

1. Motors exceeding the nameplate amperage shall be promptly replaced at no cost to the Owner. Horsepower shown is minimum and shall be increased as necessary to comply with above requirements. Furnish motors with splash-proof or weatherproof housings, where required or recommended by the manufacturer. Match the nameplate voltage rating with the electrical service supplied. Check Electrical Drawings. Provide a transformer for each motor not wound specifically for system voltage.
- C. Polyphase Motors: NEMA MG 1, Design B, medium induction motor, premium efficiency as defined in NEMA MG 1. Select motors with service factor of 1.15. Provide motor with random-wound, squirrel cage rotor, and permanently lubricated or regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading. Temperature rise shall match insulation rating. Provide Class F insulation.
1. Multispeed motors shall have separate windings for each speed.
- D. Polyphase Motors with Additional Requirements:
1. 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.
  2. Motors Used with Variable Frequency Controllers:
    - a. Separately Connected Motors: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
    - b. 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.
    - c. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
    - d. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
    - e. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
    - f. Each motor shall be provided with a shaft grounding device for stray current protection.
  3. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.
- E. Single-Phase Motors:
1. Select motors with service factor of 1.15.
  2. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
    - a. Permanent-split capacitor.
    - b. Split phase.
    - c. Capacitor start, inductor run.
    - d. Capacitor start, capacitor run.
  3. Motors for HVAC exhaust, transfer, and supply fans larger than 1/12 hp and smaller than 1 hp shall be the following:



- a. Electronically Commutated motor (EC type): Motor shall be electronically commutated type specifically designed for applications, with heavy duty ball bearings. The motor shall be speed controllable down to 20% of full speed and 85% efficient at all speeds.

1) Exceptions:

- a) Motors in fan-coils and terminal units that operate only when providing heating to the space served.
  - b) Motors installed in space conditioning equipment certified under California Energy Code Section 110.1 or 110.2.
- 4. Contractor's Option: Motors scheduled on Drawings as single-phase, and larger than 1/12 hp and smaller than 1 hp, for applications other than HVAC fans, may be EC type.
  - 5. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
  - 6. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
  - 7. Motors 1/20 HP and Smaller: Shaded-pole type.
  - 8. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

## 2.04 MOTOR STARTERS

- A. Square D, Allen Bradley, or equal, in NEMA Type 1 enclosure, unless otherwise specified or required. Minimum starter size shall be Size 1. Provide NEMA 3R enclosure where exposed to outdoors.
- B. Provide magnetic motor starters for all equipment provided under the Mechanical Work. Starters shall be non-combination type. Provide part winding or reduced voltage start motors where shown or as hereinafter specified. Minimum size starter shall be Size 1.
  - 1. All starters shall have the following:
    - a. Cover mounted hand-off-automatic switch. Starters installed exposed in occupied spaces shall have key operated HOA switch.
    - b. Ambient compensated thermal overload.
    - c. Fused control transformer (for 120 or 24 volt service).
    - d. Pilot lights, integral with the starters. Starters located outdoors shall be in NEMA IIIR enclosures.
  - 2. Where three phase motors are provided for two-speed operation, provide two speed motor starters.
  - 3. Starters for single-phase motors shall have thermal overloads. NEMA I enclosure for starters located indoors, NEMA IIIR enclosure for starters located outdoors.
  - 4. Provide OSHA label indicating the device starts automatically.

## 2.05 STRAINERS

- A. Charles M. Bailey #100A, Armstrong, Muessco, or equal, Fig. 11 "Y" pattern, 125 psi WP minimum, with monel screens with 20 square mesh for 2 inches and smaller and 3/64 inch perforations for 2-1/2 inches and larger. Install all strainers with a blow-off hose valve with hose adapter. Strainer shall have gasketed cover with straight thread.

## 2.06 GAUGES

- A. Marsh "Series J", U.S. Gage, Danton 800, or equal, with bronze bushed movement and front recalibration. Dials shall be white with black numerals, 3-1/2 inch dial face. Normal reading shall be at mid-scale. Provide a needle valve on each gauge connection. Supply a gauge piped with branch isolation valves across the inlet and outlet of each pump and where shown on the Drawings.
- B. Provide Pete's Plug II, Sisco P/T, or equal, test plug with Nordel core {and gasketed cap}, on inlet and outlet of each coil, boiler, condenser, chiller and heat exchanger and where shown on Drawings.

## 2.07 THERMOMETERS

- A. Marsh, Taylor, Palmer, or equal, 5 inch diameter bimetal dial, adjustable from face, with adjustable positioner, located to be easily read from normal personnel approach. Normal reading shall be at mid-scale.
  - 1. Provide extension for insulation.
  - 2. Provide thermometers with steel bulb chambers and brass separable sockets.
  - 3. Thermometers for air temperature shall have 8 inch minimum stem.
- B. Provide Ventlock, Durodyne, or equal thermometer test holes at each air conditioning unit, furnace, and make-up air unit, in mixed air and supply air, and at all locations shown or scheduled on the Drawings. Provide two portable thermometers, with sensing connection arranged to suit test connections.
- C. Provide Pete's Plug II, Sisco P/T, or equal, test plug with Nordel core, on inlet and outlet of each coil, boiler, condenser, chiller and heat exchanger and provide two digital electronic test thermometers for each range of fluid temperature and where shown on Drawings.

## 2.08 ACCESS DOORS

- A. Where floors, walls, or ceilings must be penetrated for access to mechanical equipment, provide access doors, 14 inch by 14 inch minimum size in usable opening. Where entrance of a serviceman may be required, provide 20 inch by 30 inch minimum usable opening. Locate access doors/panels for non-obstructed and easy reach.
  - 1. All access doors less than 7'-0" above floors and exposed to public access shall have keyed locks.
- B. Access doors shall match those supplied in Division 08 in all respects, except as noted herein.
- C. Provide stainless steel access doors for use in toilet rooms, shower rooms, kitchens and other damp areas. Provide steel access doors with prime coat of baked-on paint for all other areas.

- D. Where panels are located on ducts or plenums, provide neoprene gaskets to prevent air leakage, and use frames to set door out to flush with insulation.
- E. Provide insulated doors where located in internally insulated ducts or casings.
- F. Do not locate access doors in highly visible public areas such as lobbies, waiting areas, and primary entrance areas. Coordinate with the Architect when access is required in these areas.
- G. Where specific information or details relating to access panels different from the above is shown or given on the Drawings or other Divisions of work, then that information shall supersede this specification.
- H. Manufacturers: Subject to compliance with requirements, available manufacturers offering products which may be incorporated into the Work include Milcor, Karp, Nystrom, or Cesco, equal to the following:
  - 1. Milcor
    - a. Style K (plaster).
    - b. Style DW (gypsum board).
    - c. Style M (Masonry).
    - d. Style "Fire Rated" where required.

## 2.09 FLEXIBLE JOINTS

- A. Where indicated on Drawings, provide Metraflex Metrasphere, Style R, Mason Industries, or equal, Spherical Expansion Joints. Provide control units at each expansion joint, arranged to limit both expansion and compression.
- B. Flexible joints at entry points to building shall be Barco Ductile iron, Advanced Thermal Systems, or equal, threaded style with stainless ball and mineral filled seal.

## 2.10 PIPE GUIDES

- A. Where flexible connections are indicated on Drawings, provide Metraflex style IV, B-Line, or equal, pipe guides in locations recommended by manufacturer. Maximum spacing from flexible connection to first pipe guide is 4 pipe diameters, and maximum spacing from second pipe guide is 14 pipe diameters.

## 2.11 EQUIPMENT IDENTIFICATION

- A. Refer to Section 23 05 53 – Mechanical Identification.

## 2.12 PIPE IDENTIFICATION

- A. Refer to Section 23 05 53 – Mechanical Identification.

**PART 3 - EXECUTION****3.01 EXISTING MATERIALS:**

- A. Remove existing equipment, piping, wiring, construction, etc., which interferes with Work of this Contract. Promptly return to service upon completion of work in the area. Replace items damaged by Contractor with new material to match existing.
- B. Removed materials which will not be re-installed and which are not claimed by Owner shall become the property of Contractor and shall be removed from the Project site. Consult Owner before removing any material from the Project site. Carefully remove materials claimed by Owner to prevent damage and deliver to Owner-designated storage location.
- C. Existing piping and wiring not reused and are concealed in building construction may be abandoned in place and all ends shall be capped or plugged. Remove unused piping and wiring exposed in Equipment Rooms or occupied spaces. Material shall be removed from the premises. Disconnect power, water, gas, pump or any other active energy source from piping or electrical service prior to abandoning in place.

**3.02 FRAMING, CUTTING, AND PATCHING**

- A. Special framing, recesses, chases and backing for Work of this Section, unless otherwise specified, are covered under other Specification Sections.
- B. Contractor is responsible for placement of pipe sleeves, hangers, inserts, supports, and location of openings for the Work.
- C. Cutting, patching, and repairing of existing construction to permit installation of equipment, and materials is the responsibility of Contractor. Repair or replace damage to existing work with skilled mechanics for each trade.
- D. Cut existing concrete construction with a concrete saw. Do not utilize pneumatic devices.
- E. Core openings through existing construction for passage of new piping and conduits. Cut holes of minimum diameter to suit size of pipe and associated insulation installed. Coordinate with building structure, and obtain Structural Engineer's approval prior to coring through existing construction.

**3.03 MECHANICAL DEMOLITION**

- A. Refer to Division 01 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.
- B. Disconnect, dismantle and remove mechanical systems, equipment, and components indicated to be removed. Coordinate with all other trades.
  - 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 to remain with same or compatible piping material. Refrigerant system must be evacuated per EPA requirements.

3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and cap remaining ducts with same or compatible ductwork material.
  4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
  5. Equipment to Be Removed: Drain down and cap remaining services and remove equipment.
  6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
  7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.
- D. Items to be salvaged and returned to District:
1. All existing direct digital control (DDC) system components including, but not limited to: duct air temp sensors, duct pressure sensors, damper actuators, water temp sensors, water flow sensors, valve actuators, DDC unit controllers, zone temp sensors, zone CO2 sensors, door/window switches, current sensors, control relays (RIBs), duct smoke detectors, etc.
  2. All existing refrigerant evacuated from existing hvac systems to be demo'd. Contactor shall deliver evacuated refrigerant to District M&O facilities in contractor provided tanks.

#### 3.04 ELECTRICAL REQUIREMENTS

- A. Provide adequate working space around electrical equipment in compliance with the California Electrical Code. Coordinate the Mechanical Work with the Electrical Work to comply.
- B. Furnish necessary control diagrams and instructions for the controls. Before permitting operation of any equipment which is furnished, installed, or modified under this Section, review all associated electrical work, including overload protection devices, and assume complete responsibility for the correctness of the electrical connections and protective devices. Motors and control equipment shall conform to the Standards of the National Electrical Manufacturers' Association. All equipment and connections exposed to the weather shall be NEMA IIIIR with factory-wired strip heaters in each starter enclosure and temperature control panel where required to inhibit condensation.
- C. All line voltage and low voltage wiring and conduit associated with the Temperature Control System are included in this Section. Wiring and conduit shall comply with Division 26.

#### 3.05 PIPING SYSTEM REQUIREMENTS

- A. Drawing plans, schematic 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.

#### 3.06 PRIMING AND PAINTING

- A. Perform priming and painting on the equipment and materials as specified herein.
- B. See Division 09 Painting Section(s) for detailed requirements.

C. Priming and painting:

1. Exposed ferrous metals, including piping, which are not galvanized or factory-finished shall be primed and painted.
  - a. Black Steel Piping:
    - 1) Primer: One coat gray Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, comparable products by Rust-Oleum, Kelly Moore, or equal.
    - 2) Topcoat: Two coats gray Sherwin-Williams Pro Industrial Waterbased Alkyd Urethane Enamel, comparable products by Rust-Oleum, Kelly Moore, or equal.
  - b. Interior Ductwork: Refer to Division 09 Painting Section(s). Architect shall select paint color.
2. Metal surfaces of items to be jacketed or insulated except ductwork and piping shall be given two coats of primer unless furnished with equivalent factory finish. Items to be primed shall be properly cleaned by effective means free of rust, dirt, scale, grease and other deleterious matter and then primed with the best available grade of zinc rich primer. After erection or installation, all primed surfaces shall be properly cleaned of any foreign or deleterious matter that might impair proper bonding of subsequent paint coatings. Any abrasion or other damage to the shop or field prime coat shall be properly repaired and touched up with the same material used for the original priming.
3. Where equipment is provided with nameplate data, the nameplate shall be masked off prior to painting. When painting is completed, remove masking material.

3.07 EXCAVATING

- A. Perform all excavating required for work of this Section. Provide the services of a pipe/cable locating service prior to excavating activities to determine location of existing utilities.
- B. Unless shown otherwise, provide a minimum of 2'-6" cover above top of pipe to finished grade for all service piping, unless otherwise noted. Trim trench bottom by hand or provide a 4 inch deep minimum bed of sand to provide a uniform grade and firm support throughout entire length of pipe. For all PVC pipe and for PE gas pipe, bed the pipe in 4 inch sand bed. Pipe bedding materials should be clean crushed rock, gravel or sand of which 100 percent will pass a 1 inch sieve. For pipes that are larger than 10 inches in diameter, at least 95 percent should pass a 3/4 inch sieve, and for pipes 10 inches in diameter or smaller, 100 percent should pass a 1/2 inch sieve. All other materials should have a minimum sand equivalent of 50. Only a small proportion of the native soils will meet these requirements without extensive processing; therefore, importation of pipe bedding materials should be anticipated. Pipe bedding materials shall be compacted in lifts not exceeding 6 inches in compacted thickness. Each lift shall be compacted to not less than 90 percent relative compaction at or above the optimum moisture content, in accordance with ASTM Specification D2940, except that bedding materials graded such 100 percent of the material will pass a No. 200 sieve shall be compacted in 6 inch lifts using a single pass of a flat-plate, vibratory compactor or vibratory drum. Pipe bedding materials should extend at least to the spring line.
- C. Maintain all warning signs, barricades, flares, and red lanterns as required.

- D. For all trenches 5 feet or more in depth, submit copy of permit detailed drawings showing shoring, bracing, sloping, or other provisions to be made for worker protection from the hazard of caving ground during the excavation of such trenches. Obtain a permit from the Division of Industrial Safety prior to beginning excavations. A copy of the permit shall be available at the site at all times.

### 3.08 BACKFILLING

- A. Backfill shall comply with applicable provisions of Division 31 of these Specifications.
- B. Except under existing or proposed paved areas, walks, roads, or similar surfaces, backfill for other types of pipe shall be made using suitable excavated material or other approved material. Place backfill in 8 inch layers, measured before compaction, and compact with impact hammer to at least 90 percent relative compaction per ASTM D2940.
  - 1. Backfill plastic pipe and insulated pipe with sand for a minimum distance of 12 inches above the top of the pipe. Compact using mechanical tamping equipment.
- C. Entire backfill for excavations under existing or proposed pavements, walks, roads, or similar surfaces, under new slabs on grade, shall be made with clean sand compacted with mechanical tamping equipment vibrator to at least 90 percent relative compaction per ASTM D2940. Remove excess earth. Increase the minimum compaction within the uppermost two feet of backfill to 95 percent.
- D. Replace or repair to its original condition all sod, concrete, asphalt paving, or other materials disturbed by the trenching operation. Repair within the guarantee period as required.

### 3.09 UNION AND FLANGE INSTALLATION

- A. Install Epco, Nibco, or equal, dielectric unions or flanges at points of connection between copper or brass piping or material and steel or cast iron pipe or material except in drain piping. Bushings or couplings shall not be used.
- B. Install unions in piping NPS 2" and smaller 3 or flanges in piping NPS 2-1/2" and larger whether shown or not at each connection to all equipment and tanks, and at all connections to all automatic valves, such as temperature control valves.
- C. Locate the unions for easy removal of the equipment, tank, or valve.
- D. Do not install unions or flanges in refrigerant piping systems.

### 3.10 ACCESS DOOR INSTALLATION

- A. Furnish and install access doors wherever required whether shown or not for easy maintenance of mechanical systems; for example, at concealed valves, strainers, traps, cleanouts, dampers, motors, controls, operating equipment, etc. Access doors shall provide for complete removal and replacement of equipment.

### 3.11 CONCRETE WORK

- A. Concrete work required for work of this Section shall be included under another section of the Specification, unless otherwise noted, including poured-in-place concrete work for installing precast manholes, catch basins, etc., and shall include reinforced concrete bases for pumps, tanks, compressors, fan units, boilers, unless the work is specifically indicated on the Drawings to be furnished under this Section.
- B. Underground anchors, and pads for valve access boxes are included under this Section of the Specification. Concrete shall be 3000 psi test minimum. Refer to Division 03 for concrete types.

### 3.12 PIPE PROTECTION

- A. Wrap bare galvanized and black steel pipe buried in the ground and to 6" above grade, including piping in conduit, with one of the following, or equal:
  - 1. Polyethylene Coating: Pressure sensitive polyethylene coating, "X-Tru-Coat" as manufactured by Pipe Line Service Corporation or "Green Line" wrap as manufactured by Royston Products, or equal.
    - a. Field Joints and Fittings: Protecto Wrap #1170 tape as manufactured by Pipe Line Service Corporation, or Primer #200 tape by Royston Products, or equal. Installation shall be as per manufacturer's recommendation and instructions.
  - 2. Tape Wrap: Pressure-sensitive polyvinyl chloride tape, "Transtex #V-10 or V-20", "Scotchwrap 50", Slipknot 100, PASCO Specialty & Mfg., Inc., or equal, with continuous identification. Tape shall be a minimum of 20 mils thick for fittings and irregular surfaces, two wraps, 50 percent overlap, 40 mils total thickness. Tape shall be laminated with a suitable adhesive; widths as recommended by the manufacturer for the pipe size. Wrap straight lengths of piping with an approved wrapping machine.
- B. Field Joints: Valves and Fittings: double wrap polyvinyl chloride tape as above. Provide at least two thicknesses of tape over the joint and extend a minimum of 4 inches over adjacent pipe covering. Build up with primer to match adjacent covering thickness. Width of tape of fittings shall not exceed 3 inches. Tape shall adhere tightly to all surfaces of the fittings without air pockets.
- C. Testing: Test completed wrap of piping, including all epoxy painted piping with Tinker and Rasor Co. holiday detector, or equal.
- D. Cleaning: Clean all piping thoroughly before wrapping.
  - 1. Inspection: Damaged or defective wraps shall be repaired as directed. No wrapped pipe shall be covered until approved by Architect.
- E. Covering: No rocks or sharp edges shall be backfilled against the wrap. When backfilling with other than sand, protect wrap with an outer wrapping of Kraft paper; leave in place during backfill.

### 3.13 PIPE IDENTIFICATION

- A. Refer to Section 23 05 53 – Mechanical Identification.



### 3.14 EXPANSION ANCHORS IN HARDENED CONCRETE

- A. Qualification Tests: The specific anchor shall have a current ICC-ES report and evaluated in cracked concrete in accordance with Acceptance Criteria AC193. If the specific anchor satisfies cyclic testing requirements per Acceptance Criteria AC01, Section 5.6, the full allowable shear and tension loads listed in the current ICC-ES report and manufacturer's recommendations for the specific anchor may be used. Otherwise, the design shear and tension loads shall not be more than 80% of the listed allowable shear and tension loads for the specific anchor.
- B. Installation: The anchors must be installed in accordance with the requirements given in ICC Research Committee Recommendations for the specific anchor.
- C. Testing: Fifty percent of the anchors shall be load-tested on each job to twice the allowable capacity in tension, except that if the design load is less than 75 pounds; only one anchor in ten need be tested. If any anchor fails, all anchors must be tested. The load test shall be performed in the presence of a special inspector.
- D. The load may be applied by any method that will effectively measure the tension in the anchor, such as direct pull with a hydraulic jack, a torque wrench calibrated using the specific anchor or calibrated spring-loading devices. Anchors in which the torque is used to expand the anchor without applying tension to the bolt may not be verified with a torque wrench.

### 3.15 PIPING SYSTEM PRESSURE TESTING

- A. General:
  - 1. Perform operational tests under simulated or actual service conditions.
  - 2. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
- B. Piping Systems: Test the installations in accordance with the following requirements and applicable codes:
  - 1. Notify the Architect at least seven days in advance of testing.
  - 2. Authority having jurisdiction shall witness tests of piping systems.
  - 3. Piping shall be tested at completion of roughing-in, or at other times as directed by the Architect.
  - 4. Furnish necessary materials, test pumps, gases, instruments and labor required for testing.
  - 5. Isolate from system equipment that may be damaged by test pressure.
  - 6. Make connections to existing systems with flanged connection. During testing of new work, provide a slip-in plate to restrict test pressure to new systems. Remove plate and make final connection to existing system at completion of testing.
    - a. Authority having jurisdiction shall witness final connection to system.
- C. Test Schedule: No loss in pressure or visible leaks shall show after four hours at the pressures indicated.

| <u>System Tested</u>                                     | <u>Test Pressure PSI</u>            | <u>Test With</u> |
|----------------------------------------------------------|-------------------------------------|------------------|
| All Hot, Chilled, Combination,<br>Condenser Water Piping | Greater of 1-1/2 x WP<br>or 100 psi | Water            |

D. Testing, Evacuating, Charging and Lubrication of Refrigeration Systems:

1. Pressurize with dry nitrogen and/or refrigerant to 300 psig and test all joints with an electronic detector or halide torch. Release the pressure and attach a high vacuum pump. Evacuate to 4 mm (4000 microns) and hold for 30 minutes. Break to 5 psig with dry nitrogen and allow to remain in the system for ten minutes. Evacuate to 2 mm (2000 microns) and hold for 30 minutes. Use a mercury manometer or electronic vacuum gauge. Do not start timing until recommended vacuum range is reached.
2. At the end of the evacuation, if the system has been proved leak-free, charge with refrigerant and fill the crankcase to the oil level specified by the manufacturer. All refrigerant oil shall be delivered to the location in sealed containers.
3. Replenish for a period of one year without cost to the Owner all refrigerant and oil required to maintain the proper levels.

3.16 TRACER WIRE INSTALLATION

- A. Provide tracer wire for non-metallic water pipe in ground outside of buildings. Use AWG #14 tracer wire with blue colored low density high molecular weight polyethylene insulation, and lay continuously on pipe so that it is not broken or stressed by backfilling operations. Secure wire to the piping with tape at 18 inch intervals. Solder all joints.
- B. Terminals: Precast concrete box and cast iron locking traffic cover, Brooks 3TL, or equal; cover marked with name of service; 6 inches of loose gravel below box. Plastic terminal board with brass bolts; identify line direction with plastic tags. Test for continuity between terminals, after backfilling, in presence of Inspector.
- C. Alternate: Use electronically detectable plastic tape with metallic core, Terra Tape D, manufactured by Reef Industries, Inc., Seton, Inc., Marking Services, Inc., or equal; tape 2 inches wide, continuously imprinted "CAUTION WATER (GAS, etc.) LINE BELOW". Install, with printed side up, directly over pipe, 18 inches below finish grade. Backfill material shall be as previously specified for the particular condition where pipe is installed, but avoid use of crushed rock or of earth with particles larger than 1/2 inch within the top 12 inches of backfill. Take precautions to insure that tape is not damaged or misplaced during backfill operations. Terminal boxes not required.

3.17 OPERATION OF SYSTEMS

- A. Do not operate any mechanical equipment for any purpose, temporary or permanent, until all of the following has been completed:
  1. Complete all requirements listed under "Check, Test and Start Requirements."
  2. Ductwork and piping has been properly cleaned. Piping systems shall be flushed and treated prior to operation.
  3. Filters, strainers etc. are in place.

4. Bearings have been lubricated, and alignment of rotating equipment has been checked.
  5. Equipment has been run under observation, and is operating in a satisfactory manner.
- B. Provide test and balance agency with one set of Contract Drawings, Specifications, Addenda, Change orders issued, applicable shop drawings and submittals and temperature control drawings.
- C. Operate every fire damper, smoke damper, combination smoke and fire damper under normal operating conditions. Activate smoke detectors as required to operate the damper, stage fan, etc. Provide written confirmation that all systems operate in a satisfactory manner.

### 3.18 TEMPORARY HEAT

- A. The General Contractor will provide for all temporary heat at such times as may be required or directed by the Architect and pay all fuel and energy costs incurred.
- B. Temporary heating facilities proposed for use by the Contractor will be subject to review of the Architect. Prior to use of any equipment for temporary heat, install temporary filters on all return air inlets, to preclude dust and construction debris from entering the duct system. In addition, install filters in air handling units, and replace at the completion of temporary operation.
- C. Filters used for temporary operation of systems shall be as specified for permanent filters specified herein.
- D. Comply with Check, Test and Start Requirements for start-up of equipment prior to operation for temporary heat.
- E. Contractor shall complete the permanent heating system as soon as possible, thereby making it available for temporary heat. When available, the system may be used as required at the direction of the Architect after systems are properly prepared for use as specified elsewhere. Contractor shall then be responsible for operating the system during periods required and the General Contractor shall pay the fuel and energy costs incurred. Operation of the heating system prior to the filing of "notice of completion" shall not change the Guarantee provisions in any way.

### 3.19 CHECK, TEST AND START REQUIREMENTS

- A. An authorized representative of the equipment manufacturer shall perform check, test and start of each piece of mechanical equipment. The representative may be an employee of the equipment manufacturer, or a manufacturer-certified contractor. Submit written certification from the manufacturer stating that the representative is qualified to perform the check test and start of the equipment.
1. As part of the submittal process, provide a copy of each manufacturer's printed startup form to be used.
  2. Some items of specified equipment may require that check, test and start of equipment must be performed by the manufacturer, using manufacturer's employees. See specific equipment Articles in these Specifications for this requirement.
  3. Provide all personnel, test instruments, and equipment to properly perform the check, test and start work.

4. When work has been completed, provide copies of reports for review, prior to final observation of work.
- B. Provide copies of the completed check, test and start report of each item of equipment, bound with the Operation and Maintenance Manual.
- C. Upon completion of the work, provide a schedule of planned maintenance for each piece of equipment. Indicate frequency of service, recommended spare parts (including filters and lubricants), and methods for adjustment and alignment of all equipment components. Provide a copy of the schedule with each Operation and Maintenance Manual. Provide a copy of certification from the Owner's representative indicating that they have been properly instructed in maintenance requirements for the equipment installed.

### 3.20 PRELIMINARY OPERATIONAL REQUIREMENTS AND TESTS

- A. Prior to observation to determine final acceptance, put HVAC, plumbing, and fire protection systems into service and check that work required for that purpose has been done, including but not limited to the following condensed check list. Provide indexed report to tabulating the results of all work.
  1. All equipment has been started, checked, lubricated and adjusted in accordance with the manufacturer's recommendations, including modulating power exhausts if present.
  2. Correct rotation of motors and ratings of overload heaters are verified.
  3. Specified filters are installed and spare filters have been turned over to Owner.
  4. All manufacturers' certificates of start-up specified have been delivered to the Owner.
  5. All equipment has been cleaned, and damaged painted finishes touched up.
  6. Damaged fins on heat exchangers have been combed out.
  7. Missing or damaged parts have been replaced.
  8. Flushing and chemical treatment of piping systems has been completed and water treatment equipment, where specified, is in operation.
  9. Equipment labels, pipe marker labels, ceiling markers and valve tags are installed.
  10. Valve tag schedules, corrected control diagrams, sequence of operation lists and start-stop instructions have been posted.
  11. Preliminary test and balance work is complete, and reports have been forwarded for review.
  12. Automatic control set points are as designated and performance of controls checks out to agree with the sequence of operation.
  13. Operation and Maintenance Manuals have been delivered and instructions to the operating personnel have been made.
- B. Prior to the observation to determine final acceptance, operate all mechanical systems as required to demonstrate that the installation and performance of these systems conform to the requirements of these specifications.
  1. Operate and test all mechanical equipment and systems for a period of at least five consecutive 8 hour days to demonstrate the satisfactory overall operation of the project as a complete unit.
  2. Include operation of heating and air conditioning equipment and systems for a period of not less than two 8 hour days at not less than 90 percent of full specified heating and cooling capacities in tests.

3. Commence tests after preliminary balancing and adjustments to equipment have been checked. Immediately before starting tests, install air filters and lubricate all running equipment. Notify the Architect at least seven calendar days in advance of starting the above tests.
  4. During the test period, make final adjustments and balancing of equipment, systems controls, and circuits so that all are placed in first class operating condition.
  5. Where Utility District rebates are applicable, demonstrate that the systems meet the rebate program requirements.
- C. Before handing over the system to Owner replace all filters with complete new set of filters.
- D. Review of Contractor's Tests:
1. All tests made by the Contractor or manufacturers' representatives are subject to observation and review by the Owner. Provide timely notice prior to start of each test, in order to allow for observation of testing. Upon the completion of all tests, provide a letter to confirm that all testing has been successful.
- E. Test Logs:
1. Maintain test logs listing the tests on all mechanical systems showing dates, items tested, inspectors' names, remarks on success or failure of the tests.
- F. Preliminary Operation:
1. The Owner reserves the right to operate portions of the mechanical system on a preliminary basis without voiding the guarantee.
- G. Operational Tests:
1. Before operational tests are performed, demonstrate that all systems and components are complete and fully charged with operating fluid and lubricants.
  2. Systems shall be operable and capable of maintaining continuous uninterrupted operation during the operating and demonstration period. After all systems have been completely installed, connections made, and tests completed, operate the systems continuously for a period of five working days during the hours of a normal working day.
  3. This period of continuous systems operation may be coordinated with the removal of Volatile Organic Compounds (VOCs) from the building prior to occupancy should the Owner decide to implement such a program.
  4. Control systems shall be completely operable with settings properly calibrated and adjusted.
  5. Rotating equipment shall be in dynamic balance and alignment.
  6. If the system fails to operate continuously during the test period, the deficiencies shall be corrected and the entire test repeated.
- H. Pre-Occupancy Building Purge:
1. Prior to occupancy, ventilate the building on 100 percent outside air, 100 percent exhaust for a continuous period determined by a qualified industrial hygienist (engaged by the Contractor) to reduce V.O.C's prior to occupancy.

2. Submit report by the industrial hygienist verifying satisfactory completion of the pre-occupancy purge.

### 3.21 DEMONSTRATION AND TRAINING

- A. An authorized representative of the equipment manufacturer shall train Owner-designated personnel in maintenance and adjustment of equipment. The representative may be an employee of the equipment manufacturer, or a manufacturer-certified contractor. Submit written certification from the manufacturer stating that the representative is qualified to perform the Owner training for the equipment installed.
  1. As part of the submittal process, provide a training agenda outlining major topics and time allowed for each topic.
  2. Some items of specified equipment require that training must be performed by the manufacturer, using manufacturer's employees. See specific equipment Articles in these Specifications for this requirement.
  3. Contractor shall provide three copies of certification by Contractor that training has been completed, signed by Owner's representative, for inclusion in Operation and Maintenance Manual. Certificates shall include:
    - a. Listing of Owner-designated personnel completing training, by name and title.
    - b. Name and title of training instructor.
    - c. Date(s) of training.
    - d. List of topics covered in training sessions.
  4. Refer to specific equipment Articles for minimum training period duration for each piece of equipment.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 09/30/2022 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 01/31/2025 – Revised district standard approved unit manufacturers to remove York, as they are no longer available with 4” filter racks. Added AAON as district standard approved unit manufacturer. Added requirement for rooftop units to have 4” filter rack to district standard. Revised district standards to not allow VRF without written approval from the district.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District’s intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Design around Johnson Controls. Do not spec or accept Pelican controls.
- Units shall be by Lennox, Carrier, or AAON.
- Rooftop units shall be capable of accepting 4” thick air filters inside the unit’s cabinet.
- Design with full control of economizer.
- District wants trend logs, zone temps, discharge air temps.
- District does not allow VRF systems, without written approval from the district.

- Exposed ducts at interior spaces is okay.
- Design with VAV modes.
- Provide motorized air relief damper.
- District desires exterior mechanical closet doors at new construction.
- Use of Team Air enclosures is approved.
- Provide adequate training requirements in the spec.
- Provide requirements for physical labeling of equipment.
- No SE boards in equipment.



## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 09/30/2022 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

## SECTION 23 05 15

## HVAC EQUIPMENT AND AIR DISTRIBUTION SYSTEM CLEANING

**PART 1 - GENERAL****1.01 PROJECT STANDARDS:**

- A. Become familiar with the general layout of the facility. Provide the Engineer with a written report including hours worked, work accomplished, and work to be completed on the next shift. All reports shall be submitted at shift end to the Engineer.

**1.02 PRE-PROJECT REPORT:**

- A. Submit a pre-project document including findings and recommendations for cleaning of all air delivery system services. Provide photographic evidence of conditions found in duct work, components, and air handlers including lab reports. See Article 3.02 of this Section for establishment of existing contamination levels.

**1.03 QUALITY ASSURANCE:**

- A. Inspection, contamination evaluation, hygienic maintenance service, and monitoring probe installation shall be performed by a supervisor with a minimum of two (2) years experience in projects of equal or greater scope.
- B. Do not cause or allow any of the work to be covered up or enclosed until it has been inspected and approved by the engineer. Should any of the work be covered up or enclosed before such inspection, the contractor shall at his own expense, uncover the work, and after it has been inspected and approved, make all repairs with such materials as may be necessary to restore all his work to its original and proper conditions.

**1.04 SAFETY:**

- A. Contractor shall provide the Engineer with a copy of the safety manual or document utilized by the crew leader. Safety meetings shall be conducted on a daily basis before shift starts.

**1.05 LAB REQUIREMENTS:**

- A. The laboratory used shall be registered by the State of California. Contractor shall provide the Engineer with the laboratory analysis and reporting techniques to be used. All work provided by the laboratory to the Contractor shall be submitted in the project report as received from the lab.

**1.06 CONSTRUCTION SCHEDULE:**

- A. All work shall be performed during non-business hours of the facility. All HVAC systems shall be returned to normal operating conditions at the end of each shift. All work areas shall be cleaned up after each shift so to have no impact on normal operations of the facility or personnel. Refer to Division 1 of the specifications for approved work schedules.

**PART 2 - EQUIPMENT****2.01 CLEANING EQUIPMENT:**

- A. Provide equipment and materials for cleaning, repairing and inspection work including scaffolding, wire brushes, rotary brushes, filters, air lances, mechanical agitators, fiber optic borescopes, vacuums, or other equipment and materials necessary for workmen to perform work specified. Any chemical utilized in this project shall have a Material Safety Data Sheet (MSDS) submitted to the State before product usage.
- B. Should the cleaning methodology require power vacuuming, the Contractor shall provide HEPA filtered power vacuum(s) operating at a minimum of 16,000 C.F.M. at 21" P.S.I., 25 C.F.M. air compressor operating at 210# P.S.I.; electric power vent cleaner and reverse jet air flow nozzle, or similar equipment required to properly carry out the work. Suitable protective covering shall be provided by the Contractor in all areas of work operation. Any mechanical defects to be reported to the Engineer and logged.

**2.02 ACCESS DOORS:**

- A. Galvanized steel access doors and frames in duct work and plenums shall be, as a minimum, of same thickness sheet metal as duct or plenum in which installed and shall be of the double paneled or hollow type. Doors in insulated ducts shall be set flush with the exterior insulation surface and shall be of the double panel insulated type with a minimum of one inch (1:) thick insulation.
- B. Doors 72 inches and over in height shall have four hinges; doors 24" to 71" shall have three hinges and doors under 24" shall have two hinges. Access doors over 22" in height shall be equipped with two latches; doors 14" to 21" with one latch. Access doors which are 14" x 14" and smaller shall be removable (without hinges and shall have a minimum of two sash latch fasteners).
- C. Access doors to outside air, return air, mixed air and coil plenums for air handlers shall have operable handles both sides of door.
- D. All doors shall seal against neoprene gaskets. Door installations shall be made air tight on all supply, return and exhaust ducts, plenums and equipment with a four ounce, four inch (4") wide tape saturated with solvent lagging adhesive and firmly applied. Solvent shall be non-flammable. The stripping shall be applied prior to insulation repairs. All materials shall be 25/50 flame/smoke spread rated.
- E. Ceiling access shall be Karp Associates type Katr or equal. Ceiling access door shall be designed to provide access in the existing suspended ceiling that is part of the fire rated floor - ceiling assembly the combination of steel, wall board and ceiling tile shall maintain the fire resistive qualities of the existing ceiling.
- F. Ceiling access shall be 30 inches by 22 inches maximum. Duct access doors shall be a minimum of 14 x 12 inches unless further limited by duct size.
- G. The ceiling access doors shall be installed according to the manufacturer's recommendations.
- H. Ceiling access door frame shall be 16 gage steel and door shall be 18 gage steel.

- I. Door shall be recessed 1-1/2 inches to accommodate double thickness of wall board and matching ceiling tile.
- J. Door hinge shall be continuous piano hinge.
- K. Locks shall be screwdriver operated with 1 inch stainless steel cam and lock studs (or shall be key operated cylinder lock with automatic dust shutter) furnished with plastic grommet to protect hole made in wall board and tile.
- L. Finish shall be prime coat of rust inhibitive electrostatic powder, baked grey or white enamel.
- M. Refer to contract drawings for framing details.

#### 2.03 SANITIZING FLUID:

- A. Microban X580, Dichlorothen, Certi-Phene, or equal. Sanitizing fluid shall be applied to all scope-related surfaces after cleaning.

### **PART 3 - HYGIENIC MAINTENANCE PROCESS**

#### 3.01 TEMPORARY FILTER MEDIA (IF REQUIRED):

- A. Prior to any cleaning, temporary filter media is to be fitted to those diffusers/grilles or they may be sealed with a minimum of 6 mil polyethylene sheeting. All openings shall be suitably protected to avoid contamination and debris from entering the conditioned air spaces.

#### 3.02 ESTABLISHMENT OF EXISTING CONTAMINATION LEVELS:

- A. As directed by the Engineer to evaluate existing contamination levels, Contractor shall take samples of contaminants within the duct work and in other strategic locations to track contaminants throughout the air delivery system. Particulate samples shall be gathered with sterile swabs and then analyzed for general identification. Microbial samples shall be collected by utilizing HYCON Contact Slides. Culturing methodology shall conform to manufacturer's specifications and requirements. Molds and Bacteria are the general microbial constituents to be sampled for at designated areas. Samples shall be clearly identified in the Pre and Post-Project Reports as to sampling locations. In addition, photographs shall be taken of these sample locations for documentation in the Pre and Post-Project Reports.
- B. Sample Locations:
  - 1. 4 Supply duct
  - 2. 1 Mixing box (if any exist)
  - 3. 1 Return air duct
  - 4. 1 Air handling unit (coil area)
  - 5. 4 Ceiling return air plenum
- C. Locations are to be sampled for ea/ Air Handling Unit System & related ductwork, as a minimum.
- D. Particulate Samples (Wipes): Shall be analyzed using microscopic techniques to identify general content; i.e. rust, fibrous, carbon, crystalline, etc. These will assist in tracking movement of material within the system and the areas of breakdown.

- E. Microbial Samples: Use Hycon agar contact surface slides to identify general levels of mold and bacteria present. Results shall be expressed in total CFU's (Colony Forming Units).
- F. Verification of Systems Cleaning: Shall be established initially by NADCA (National Air Duct Cleaning Association) Standards.

### 3.03 DUCTWORK CLEANING PROCESS:

#### A. Area Preparation:

1. Refer to Section 02 41 00, Article 3.02(B) for area preparation requirements.

#### B. Cleaning Methodology Option #1:

1. Contractor shall install access ports into all supply and return ductwork at 15 feet maximum intervals. Access ports shall be a permanent reusable system 50 mm round or provide access doors that conform to Article 2.02 of this Section. All related duct work must not be cut into for cleaning purposes other than to install access points. The structural integrity of the duct work shall not be altered by access system installation. The duct access ports shall be installed with sheet metal screws onto the outside of the duct.
  - a. When access points are installed in concealed attic areas, visual checks are to be made of the condition of both the external duct insulation and the ducts themselves at "T" joints, etc. Where breaks in either insulation or duct work are found, these are to be documented and submitted as found.
  - b. After the work is done, the duct penetration (through the access port) shall be closed airtight with a threaded plug screwed into the access port.
2. Prior to the start of the cleaning process the fan powered HEPA filtered collection devices shall be securely connected to the supply outlets to be treated. Sufficient negative pressure shall be generated within the designated duct runs to ensure all particulate contamination is removed and contained under controlled conditions.
3. By inserting special air lances, mechanical agitators or rotary brushes through the installed access points, gently remove all loose contaminants from the interior surfaces of the duct work. Where duct work has internal insulation or other fragile components, take precautions not to disrupt or damage these sensitive areas. Under no circumstances shall any workers be allowed to climb inside of the duct work onto any fragile internal surfaces or components.
4. Fan powered, high efficiency dust and particulate collection systems shall be utilized in areas where contaminants are being removed from the system. Contractor shall take all necessary precautions to prevent dirt and debris from entering the conditioned areas. The collection systems shall be a self-contained unit, with appropriate components to adequately prevent dirt and debris loosened from upstream duct mains and branches during cleaning operations from entering the conditioned spaces by capturing this debris within the collection device. The filter(s) utilized in the collection systems shall be an industrial grade type, labeled and certified HEPA filter to be no less than 99.97 percent efficient on particles of 0.3 microns and greater at rated flow.

#### C. Cleaning Methodology Option #2:

1. All ducts shall be thoroughly cleaned by power vacuuming. Ductwork that does not allow complete access shall be entered by means of access doors as described in Article 2.02 of this Section.
  - D. All ducts shall be inspected as work proceeds. Any defects in the duct system found during the cleaning process shall be immediately brought to the attention of the Engineer. All minor repairs such as caulking, sealing, and reconnecting shall be performed as part of the contracted scope of work.
    1. Caulking or sealing compound:
      - a. 3-M No. 900 duct sealer, Tuff Bond No. 29, Permacel No. EZ-4719, Foster 32-14, United Duct Sealer, or equal.
  - E. Doors shall be installed at selected locations so as to accommodate the complete cleaning of the ductwork systems but not exceeding 10 foot intervals.
  - F. Internal Lining or Fiberglas Manufactured Ducts:
    1. Where supply ducts have either internal lining (fiberglass) insulation or are fiberglass manufactured ducts, the internal surfaces shall be coated, to control surface breakdown. Apply second coating, if required, to ensure complete encapsulation. Coating shall meet 25/50 flame and smoke spread as tested in accordance with ASTM E84.
  - G. Grilles, Registers, and Diffusers:
    1. Whenever the grilles, registers and diffusers are removable, they shall be removed, vacuum cleaned, washed, dried and then reinstalled. Non-removable grilles, registers, and diffusers shall be cleaned in place.
  - H. Duct Coils:
    1. Clean duct coils by air washing and brushing to ensure all contaminants are removed from between the fins. If fins are bent prior to cleaning, utilize a coil combing system to straighten fins as best as possible.
- 3.04 DUCT COIL CLEANING PROCESS:
- A. Duct mounted coils shall be hand washed (air or water) on both coil faces carefully to avoid damage to tubes and fins. Thoroughly clean coil faces ensuring contaminants are removed. Remove corrosion from around coil frames; hand brush and vacuum clean. Paint all corroded metal frame surfaces. Where necessary, recomb coil fins to restore them to original condition. Before cleaning process begins on both sides of the coil perform before and after pressure readings.
- 3.05 DAMPER, MOTOR, TURNING VANES AND LINKAGE CLEANING AND REPAIR PROCESS:
- A. Control dampers for air handling systems, duct-mounted volume, fire and zone dampers, and turning vanes shall be inspected, cleaned and repaired. Mark dampers to their current setting. Contractor shall assume one volume damper per branch and that 50% are not functioning and will require major repairs or replacement.

- B. Repairs shall include straightening and aligning of vanes, blades and linkages.
- C. All related equipment shall be power vacuumed and high pressure washed where required.
- D. Areas with rust or scale build-up shall be wire brushed or scraped.
- E. All damper motors and linkages shall be lubricated and set into their original position upon completion of work. Lubricant material - Aerolex Dry Moly, or equal.

### 3.06 MIXING BOX CLEANING AND REPAIR:

- A. Mixing boxes shall be cleaned. Work on each unit includes the following:
  - 1. Enclose mixing box or mixing box access in a glove bag to contain lead dust (see Section 02 41 00, Article 3.05).
  - 2. Remove access panel from the base of mixing box, taking precautions not to disturb wires, cables, or setting of appurtenances of each mixing box or appurtenances adjacent to box.
  - 3. Remove loose contamination from the internal areas of the box.
  - 4. Repair patch all damaged insulation where necessary with Linacoustic fiber glass duct liner or equivalent. All insulation shall have as a minimum 1 inch thickness.
  - 5. After the removal of all loosened contaminants is completed and damaged insulation is repaired, the coating shall be carried out. Coat all insulated surfaces of the box interiors with a insulation sealant; Fosters 30-36, or equal. Apply second coating, if required, to ensure complete encapsulation.
  - 6. Actuators, linkages and dampers on all boxes shall be inspected and repaired. It is estimated 75% or more of the boxes need repair.

### 3.07 EQUIPMENT ROOMS AND AIR PLENUM CLEANING PROCESS:

- A. Related air plenums and/or equipment room locations that are within the airstream of this project shall be thoroughly cleaned and sanitized utilizing lead dust cleanup procedures as required in Section 02 41 00. Such work except ceiling return air plenums shall include the following:
- B. Remove all water from floor area, note leaks; report on pipe work conditions. Vacuum clean all surfaces, including walls, floors, and ceiling surfaces. All other debris shall be removed from the area by the Contractor. Plenum areas shall be visually inspected and sealed air-tight with an approved caulking compound.
- C. All supply duct lining shall be coated as in paragraph 3.03F.
- D. Remove all corrosion from all metal areas by scraping, sanding, or wire brushing.
- E. Contractor has the responsibility to ensure that all areas are left in a correct operating mode; all switches, lights, doors, hatches, and controls are returned to their original setting.
- F. Contractor shall, at the end of each shift, remove all waste dirt and debris resulting from the work performed.
- G. Such material shall be removed from the property in accordance with Sec. 23 05 50 Article 1.09.
- H. Refer to Specification Section 02 41 00 for requirements regarding ceiling return air plenums.

**3.08 AIR HANDLING UNIT CLEANING PROCESS:**

- A. The air handling units shall be cleaned. Prior to work commencement, a pre-arranged schedule shall be established with the State Construction Supervisor. Work on each unit includes the following:
1. Fresh air plenums shall be cleaned thoroughly. Inlet louvers, mixing dampers, and turning vanes, if corroded, shall be scraped, primed, and top coated as necessary. All debris shall be removed from plenum areas and concrete floors thoroughly cleaned to remove surface debris.
  2. Remove air filters. If metal is corroded, hand scrape, prime, and top coat the filter holding frames. See Section 23 05 50, Article 3.05 for replacement of air filters.
  3. Hand wire brush all areas of side, roof, and ceiling panels as necessary.
  4. Remove all corrosion from around coil frames and drain pans; hand brush and vacuum clean.
  5. Paint affected areas of coil frames, using a zinc rich primer and enamel top coat paint.
  6. Heating and Cooling Coils:
    - a. Prior to cleaning of coils, take a pressure reading on both sides of the coil while system is in operation. Take identical readings after the coil is cleaned; note pressure change and submit findings.
    - b. Cleaning will consist of washing downstream of coil first and then upstream utilizing a high pressure water cleaning system with a suitable biodegradable cleaning agent, thoroughly cleaning coil faces ensure all contaminants and materials are removed. Take precautions not to damage coil fins. If fins are bent prior to cleaning, straighten (as best as possible) fins utilizing a coil combing system. High power wash will be performed with a water spray device that delivers a minimum of 500 PSI. Detergent cleaning shall be followed by thorough rinsing with fresh water. Any degreasing of the coils shall be performed before final cleaning to ensure complete removal of any residual build-up.
    - c. Drain pans are to be cleaned and cleared before any pressure washing be performed, thus assuring complete and safe drainage.
  7. Vacuum clean and hand wash fan casing, motors and fan wheels so that all grease and debris is removed. A degreasing solution shall be used in areas where required.
  8. Hand scrape fan impellers and remove all loose contaminants from within the fan casing.
  9. Where insulation is damaged or fragile, repair patch as necessary. If the insulation facing is damaged non-existent, the facing shall be coated.
  10. Report all locations where access doors are missing and filter housings damaged or destroyed to the engineer.

**PART 4 - POST PROJECT REQUIREMENTS****4.01 MONITORING PROGRAM AND WARRANTY:**

- A. Provide one (1) year warranty of all work, dated from the project completion date. Provide quarterly visual inspections during the warranty period in 4 different areas of the building. Set up monitoring probes as required.

**4.02 POST PROJECT REPORT:**

- A. Submit a post-project report within 45 calendar days of the completion of the project. The report shall summarize the project, contrast contamination levels of the sampling locations in the pre-



- project report, and provide photographic evidence documenting the results of the project (see Article 3.02 B of this Section).
- B. Record mechanical defects, insulation encapsulation, pressure readings from coils, and all air delivery system improvements. Provide photographic documentation of all information.
  - C. Provide a record drawing showing the exact installed positions of all access doors and access ports.

## **PART 5 - MISCELLANEOUS**

### **5.01 CLEAN UP PROCEDURES:**

- A. Upon completion of work, and at the end of each shift, clean up the assigned work area of all trash, rubble, rags, containers, materials, and equipment resulting from work on this contract, and remove same from the premises at no additional cost.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 01/31/2025 - Section was added in its entirety.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

## SECTION 23 05 29

### MECHANICAL PIPE SUPPORTS AND ANCHORS

#### PART 1 - GENERAL

##### 1.01 CONDITIONS OF THE CONTRACT

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to Work of this section.
- B. This section is a Division-23 Basic Mechanical Materials and Methods section and is part of each Division-23 section making reference to pipes and pipe fittings specified herein.

## 1.02 WORK INCLUDED

- A. Types of supports and anchors specified in this section include the following:

Horizontal-piping hangers and supports

Vertical-piping clamps

Hanger-rod attachments

Building attachments

Saddles and shields

Spring hangers and supports

Miscellaneous materials

Anchors

## 1.03 QUALITY ASSURANCE

- A. Manufacturer's: Firms regularly engaged in manufacture of supports, anchors, and seals of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. UL and FM Compliance: Provide products which are Underwriters' Laboratories listed and Factory Mutual approved.
- C. Provide pipe hangers and supports of which materials, design, and manufacture comply with ANSI/MSS SP-58.
- D. Select and apply pipe hangers and supports, complying with MSS SP-69.
- E. Fabricate and install pipe hangers and supports, complying with MSS SP-89.
- F. Terminology used in this section is defined in MSS SP-90.
- G. Provide hangers and supports in conformance with SMACNA Standards, latest edition.

## 1.04 SUBMITTALS

- A. Product Data: Submit catalog cuts, specifications, installation instructions, and dimensioned drawings for each type of support, anchor, and seal. Submit pipe hanger and support schedule showing manufacturer's figure number, size, location, and features for each required pipe

hanger and support, all in accordance with Division 1.

## PART 2 - MATERIALS

### 2.01 GENERAL

- A. Support all piping so that it is firmly held in place by approved hangers and supports and special hangers as required. All Components shall support the weight of pipe, fluid, and pipe insulation based on spacing between supports with minimum factor of safety of five based on ultimate strength of material used. Do not exceed manufacturer's load rating. Do not support piping or ductwork with plumbers tape, wire, rope, wood, or other makeshift devices.
- B. Structural considerations:
  - 1. Steel or concrete or wood roof/floor system including slabs or roof deck shall be in place and complete before installation of any mechanical piping system.
  - 2. Space hangers so maximum individual hanger load will not exceed values listed in paragraph "Installation of Hangers and Supports".
  - 3. Do not attach hangers to steel roof deck.
  - 4. Do not attach hangers to bottom of concrete filled floor deck except by permission of Architect.
  - 5. Attach hangers to beams whenever possible.
- C. Provide electroplate or galvanized finish for all material used for support of piping.

### 2.02 HORIZONTAL-PIPING HANGERS AND SUPPORT

- A. General: Except as otherwise indicated, provide factory-fabricated horizontal-piping hangers and supports complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS-SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Use felt lined J hangers for installation at copper piping.

|                            |              |             |
|----------------------------|--------------|-------------|
| Adjustable Steel Clevises: | B-Line B3100 | MSS Type 1  |
| Adjustable J Hanger        | B-Line B3690 | MSS Type 5  |
| Vee Bottom Clevis Hanger   | B-Line B3106 | with B3106V |
| Split Pipe Rings:          | B-Line B3173 | MSS Type 11 |

|                            |              |             |
|----------------------------|--------------|-------------|
| Clips:                     | B-Line B3180 | MSS Type 26 |
| Single Pipe Rolls:         | B-Line B3114 | MSS Type 41 |
| Adjustable Roller Hangers: | B-Line B3110 | MSS Type 43 |

- B. Isolate copper tubing from ferrous materials and hangers with two thicknesses of 1-inch wide 10-mil polyvinyl tape, spiral-wrapped around pipe. Total width shall be minimum of 3-inches.

### 2.03 HANGER-RODS AND ATTACHMENTS

- A. General: Except as otherwise indicated, provide factory-fabricated hanger-rods and attachments complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal- piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide lock nuts at all threaded connections.

|                          |              |             |
|--------------------------|--------------|-------------|
| Steel Turnbuckles:       | B-Line B3202 | MSS Type 13 |
| Swivel Turnbuckles:      | B-Line B3224 | MSS Type 15 |
| Steel Weldless Eye Nuts: | B-Line B3200 | MSS Type 17 |
| Threaded Rod:            | B-Line B3205 |             |

- B. Pipe hanger rod size:

| Pipe Size                    | Rod Size   |
|------------------------------|------------|
| 2 Inches and Smaller         | 3/8 Inches |
| 2-1/2 Inches to 3-1/2 Inches | 1/2 Inches |
| 4 Inches to 5 Inches         | 5/8 Inches |
| 6 Inches 3/4 Inches          |            |
| 8 Inches to 12 Inches        | 7/8 Inches |

Provide 3/8-inch rod for support of PVC and CPVC and provide continuous support.

- C. Trapeze suspension: B-Line B-22, or equal, 1-5/8 Inches width channel in accordance with manufacturer's published load ratings. No deflection to exceed 1/180 of a span.

1. Trapeze Supporting Rods shall have a safety factor of five; securely anchor to building structure.
2. Provide B-Line B2000 series pipe straps, or equal. Isolate copper pipe with two thicknesses of 2 Inches wide 10 mil polyvinyl tape, 3 inches wide.

## 2.04 BUILDING ATTACHMENTS

- A. General: Except as otherwise indicated, provide factory-fabricated building attachments complying with ANSI/MSS SP-58, of one of the following types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems.

### 1. Steel Structure

|                        |              |             |
|------------------------|--------------|-------------|
| Top Beam C-Clamps:     | B-Line B3031 | MSS Type 19 |
| Center Beam Clamps:    | B-Line B3050 | MSS Type 21 |
| Welded Attachments:    | B-Line B3083 | MSS Type 22 |
| Malleable C-Clamps:    | B-Line B3036 | MSS Type 23 |
| Malleable Beam Clamps: | B-Line B3054 | MSS Type 30 |

Provide retaining straps for all single sided beam clamps and C-clamps.

2. Wood Structure: Provide and install wood blocking as required to suit structure. Provide lag screws or thru bolts with length to suit requirements, and with size (diameter) to match the size of hanger rods required. Lag screws shall not be installed in tension, without written review and acceptance by Structural Engineer.

|                      |              |             |
|----------------------|--------------|-------------|
| Side Beam Angle Clip | B-Line B3062 | MSS Type 34 |
| Side Beam Angle Clip | B-Line B3060 |             |
| Ceiling Flange       | B-Line B3199 |             |

Blocking for support of piping shall be not less than 2-inch-thick for piping up to 2-inch size (water filled) or 3-inch size (vapor filled). Provide 3-inch blocking for piping up through 5-inch size, and 4-inch blocking for larger piping. Provide support for blocking in accordance with Structural Engineers requirements.

Where lag screws are used, length of screw shall be 1/2 inch less than the wood blocking. Pre-drill

starter holes for each lag screw.

3. Concrete Structure: Do not use powder actuated fasteners for support of overhead piping unless approved by Architect.

|                         |              |
|-------------------------|--------------|
| Concrete Insert         | B-Line B3014 |
| Spot inserts            | B-Line B2505 |
| Equipment Anchor Bolt   | B-Line B3022 |
| Metal Deck Ceiling Bolt | B-Line B3019 |
| Light Duty Spot Inserts | B-Line B2500 |

## 2.05 SADDLES AND SHIELDS

- A. General: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.

1. Protection Saddles: Fill interior voids with segments of insulation matching adjoining insulation.

Welded Protection Saddle      B-Line B3160      MSS Type 39

2. Thermal Hanger Shields: Constructed of 360-degree insert of high density, 100 psi, water resistant calcium silicate, encased in 360-degree sheet metal shield. Provide assembly of same thickness as adjoining insulation.

- B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering thermal hanger shields, which may be incorporated in the work include the following:

B-Line systems Inc.

McDonald Supply

Pipe Shields, Inc.

## 2.06 VERTICAL-PIPING CLAMPS

- A. General: Except as otherwise indicated, provide factory-fabricated vertical-piping clamps complying with ANSI/MSS SP-58, of one of the following types listed, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product



information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated clamps for copper-piping systems.

Two-Bolt Riser Clamps: B-Line B3373 - MSS Type 8

- B. Support vertical piping risers securely to the pipe above each floor slab, with the arms of the clamp resting on the slab or the structural supports.
- C. Support pipe lines passing up through the building at each floor of the building. Bolt riser clamps securely to the floor slab.
- D. Support vertical piping risers securely to the structure at 10 foot centers maximum, for locations where vertical pipe length exceeds 12 feet.

2.07 MANUFACTURERS OF HANGERS AND SUPPORTS

- A. Available Manufacturers: Products listed are B-Line. Subject to compliance with requirements, manufacturers offering hangers and supports, which may be incorporated in the work include the following:

B-Line Systems Inc.

Super Strut

Power Strut

Mason Mfg. Co., Div. of A-T-O, Inc.

Grinnell Corp.

Tolco Incorporated

2.08 MISCELLANEOUS MATERIALS

- A. Metal Framing: Provide products complying with NEMA Standard ML1.
- B. Steel Plates: Shapes and Bars: Provide products complying with ANSI/ASTM A36.
- C. Cement Grout: Portland cement (ANSI/ASTM C150, Type I or Type III) and clean, uniformly graded, natural sand (ANSI/ASTM C404, Size No. 2). Mix at a ratio of 1.0-part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.
- D. Heavy Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards.

- E. Pipe Guides: Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of a bolted two-section outer cylinder and base with a two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation, (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

### **PART 3 - EXECUTION**

#### **3.01 PRODUCT HANDLING AND PROTECTION**

- A. Deliver packaged materials in their original, unopened wrapping with labels intact. Protect materials from water, the elements and other damage during delivery, storage and handling.

#### **3.02 PREPARATORY PROVISIONS**

- A. The Contractor shall be responsible for the examination and acceptance of all conditions affecting the proper construction and/or installation of the Work of this Section and shall not proceed until all unsatisfactory conditions have been corrected. Commencing work shall be construed as acceptance of all conditions by the Contractor as satisfactory for the construction and/or installation of the Work.

#### **3.03 PREPARATION**

- A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments.
- B. Prior to installation of hangers, supports, anchors and associated work, Installer shall meet at project site with Contractor, Installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section, for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

#### **3.04 INSTALLATION OF BUILDING ATTACHMENTS**

- A. Install building attachments at required locations within concrete or on structural steel for proper piping support. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.
- B. Install building attachments for wood frame construction to structural framing or to blocking

provided for this purpose. Install fasteners in wood structure or blocking in the top 1/3 of the wood structure. Provide and install blocking in accordance with the requirements of the structure it is being attached to.

1. Install blocking for manufactured joists on both sides of joist, to provide equal loading. Install side beam angle clips with thru bolts and flat washers. Secure blocking to manufactured joists in accordance with manufacture's recommendations.
2. Where blocking is provided, coordinate the location and installation with other trades.
3. Install ceiling flanges on bottom of solid joists only, at ceiling construction.
4. Where lag screws are used, pre-drill holes to suit the diameter of the lag screw.

### 3.05 INSTALLATION OF HANGERS AND SUPPORTS

- A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze-type hangers where possible. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not support piping from other piping. Install seismic restraints in accordance with CBC Chapter 16 and ASCE7-10.
- B. Pipe hanger and support spacing: Locate hangers or supports at each change of direction, within one foot of elbow, and space at or within following maximum limits (feet):

| Pipe Dia.        | Steel Fluid | Steel Vapor | Copper Fluid | Copper Vapor | CPVC & PVC |
|------------------|-------------|-------------|--------------|--------------|------------|
| 1/2 – 1 inches   | 6           | 8           | 5            | 6            | 4          |
| 1-1/4 - 2 inches | 7           | 10          | 6            | 6            | 4          |
| 2-1/2 - 3 inches | 10          | 10          | 10           | 10           | 4          |
| over 4 inches    | 10          | 10          | 10           | 10           | 4          |

1. Provide continuous support channel for all CPVC piping, with a minimum of one hanger per length of pipe.
2. For fire protection piping, space hangers according to NFPA Section 13.
3. For cast iron soil piping:
  - a) Support piping at every other joint for piping length of less than 4 feet.
  - b) For piping longer than 4 feet, provide support adjacent within 18-inches to each

- joint.
  - c) Hanger shall not be installed on the coupling.
  - d) Provide support at each horizontal branch connection.
  - e) Provide sway brace at 40 feet- 0 inch maximum spacing for all suspended pipe with No-Hub joints.
- 4. Where grooved couplings are used, place hanger within 2 foot each side of fittings or refer to manufacturer's pipe support and anchorage guide.
  - 5. For piping of other materials, space hangers according to manufacturer's recommendations.
- C. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping. Where hangers and supports are used, the piping shall be hung independently of other piping.
  - D. Support fire protection system piping independently of other piping.
  - E. Prevent electrolysis in support of copper tubing by use of hanger, and supports which are copper plated, or by other recognized industry methods.
  - F. Provisions for Movement: Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.
  - G. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
  - H. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 are not exceeded.
  - I. Insulated Piping: Comply with the following installation requirements.
    - 1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.
    - 2. Shields: Where low-compressive-strength insulation or vapor barriers are indicated on cold and chilled water piping, install thermal hanger shields. For pipe 8 inches and over, install wood insulation saddles.
    - 3. Saddles: Where insulation without vapor barrier is indicated, install protection saddles.
  - J. Gas piping – Anchor roof curb support at roof egress and transverse at 40-foot intervals.

### 3.06 INSTALLATION OF ANCHORS

- A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31, and to prevent transfer of loading and stresses to connected equipment, and as indicated on the drawings.
- B. Fabricate and install anchor by welding steel shapes, plates, and bars to piping and to structure. Comply with ANSI B31 and with AWS standards.
- C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to limit movement of piping and forces to maximums recommended by manufacturer for each unit.
- D. Anchor Spacing: Where not otherwise indicated, install fixed to structure anchors at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and bends at 40-feet on center. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping, and as indicated on the Drawings.
  - 1. Provide two guides at each side of expansion loop or compensator, and at all locations indicated on the Contract Drawings.

### 3.07 EXPANSION ANCHORS IN HARDENED CONCRETE

- A. Qualification Tests: Base allowable shear and withdrawal load on qualification tests of at least three (3) test specimens, using a factor of safety of five (5) on the average of the test values, or a factor of safety of four (4) on the lowest test value, whichever is lower. Until the test data for the various anchors can be evaluated, use no more than 80% of the allowable load listed in the ICBO Research Committee Recommendation for the specific anchor, & shall comply with latest CBC.
- B. Installation: The anchors must be installed in accordance with the requirements given in ICBO Research Committee Recommendations for the specific anchor.
- C. Limitations on Anchors in Withdrawal: Anchors acting in withdrawal shall not be used for major connections such as anchoring tilt-up walls, tie-downs, heavy continuously applied loads, frequent vibratory loads, etc.
- D. Job Testing: Fifty percent of the anchors shall be load-tested on each job to twice the allowable capacity in tension, except that if the design load is less than 75 pounds; only one anchor in ten need be tested. If any anchor fails, all anchors must be tested. The load test shall be performed in the presence of the project inspector.
- E. The load may be applied by any method that will effectively measure the tension in the anchor, such as direct pull with a hydraulic jack, a torque wrench calibrated using the specific anchor,

calibrated spring-loading devices, etc. Anchors in which the torque is used to expand the anchor without applying tension to the bolt may not be verified with a torque wrench.

### 3.08 ADJUSTMENT OF HANGERS AND SUPPORTS

- A. Adjust hangers and supports and place grout as required under supports to bring piping to proper levels and elevations.

### 3.09 EQUIPMENT BASES

- A. Concrete housekeeping bases will be provided as work of Division 32. Furnish to Contractor, scaled layouts of all required bases, with dimensions of bases, and location to column center lines. Furnish templates, anchor bolts, and accessories, necessary for base construction.
- B. Provide structural steel stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide factory-fabricated tank saddles for tanks mounted on steel stands.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 01/31/2025 - Section was added in its entirety.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

## SECTION 23 05 48

## MECHANICAL VIBRATION AND SEISMIC CONTROL

**PART 1 – GENERAL****1.01 CONDITIONS OF THE CONTRACT**

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to Work of this section.
- B. This section is a Division-23 Basic Mechanical Materials and Methods section and is part of each Division-23 section making reference to pipes and pipe fittings specified herein.

**1.02 WORK INCLUDED**

- A. Types of vibration isolation products specified in this section include the following:
  - 1. Vibration isolators and hangers.
  - 2. Base and rails.
  - 3. Flexible pipe connectors.
  - 4. Isolation pads.
  - 5. Flexible Vents Couplings
- B. Seismic restraints, isolators and associated miscellaneous support steel.
- C. Vibration isolation products, furnished as part of factory-fabricated equipment, are specified as part of the equipment assembly in other Division 23 section.
- D. Pipe supports and anchors are specified as part of other Division 23 sections.

**1.03 QUALITY ASSURANCE**

- A. Product Qualification: Provide each type of vibration isolation unit produced by specialized manufacturer, with not less than 5 years' successful experience in production of units similar to those required for project.
- B. Manufacturer Certification: Where vibration isolation support units are indicated for minimum static deflection, provide manufacturer's certification that units have been tested and comply with indicated requirements.
- C. Design Criteria:
  - 1. SMACNA Compliance: Provide isolation and seismic snubbing in accordance with standards of SMACNA.
  - 2. Unless noted otherwise, all isolators shall be from single manufacturer.
  - 3. Select isolation devices for uniform static deflections according to distribution of weight.
  - 4. Select isolators to ensure against vibration & noise transmission from equipment to building structure through mounts & hangers. Coordinate weights & locations as required.



5. Isolators shall be OSHPD pre-approved. Non-approved isolators will not be considered.

D. Reference Standards:

1. SMACNA: "Sheet Metal and Air Conditioning Contractors National Association, Inc." Reference shall be to the latest material available, and to all SMACNA manuals which apply.

1.04 SUBMITTALS

A. Product Data:

1. Provide materials lists, catalog data sheets, manufacturer's drawings and technical literature covering details of all items specified or shown on drawings.
2. Spring isolators:
  - a. Spring diameter.
  - b. Static deflection.
  - c. Compressed spring height.
  - d. Solid spring height.
  - e. Number of active coils.
  - f. Ratio of horizontal to vertical stiffness.
  - g. Operating height.
  - h. Spring constant.
  - i. Vertical load for each spring.
  - j. Location and designation of each isolator.
  - k. Calculate horizontal and vertical loading and bending moment due to horizontal force applied at the center of gravity of the equipment. Calculate bolt requirements.
  - l. Indicate all bases and rail clearance of 1 IN.

B. Shop Drawings:

1. Submit plans, elevations and sections and details showing installation, operating heights and spring constants.

C. Project information:

1. Static seismic calculations for all equipment, piping and miscellaneous structural steel connections to building frame.
  - a. Calculations performed by a licensed Civil or Structural Engineer employed by isolation manufacturer for a minimum of five years.
2. Dynamic seismic calculations:
  - a. Provide in the form of a computer report.
  - b. Performed by a licensed Civil or Structural Engineer employed by isolation manufacturer for a minimum of five years.
  - c. List six natural frequencies of the system, with and without restraints.

- d. List most probable maximum displacements at restraint locations.
  - e. List maximum acceleration at center of gravity of each piece of equipment.
  - f. List most probable force at each restraint.
3. Certification of seismic restraints.
- a. Substantiated by calculations or test reports verified by a licensed Civil or Structural Engineer.

## **PART 2 – PRODUCTS**

### **2.01 GENERAL**

- A. Provide piping and equipment isolation systems as specified or as indicated on drawings.
- B. Manufacturer shall be responsible for the proper selection of isolators to accomplish the specified minimum static deflection, based on weight distribution of equipment to be isolated.
  - 1. Select vibration isolators in accordance with weight distribution to produce reasonably uniform deflection.
  - 2. The vibration isolators selected shall have no less than 80 percent of the deflections given in the vibration isolation schedule.
  - 3. Furnish a complete set of shop drawings of all mechanical and electrical equipment to receive vibration isolation devices to the vibration isolation materials manufacturer. The shop drawings to be furnished shall include operating weights of the equipment to be isolated and the distribution of weight at support points.
- C. Manufacturer shall be responsible for selection of isolators to meet seismic codes.
- D. Provide vibration isolation equipment including mountings and miscellaneous structural steel connections to building frame, hangers, structural steel bases, welded concrete pouring forms and flexible pipe connectors from a single manufacturer of vibration isolation equipment. The isolation materials manufacturer shall be responsible for the structural design of steel beam bases and concrete inertia bases to support mechanical equipment scheduled to receive such supplementary base.
- E. The Contractor shall furnish a complete layout of piping and ductwork, including vertical risers, to be isolated to the vibration isolation materials manufacturer. Layout shall show size or weight and support points of the piping or ductwork system.
- F. If vibration isolators with a deflection greater than the minimum specified are required to meet sound criteria or because of system dynamics, suitable isolation systems shall be submitted for review prior to any installation work.
- G. Coat all vibration isolation systems exposed to moisture or an outdoor environment as follows:
  - 1. All steel parts to be hot dipped galvanized.
  - 2. All bolts to be cadmium plated.
  - 3. All springs to be cadmium plated and neoprene coated.

H. Manufacturer: Subject to compliance with requirements, provide vibration isolation products of one of the following:

1. Kinetics Noise Control, Inc.
2. Korfund Dynamics Corp.
3. Mason Industries, Inc.
4. Vibration Eliminator Co., Inc.
5. Vibration Mountings and Controls, Inc.

## 2.02 VIBRATION ISOLATION SCHEDULE:

A. The minimum static deflection and type of vibration isolation system shall be as follows:

B. Vibration Isolator Types and Minimum Static Deflection for Equipment and Components

| Type of Machinery                                  | Isolator Type (*) | Suggested Min static Deflection, inches. Shall Meet Job Conditions |
|----------------------------------------------------|-------------------|--------------------------------------------------------------------|
| Packaged Roof top HVAC Units Over 15 Tons Capacity | RVIR-CR           | 3.0                                                                |
| Multizone Air Handlers                             | RVIR-CR           | 3.0                                                                |
| Make-up Air Handlers (Evaporative Coolers)         | N-B               | 0.75                                                               |
| Fan Coils                                          | H-B-3             | 0.75                                                               |
| Air Handlers                                       | H-B-2             | 0.75                                                               |
| Furnaces Assemblies, Suspended                     | H-B-3             | 0.75                                                               |
| Exhaust Fans                                       | H-B-N-3           | 0.75                                                               |
| Pumps                                              | N-B-2             | 0.10                                                               |
| Mechanical Room Piping                             | H-3               | 0.50                                                               |
| Piping Over 3"                                     | PNR-3             | ---                                                                |
| Miscellaneous Suspended Pumps                      | H-3               | 1.5                                                                |
| Pump Flexible Connections                          | PFC               | ---                                                                |
| Duct Flexible Connections                          | DFC               | ---                                                                |
| Pipe Flexible Hoses                                | PFH               | ---                                                                |
| Vents Connections, Furnaces                        | VF                | 0.5, 10-degrees                                                    |

(\*) Equipment Vibration Isolation Schedule designations as follows. Hyphenated designations are

combinations of the following:

1. H – Hanger-type spring isolator
2. B - Structural steel base, Type B
3. 2 - Seismic snubber, Type 2
4. 3 - Seismic cables, Type 3
5. N - Neoprene rubber
6. CRI - Composite rubber isolator
7. PNR - Neoprene/rubber isolators for pipe hangers
8. MF - Stainless steel flexible connectors
9. PFC - Twin Sphere Type flexible connectors
10. PFH - Rubber/cloth pipe flexible hoses
11. DFC - Rubber/cloth flexible duct connectors
12. RVIR-CR – Restrained vibration isolation roof – curb rails.
13. VF – Neoprene rubber, neoprene impregnated woven nylon.

## 2.03 DESCRIPTION OF ISOLATORS:

### A. Hanger Type Isolators:

1. Provide combination metal spring and rubber isolator in series.
2. Spring isolators shall be adjustable, free-standing and laterally stable without the housing. Mount spring in a neoprene cup between the spring and the bottom of the hanger. The neoprene/rubber cup shall include a bushing that projects into the bottom opening.
3. Provide springs with horizontal stiffness equal to at least 0.75 times the vertical stiffness and a minimum additional travel to solid equal to 50 percent of the rated deflection.
4. A double deflection neoprene or rubber spring shall be in series with the metal spring. The spring shall have a minimum thickness of 2 IN.
5. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30-degree arc before contacting the hole.
6. Metal and neoprene spring shall be encased in a steel bracket.
7. Pipes and equipment that must not move during installation shall use pre-compressed springs. Deflection shall be clearly indicated by means of a permanent scale.
8. Acceptable Suppliers: The following or equal:
  - a. Mason Industries, Inc.;
    - 1) Model: 30N or W30N, standard or equal.
    - 2) Model: PC30N or W30N, pre-compressed or equal.

### B. Composite Rubber Isolators:

1. Provide pads to fit under frame of equipment to be isolated plus a combined washer and bushing that fits through bolt holes to prevent contact between fastener and frame. Washer and bushing may be single piece or two separate pieces.
2. Synthetic rubber isolator shall be manufactured of all new materials and composed of multiple layers of pre-stressed duct, 8 ounce per net square yard impregnated and bound with a high quality rubber compound. Pads shall be of uniform thickness.

3. The rubber shall contain rot and mildew inhibitors and anti-oxidants.
4. Material shall withstand moderate exposure to moisture, oils and chemicals.
5. The dynamic spring rate properties shall resist more than five percent permanent compression set.
6. Shore Durometer shall not be less than 80 nor more than 95.
7. Acceptable Suppliers: Fabreeka Products Company, Inc.

C. Neoprene Isolators:

1. Rubber pads shall be at least 5/16 inch thick with cross-ribbed or waffle design. Provide optional pad thickness to suit application.
2. Material shall be resistant to water and to chemicals and oils to be encountered in the pumping station.
3. For concentrated loads, provide steel bearing plates bonded or cold cemented to the pads.
4. Size pads for not more than 50 psi or as recommended by the pad manufacturer. Select durometer to suit application.
5. Acceptable Suppliers: Mason Industries, Inc.; Model: Super W or equal.

D. Rubber Neoprene Pipe Isolators:

1. Pipe isolators shall comprise an internal rubber or neoprene material that isolates pipe from hanger and structure.
2. Isolation material shall be either a rubber or neoprene material that prevents contact between the pipe and the structure. The rubber shall have between a 45 to 55 durometer rating and a minimum thickness of 1/2 inch.
3. Acceptable Suppliers:
  - a. Vertical runs to fixture: Acousto-Plumb or equal.
  - b. Horizontal runs: B-Line Systems, Inc.; Kin-Line, Inc.; Acousto-Plumb or equal.

E. Wall Penetration Isolators:

1. Either a split seal isolator or loose fill isolator shall be used.
2. The split seal shall comprise of two bolted pipe halves with at least 0.25 inches thick neoprene sponge bonded to the inner faces.
  - a. The seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping.
  - b. Seals shall project a minimum of 1 inch past either face of the wall.
  - c. Where temperatures exceed 240°F, 6 lb./cu. it. or greater density fiberglass may be used in place of the neoprene sponge.
3. The loose fill isolator shall comprise a combination of fiberglass insulating and non-hardening caulking.
  - a. A 1/4 inch to 3/4 inch gap shall be left around the object penetrating the wall of floor.
  - b. Objects penetrating a wall shall be supported on either side of the wall. Objects

- penetrating the floor shall be support on the top of the floor.
- c. The opening around the penetration shall be filled loosely with the fiberglass insulation.
- d. The opening is then to be sealed air tight with the non- hardening caulking compound.
- e. A rubber or metal escutcheon may be used over this to cover the mastic.

## 2.04 DESCRIPTION OF BASES AND RAILS

### A. Restrained Vibration Isolation Roof-Curb Rails:

1. Manufacturers:
  - a. Kinetics Noise Control, Inc.
  - b. Mason Industries, Inc.
  - c. Vibration Mountings & Controls/Korfund.
  - d. M. A. Sausse
2. Curb mounted rooftop equipment shall be mounted on spring isolation curbs. The lower member shall consist of a sheet metal Z section containing adjustable and removable steel springs that support the upper floating section. The upper frame must provide continuous support for the equipment and must be captive so as to resiliently resist wind and seismic forces. Limit stops shall be located below the upper spring attachment to limit horizontal displacement due to angular misalignment. All directional neoprene snubber bushings shall be a minimum of 1/4" thick.
3. Steel springs shall be laterally stable and rest on 1/4" thick neoprene acoustical pads and have a minimum deflection of 3" with an additional 1-1/2" deflection to solid. Spring diameter must be a minimum of 4". Spring adjustment shall utilize a level lift mechanism to reduce side-sway and limit short circuits.
4. Hardware must be plated and the springs provided with a rust resistant finish.
5. The curbs waterproofing shall consist of a continuous galvanized flexible counter flashing nailed over the lower curbs waterproofing and joined at the corners by EPDM bellows.
6. All spring locations shall have access ports with removable waterproof covers. Lower curbs shall have provision for 2" of insulation.
7. The roof curbs shall be built to seismically contain the rooftop unit. The unit must be solidly fastened to the top floating rail, and the lower Z section anchored to the roof structure. Curb shall have anchorage preapproval "R" from OSHPD in the state of California attesting to the maximum certified horizontal and vertical load ratings. Anchorage of the isolation system shall be certified by a licensed engineer, employed by the isolation manufacturer for a minimum of 5 years with documented experience in the design of flexibly mounted systems.
8. The roof curb void space shall have a steel or wood framework that supports 2 layers of 5/8" thick waterproof gypsum board. Gypsum board must surround ducts to provide a continuous sound break. This acoustical barrier shall be caulked to minimize sound transmission. A 4" thick layer of 1.5 density fiberglass shall cover the entire solid roof surface under the unit. Ductwork shall be lined with a sound absorbent material or coated with a damping compound such as Mason Industries MDC-10. Submittals shall

include a test report by an independent acoustical consultant showing a minimum 10 NC reduction in noise and vibration levels in a typical installation. Curb shall be type RSC-db as manufactured by Mason Industries, Inc.

B. Type B:

1. Structural steel base:

- a. Rectangular structural beam frames shall be furnished.
- b. The frame will be specifically designed for rigidity without concrete fill.
- c. All perimeter beam members shall have a minimum depth of 1/10 of the longest dimension. The beam depth need not exceed 14 inches.
- d. Height saving brackets will be employed where possible to provide a base clearance of 1 inch.
- e. Acceptable Suppliers: Mason Industries; Type W or equal.

2.05 DESCRIPTION OF SEISMIC RESTRAINT

A. Type 2: Snubber.

1. The snubber shall be capable of handling shock or seismic loads in all directions.
2. The unit shall comprise interlocking steel members restrained by a bridge bearing neoprene bushing.
3. The bushing shall be replaceable and shall be a minimum of 1/4 inch thick.
4. Provide a 1/8 inch minimum air gap in the snubber design in all direction before contact is made between the rigid and resilient surfaces.
5. Snubber end shall be removable to allow inspection of internal clearance. Neoprene bushing shall be rotated to insure no short circuit exists.
6. Acceptable Suppliers: Mason Industries; Model: Z-1225 or equal.

B. Type 3: Cables

1. Steel cables shall be capable of handling supported load plus seismic load.
2. Cables shall be arranged to achieve all directional restraint.
3. Cables shall have sufficient slack to avoid short circuiting the vibration isolators.
4. Submittal drawings shall indicate proposed method of achieving vertical restraint.
5. Acceptable Suppliers: Mason Industries; Model; SSC or equal.

2.06 DESCRIPTION OF FLEXIBLE CONNECTORS

A. Metal Flexible Connectors:

1. An 18-inch long metal flexible connector shall be used at the connection of the turbocharger outlet to the exhaust pipe.
2. A minimum 6-inch long flexible connection shall be used at the connection of the exhaust pipe to the first silencer inlet.
3. Connections shall be all stainless steel.
4. Acceptable Products: Hyspan Precision Products; Model: Exhaust Flexible Connectors or equal.

## B. Pipe Flexible Connectors: Neoprene type.

1. All pump inlet and discharges shall be joined to the pipes using flexible neoprene connectors.
2. Flexible connectors shall be manufactured of multiple ply of tire cord fabric and neoprene for uses on all lines except refrigerant lines.
3. No steel wire or rings shall be used as pressure reinforcement.
4. Double sphere flexible connectors shall be used at all locations. Single sphere flexible elbows shall not be used.
5. Control cables or rods shall only be used where pipe sizes exceed 12 inches and pressures are at or above 100 psi. If control cables or rods are used, the end fittings shall be isolated from the cable or rod by means of 1/2 inch thick bridge bearing neoprene washer bushings designed for a maximum of 1000 psi.
6. Connectors 2 inches diameter or less shall use threaded or flanged ends.
7. Connectors greater than 2 inches diameter shall use floating galvanized steel flanges.
8. The minimum pressure rating shall be 150 psi at 220°F.
9. Acceptable suppliers: Mason Industries, Inc.; Model: MFTNC, or equal.

## C. Flexible pipe hoses: Stainless steel type.

1. Flexible connections in refrigerant and other high temperature lines shall be stainless steel braid and carbon steel fittings.
2. Connectors 2 inch diameter or less shall use male threaded nipples.
3. Connectors greater than 2 inch diameter shall be flanged flanges.
4. Hoses for thermal fluid must be suitable for 500°F operating temperature and flanged.
5. Acceptable Suppliers: Mason Industries, Inc.; Model: BSS, or equal.

## D. Flexible pipe hoses: Stainless steel type.

1. Provide an inner tube of a non-toxic synthetic polymer, suitable for water temperatures from 5 to 230 degrees F., and an outer covering of braided stainless steel.
2. Provide swivel end connections, female or male pipe thread as required.
3. Hoses shall be 24 inches long, full pipe size of the branch feeding the heat pump, with pressure ratings as follows:
  - a. 3/4 inch size: 300 psi
  - b. 1 inch size: 225 psi
  - c. 1-1/4 inch size: 200 psi
4. Hoses shall meet flame retardant testing standards similar to UL No. 723, MFPA No. 255, ANSI No. 2.5, UBC No. 42-1, and ASTM No. E34. Manufacturer shall provide independent laboratory tests verifying compliance with these standards.
5. Testing for 10 minutes with 72 to 80 degree water flowing through the hose and a flame exposure temperature of 1400 to 1500 degrees F. shall be equal to the following:
  - a. Flame Spread 0
  - b. Fuel Contribution 0
  - c. Smoke Density 5



## E. Duct Flexible Connectors:

1. "Ventlon" neoprene coated glass fabric.
2. Fasten fabric to sheet metal ductwork and to fan collar extension with 3/16 inch rivets spaced not more than 5-inch O.C.
3. Provide at inlet and outlet of each supply and return fan as shown on drawings, as close to fan as possible.
4. Allow 1 inch minimum free space between metal collars each side of fabric.
5. Connection shall be nominal 6 inches wide with material taut; connections shall not be under tension.
6. Acceptable Suppliers: Ventglass or Unaflex Rubber Corporation or equal.
7. Provide at all ducts crossing building expansion joints and where indicated on drawings.

## F. Vents Flexible Couplings (for Condensing Furnaces):

1. Neoprene rubber, neoprene impregnated, woven nylon with internal and external stainless-steel rings and stainless steel, T-bolt clamps with internal sealing beads. Elongation: 0.5-inches. Angular deflection: 10 – degrees in all directions.
2. Maximum working temperature: 225F
3. Acceptable Suppliers: Metraflex Style 201 or equal.

**PART 3 – EXECUTION**

## 3.01 PREPARATION

## A. Structural Bases:

1. The cooling tower shall be supported on a structural steel base designed and supplied by the vibration isolator manufacturer.
2. Pumps shall be supported on a structural steel base designed and supplied by the vibration isolator manufacturer.

## 3.02 ISOLATORS, BASES AND SEISMIC INSTALLATION

## A. General:

1. Isolators shall be installed per the requirements of the manufacturer.
2. All vibration isolators for a single piece of equipment shall be installed to provide equal deflection and load.
3. All connections to vibration isolated equipment shall be through flexible connections. This shall include all piping, electrical connections, fuel lines, structural elements, etc.
4. Equipment installed on metal spring isolators shall rock freely or move freely within limits of stop or seismic snubber restraints.

## B. Hanger Spring Isolators:

1. Use hanger isolators on all ducts supported from the ceiling within the mechanical equipment room.
  - a. Use for all supply ducts for the first 15 feet after the mechanical equipment

- room.
  - b. They shall be used on all return ducts for the full length of the duct on each floor.
  - c. Seismic cables shall be used at isolator, Type 3.
- 2. All pipes supported from the ceiling within the mechanical equipment room shall be provided with hanger isolators. Provide hanger isolators for three supports after the mechanical equipment room. Provide seismic cables at each isolator.
  - 3. Provide hanger type isolators & Type 3 seismic cables on all ceiling supported fans & pumps.
  - 4. Hanger isolators shall be used on the engine exhaust pipes. Seismic cables shall be used at isolator, Type 3.
  - 5. Hanger spring isolators shall be hung plumb to reduce chance of rod contacting spring housing.
  - 6. After installation, confirm that unit can move or rock freely on spring.
  - 7. Confirm the operating height is per manufacturer's submittal and that minimum static deflection is per Specifications.
  - 8. Ensure that all seismic cables are slack and that equipment can move freely.
- C. Composite Rubber Isolator:
- 1. Install isolator at bearing points around both geared and gearless elevator equipment. This shall include the bearing points for the bedplate of the gearless drive, the frame of the motor generator and hoisting machine of the gearless machine.
  - 2. Install isolator material under bolts and through bolt-hole when securing equipment to structure. The isolator shall be separated from the bolt by a heavy flat washer that will not deform under the load.
  - 3. The bolts shall be torqued per isolator manufacturer's guidelines and as required by the elevator equipment manufacturer.
  - 4. Inspect that rubber isolator is not deflected to the point of excess deformation. Insure that equipment does not contact the building structure.
- D. Neoprene Isolators:
- 1. Neoprene pads shall be installed under the boilers, chillers, domestic water booster system, filter bank and coil bank.
  - 2. Install pads so that maximum stress level is not exceeded.
  - 3. Ensure that no part of isolated equipment is in contact with the structure or any un-isolated component.
- E. Neoprene/Rubber Isolators for Pipe Hangers:
- 1. All horizontal pipes not supported on a hanger isolator shall be supported using a neoprene/rubber isolator.
  - 2. The isolators shall be installed per the manufacturer's recommendations if commercial product is used.
  - 3. Contractor will insure that after pipe is secured that there is discontinuity between pipe and hanger and between pipe and structure.
  - 4. Insure that clamp around rubber/ neoprene pad is not excessively tightened as this

increases the stiffness of the isolator and short circuits the intended isolation quality of the hanger.

### 3.03 FLEXIBLE CONNECTOR INSTALLATION

#### A. Metal Flexible Connector:

1. The flexible connectors shall be installed to permit lateral and longitudinal motion of the piping.
2. Inspect installation, insuring that small motion is possible in radial and axial directions.

#### B. Duct Flexible Connectors:

1. Duct flexible connectors shall be installed between all fan housings and the duct.
2. The flexible connectors shall be installed in a manner that permits lateral and longitudinal motion of the isolated mechanical piece.
3. Attempt to move connecting members and insure that free motion is possible.
4. Install flexible connectors at duct connections to unit and at juncture of duct with fire or smoke damper at chase wall.

#### C. Where necessary, thrust restraint springs shall be used to prevent excessive motion.

#### D. Pipe Flexible Connectors:

1. All pump suction and discharges shall be joined to the pipes using flexible neoprene connectors.
2. Employ flexible connector at juncture with vibration isolated equipment.
3. Install flexible connectors per manufacturer's instructions.
4. Flexible connections are to be used within one to three pipe diameters of the prime mover.
5. Provide flexible pipe connections hose to suit the application. Shop drawings shall indicate specific applications.
6. Flexible connectors shall be installed on the equipment side of the shut-off valves.

#### E. Pipe Flexible Hoses:

1. Install metal flexible hoses at the following locations:
  - a. Air compressor discharge piping.
  - b. Supply and return piping connections to heat pumps and air handlers.
  - c. At condensate drain connections to heat pumps and air handlers.
2. Provide flexible pipe hose to suit the application. Shop drawings shall indicate specific applications.
3. Flexible connectors shall be installed on the equipment side of the shut-off valves.

#### F. Vents Flexible Couplings (for Condensing Furnaces):

1. Fasten coupling in vertical vents risers. Coupling to be slipped over vent to a depth of 2-inches. Torque bolt to 225 inch-pounds.

2. Provide at inlet and outlet of each combustion air vent and flue vent.
3. Allow ½ inch minimum free space between vent pipes each side of coupling.
4. Connections shall not be under tension.

### 3.04 INSTALLATION

- A. Install in accordance with manufactures instructions.
- B. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
- C. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- D. Provide seismic snubbers for all equipment, piping and ductwork mounted on isolators. Each inertia base shall have minimum of four seismic snubbers located close to isolators. Snub equipment designated for post-disaster use to 0.05 inch maximum clearance. Other snubbers shall have clearance between 0.15 inch and 0.25 inch.
- E. Support piping connections to equipment mounted on isolators using isolators or resilient hangers as follows:
  - a. Up to 4 inches pipe size: First three points of support.
  - b. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or ½ static deflection of isolated equipment.

### 3.05 FIELD QUALITY CONTROL

- A. Inspect isolated equipment after installation and submit report. Include static deflections.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 09/30/2022 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

## SECTION 23 05 53

## MECHANICAL IDENTIFICATION

**PART 1 - GENERAL**

## 1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe Markers.

## 1.02 RELATED REQUIREMENTS

- A. Refer to the General Conditions, Special Conditions and Division 1 General Requirements. The requirements of these sections apply to this section.
- B. Section 09 90 00 - Paints and Coatings: Identification painting.

## 1.03 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers; 2007.

## 1.04 SUBMITTALS

- A. See Section 00 72 00 - Submittals, for submittal procedures.
- B. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- E. Project Record Documents: Record actual locations of tagged valves.

**PART 2 - PRODUCTS**

## 2.01 MANUFACTURERS

- A. Brady Corporation: [www.bradycorp.com](http://www.bradycorp.com).
- B. Seton Identification Products: [www.seton.com/aec](http://www.seton.com/aec).

## 2.02 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved letters.

1. Letter Color: White.
2. Letter Height: Equipment, control panels 1 inch.
3. Letter Height: Thermostats and small control components, 1/4 inch.
4. Background Color: Black.

## 2.03 TAGS

- A. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2-inch diameter with smooth edges.
- B. Chart: Typewritten letter size list in anodized aluminum frame.

## 2.04 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
  1. Ductwork: Minimum 1-1/4" high letters.
  2. Access Doors and Similar Operational Instructions: Minimum 3/4" high letters.
- B. Stencil Paint: As specified in Section 09 90 00, semi-gloss enamel, colors conforming to ASME A13.1.

## 2.05 PIPE MARKERS

- A. Comply with ASME A13.1.
- B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.
- D. Service Markers: Identify buried plugged or capped pipe with concrete marker, 4-inch diameter by 30 inches long, set flush with grade. Provide engraved brass nameplate identifying pipe stub.

# PART 3 - EXECUTION

## 3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

## 3.02 INSTALLATION

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Apply stencil painting in accordance with Section 09 90 00.

- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- F. Identify domestic hot water heating equipment, including water heaters, pumps, expansion tanks, etc. with plastic nameplates.
- G. Identify air conditioning units, makeup air units and exhaust fans with plastic nameplates.
- H. Identify control panels and major control components outside panels with plastic nameplates.
- I. Identify thermostats relating to fan unit and/or zone unit with nameplates.
- J. Identify valves in main and branch piping with tags.
- K. Tag automatic controls, instruments, and relays. Key to control schematic.
- L. Identify piping, concealed or exposed, with plastic pipe markers. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- M. Identify ductwork with stenciled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
- N. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION



## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 09/30/2022 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

## SECTION 23 05 93

## TESTING, ADJUSTING, AND BALANCING FOR HVAC

**PART 1 - GENERAL****1.01 SUMMARY****A. Section Includes:**

1. Balancing Air Systems:
  - a. Constant-volume air systems.
  - b. Dual-duct systems.
  - c. Variable-air-volume systems.
  - d. Multizone systems.
  - e. Fume hood systems.
2. Balancing Hydronic Piping Systems:
  - a. Constant-flow hydronic systems.
  - b. Variable-flow hydronic systems.
  - c. Primary-secondary hydronic systems.
3. Balancing Domestic Water Piping Systems.

**1.02 RELATED REQUIREMENTS**

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

**1.03 REFERENCES AND STANDARDS**

- A. Associated Air Balance Council (AABC)
  1. National Standards for Total System Balance, latest edition.
- B. National Environmental Balancing Bureau (NEBB)
  1. Procedural Standards for Testing and Balancing of Environmental Systems, latest edition.

**1.04 DEFINITIONS**

- A. The intent of this Section is to use the standards pertaining to the TAB specialist engaged to perform the Work of this Contract, with additional requirements specified in this Section. Contract requirements take precedence over corresponding AABC or NEBB standards requirements. Differences in terminology between the Specifications and the specified TAB organization standards do not relieve the TAB entity engaged to perform the Work of this Contract of responsibility from completing the Work as described in the Specifications.
- B. Similar Terms: The following table is provided for clarification only:

| <u>Similar Terms</u> |                                                                                                 |                                                                                     |
|----------------------|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Contract Term        | AABC Term                                                                                       | NEBB Term                                                                           |
| TAB Specialist       | TAB Agency                                                                                      | NEBB Certified Firm                                                                 |
| TAB Standard         | National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems | Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems |
| TAB Field Supervisor | Test and Balance Engineer                                                                       | Test and Balance Supervisor                                                         |

- C. AABC: Associated Air Balance Council.
- D. NEBB: National Environmental Balancing Bureau.
- E. TAB: Testing, adjusting, and balancing.
- F. TAB Organization: Body governing practices of TAB Specialists.
- G. TAB Specialist: An entity engaged to perform TAB Work.

#### 1.05 ACTION SUBMITTALS

- A. For additional requirements, refer to Section 23 00 50, Basic HVAC Materials and Methods.
- B. LEED Submittals:
  - 1. Air-Balance Report for Prerequisite IEQ 1: Documentation of work performed for ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
  - 2. TAB Report for Prerequisite EA 2: Documentation of work performed for ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

#### 1.06 INFORMATIONAL SUBMITTALS

- A. For additional requirements, refer to Section 23 00 50, Basic HVAC Materials and Methods.
- B. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
  - 1. Provide list of similar projects completed by proposed TAB field supervisor.
  - 2. Provide copy of completed TAB report, approved by mechanical engineer of record for a completed project with similar system types and of similar complexity.

- C. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
  - 1. Submit examinations report with qualifications data.
- D. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- E. Interim Reports. Submit interim reports as specified in Part 3. Include list of system conditions requiring correction and problems not identified in Contract Documents examination report.
- F. Certified TAB reports.
  - 1. Provide three printed copies of final TAB report. Provide one electronic file copy in PDF format.
- G. Sample report forms.
- H. Instrument calibration reports, to include the following:
  - 1. Instrument type and make.
  - 2. Serial number.
  - 3. Application.
  - 4. Dates of use.
  - 5. Dates of calibration.
  - a. Instruments to be used for testing and balancing shall have been calibrated within a period of one year, or less if so recommended by instrument manufacturer and be checked for accuracy prior to start of work.

#### 1.07 CLOSEOUT SUBMITTALS

- A. For additional requirements, refer to Section 23 00 50, Basic HVAC Materials and Methods.
- B. Certified TAB reports, for inclusion in Operation and Maintenance Manual.

#### 1.08 QUALITY ASSURANCE

- A. Independent TAB Specialist Qualifications: Engage a TAB entity certified by AABC or NEBB.
  - 1. The certification shall be maintained for the entire duration of TAB work for this Project. If TAB specialist loses certification during this period, the Contractor shall immediately notify the Architect and submit another TAB specialist for approval. All work specified in this Section and in other related Sections performed by the TAB specialist shall be invalidated if the TAB specialist loses certification, and shall be performed by an approved successor.
- B. To secure approval for the proposed TAB specialist, submit information certifying that the TAB specialist is either a first tier subcontractor engaged and paid by the Contractor, or is engaged and paid directly by the Owner. TAB specialist shall not be affiliated with any other entity participating in Work of this Contract, including design, furnishing equipment, or construction. In addition, submit evidence of the following:

1. TAB Field Supervisor: Full-time employee of the TAB specialist and certified by AABC or NEBB.
  - a. TAB field supervisor shall have minimum 10 years supervisory experience in TAB work.
2. TAB Technician: Full-time employee of the TAB specialist and who is certified by AABC or NEBB as a TAB technician.
  - a. TAB technician shall have minimum 4 years TAB field experience.
- C. TAB Specialist engaged to perform TAB work in this Project shall be a business limited to and specializing in TAB work, or in TAB work and Commissioning.
- D. TAB specialist engaged to perform TAB work shall not also perform commissioning activities on this Project.
- E. Certified TAB field supervisor or certified TAB technician shall be present at the Project site at all times when TAB work is performed.
  1. TAB specialist shall maintain at the Project site a minimum ratio of one certified field supervisor or technician for each non-certified employee at times when TAB work is being performed.
- F. Contractor shall notify Architect in writing within three days of receiving direction resulting in reduction of test and balance scope or other deviations from Contract Documents. Deviations from the TAB plan shall be approved in writing by the mechanical engineer of record for the Project.
- G. TAB Standard:
  1. Perform TAB work in accordance with the requirements of the standard under which the TAB agencies' qualifications are approved unless Specifications contain different or more stringent requirements:
    - a. AABC National Standards for Total System Balance, or
    - b. NEBB Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.
  2. All recommendations and suggested practices contained in the TAB standard are mandatory. Use provisions of the TAB standard, including checklists and report forms, to the extent to which they are applicable to this Project.
  3. Testing, adjusting, balancing procedures, and reporting required for this Project, and not covered by the TAB standard applicable to the TAB specialist engaged to perform the Work of this Contract, shall be submitted for approval by the design engineer.
- H. TAB Conference: Meet with Architect and mechanical engineer on approval of the TAB strategies and procedures plan to develop a mutual understanding of the project requirements. Require the participation of the TAB field supervisor. Provide seven days' advance notice of scheduled meeting time and location. TAB conference shall take place at location selected by Architect offices of Capital.
  1. Agenda Items:
    - a. The Contract Documents examination report.

- b. The TAB plan.
    - c. Coordination and cooperation of trades and subcontractors.
    - d. Coordination of documentation and communication flow, including protocol for resolution tracking and documentation.
  - 2. The requirement for TAB conference may be waived at the discretion of the mechanical engineer of record for the Project.
  - I. Certify TAB field data reports and perform the following:
    - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
    - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
  - J. TAB Report Forms: Use standard TAB specialist's forms approved by Architect.
  - K. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."
  - L. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
  - M. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."
- 1.09 PROJECT CONDITIONS
- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- 1.10 WARRANTY
- A. Provide workmanship and performance warranty applicable to TAB specialist engaged to perform Work of this Contract:
    - 1. AABC Performance Guarantee.
    - 2. NEBB Quality Assurance Program.
  - B. Refer to Division 01 Specifications for additional requirements.
- 1.11 COORDINATION
- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
  - B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.
  - C. Coordinate TAB work with work of other trades.

**PART 2 - PRODUCTS (Not Applicable)****PART 3 - EXECUTION****3.01 EXAMINATION****A. Contract Documents Examination Report:**

1. TAB specialist shall review Contract Documents, including plans and specifications. Provide report listing conditions that would prevent the system(s) from operating in accordance with the sequence of operations specified, or would prevent accurate testing and balancing:
  - a. Identify each condition requiring correction using equipment designation shown on Drawings. Provide room number, nearest building grid line intersection, or other information necessary to identify location of condition requiring correction.
  - b. Proposed corrective action necessary for proper system operation.

**B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.****C. Examine the approved submittals for HVAC systems and equipment.****D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.****E. Examine equipment performance data including fan and pump curves.**

1. 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.

**F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.****G. Examine test reports specified in individual system and equipment Sections.****H. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.****I. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.****J. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.****K. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.**

- L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- M. Examine system pumps to ensure absence of entrained air in the suction piping.
- N. Examine operating safety interlocks and controls on HVAC equipment.
- O. Report conditions requiring correction discovered before and during performance of TAB procedures.
- P. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### 3.02 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures. TAB plan shall be specific to Project and include the following:
  - 1. General description of each air system and sequence(s) of operation.
  - 2. Complete list of measurements to be performed.
  - 3. Complete list of measurement procedures. Specify types of instruments to be utilized and method of instrument application.
  - 4. Qualifications of personnel assigned to Project.
  - 5. Single-line CAD drawings reflecting all test locations (terminal units, grilles, diffusers, traverse locations, etc).
  - 6. Table indicating pressure relationships (positive, negative, or neutral) between building spaces.
  - 7. Air terminal correction factors for the following:
    - a. Air terminal configuration.
    - b. Flow direction (supply or return/exhaust).
    - c. Effective area of each size and type of air terminal.
    - d. Air density.
- B. Complete system-readiness checks and prepare reports. Verify the following:
  - 1. Permanent electrical-power wiring is complete.
  - 2. Hydronic systems are filled, clean, and free of air.
  - 3. Automatic temperature-control systems are operational.
  - 4. Equipment and duct access doors are securely closed.
  - 5. Balance, smoke, and fire dampers are open.
  - 6. Isolating and balancing valves are open and control valves are operational.
  - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
  - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

### 3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.



1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
  1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
  2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 23 07 13 "Duct Insulation," Section 23 07 16 "HVAC Equipment Insulation," and Section 23 07 19 "HVAC Piping Insulation." Section 23 80 00 Heating, Ventilating, and Air Conditioning."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

### 3.04 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. Test each system to verify building or space operating pressure, including all stages of economizer cycle. Maximum building pressure shall not exceed 0.03 inches of pressure.
- C. Except as specifically indicated in this Specification, Pitot tube traverses shall be made of each duct to measure airflow. Pitot tubes, associated instruments, traverses, and techniques shall conform to ASHRAE Handbook, HVAC Applications, and ASHRAE Handbook, HVAC Systems and Equipment.
  1. Use state-of-the-art instrumentation approved by TAB specialists governing agency..
  2. Where ducts' design velocity and air quantity are both less than 1000 fpm/CFM, air quantity may be determined by measurements at terminals served.
- D. Test holes shall be placed in straight duct, as far as possible downstream from elbow, bends, take-offs, and other turbulence-generating devices.
- E. For variable-air-volume systems, develop a plan to simulate diversity.
- F. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- G. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- H. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- I. Verify that motor starters are equipped with properly sized thermal protection.
- J. Check dampers for proper position to achieve desired airflow path.

- K. Check for airflow blockages.
- L. Check condensate drains for proper connections and functioning.
- M. Check for proper sealing of air-handling-unit components.
- N. Verify that air duct system is sealed as specified in Section 23 31 13 "Metal Ducts." Section 23 80 00 "Heating, Ventilating, and Air Conditioning."
- O. Provide for adjustments or modifications to fan and motor sheaves, belts, damper linkages, and other components as required to achieve specified air balance at no additional cost to Owner.
- P. Automatically operated dampers shall be adjusted to operate as indicated in Contract Documents. Controls shall be checked for proper calibration.

### 3.05 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 total airflow.
    - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow. Alternative methods shall be examined for determining total CFM, i.e., Pitot-tube traversing of branch ducts, coil or filter velocity profiles, prior to utilizing airflow values at terminal outlets and inlets.
  - 2. Measure fan static pressures as follows to determine actual static pressure:
    - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
    - b. Measure static pressure directly at the fan outlet.
    - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the 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.
  - 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
    - a. Report the cleanliness status of filters and the time static pressures are measured.
  - 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
  - 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

6. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
  7. 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 mode to determine the maximum required brake horsepower.
- B. Check operation of relief air dampers. Measure total relief air quantity at each stage of normal, economizer, power exhaust, or power exhaust economizer operation, as applicable to installed equipment. Adjust relief air dampers to provide 100 percent relief in economizer mode. Ensure that relief dampers close completely upon unit shutdown.
- C. Check operation of outside air dampers. Measure total outside air quantity at each stage of normal, economizer, power exhaust, or power exhaust economizer operation, as applicable to installed equipment. Adjust outside air dampers to provide 100 percent outside air in economizer mode. Ensure that outside air dampers close completely upon unit shutdown.
- D. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure airflow of submain and branch ducts.
    - 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. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
  3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- E. Measure air outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading digital backflow compensating hood. Use outlet manufacturer's written instructions and calculating factors only when direct-reading hood cannot be used due to physical obstruction or other limiting factors. Final report shall indicate where values listed have not been obtained by direct measurement.
- F. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents, if included.

2. Adjust patterns of adjustable outlets for proper distribution without drafts. Terminal air velocity at five feet above finished floor shall not exceed 50 feet per minute in occupied air conditioned spaces.

G. Do not overpressurize ducts.

### 3.06 PROCEDURES FOR DUAL-DUCT SYSTEMS

- A. Comply with applicable requirements for constant-volume air systems in addition to those listed below.
- B. Verify that the cooling coil is capable of full-system airflow, and set mixing boxes at full-cold airflow position for fan volume.
- C. Measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.
  1. If insufficient static pressure exists, increase airflow at the fan.
- D. Test and adjust the constant-volume mixing boxes as follows:
  1. Verify both hot and cold operations by adjusting the thermostat and observing changes in air temperature and volume.
  2. Verify sufficient inlet static pressure before making volume adjustments.
  3. Adjust mixing boxes to indicated airflows within specified tolerances. Measure airflow by Pitot-tube traverse readings or by measuring static pressure at mixing-box taps if provided by mixing-box manufacturer.
- E. Remeasure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.
- F. Adjust variable-air-volume, dual-duct systems in the same way as constant-volume, dual-duct systems; adjust maximum- and minimum-airflow setting of each mixing box.

### 3.07 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Comply with applicable requirements for constant-volume air systems in addition to those listed below.
- B. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
- C. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
3. Measure total system airflow. Adjust to within indicated airflow.
4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
  - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
  - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record final fan-performance data including optimum operating static control set point.

### 3.08 PROCEDURES FOR MULTIZONE SYSTEMS

- A. Comply with applicable requirements for constant-volume air systems in addition to those listed below.
- B. Set unit at maximum airflow through the cooling coil.
- C. Adjust each zone's balancing damper to achieve indicated airflow within the zone.

### 3.09 PROCEDURES FOR FUME HOODS

- A. Fume Hood Air Flow Measurement Procedures:
  1. Rooms under study cleared of all but study personnel.
  2. All doors in rooms under study closed securely (unless otherwise indicated on fume exhaust hood data sheets) to simulate most adverse conditions.
  3. Power supply to all fans operating the fume hoods in rooms under study activated.
  4. All fume hood sashes positioned wide open or to facility or manufacturer required operating height.

5. Airflow data obtained by holding test instrument flush with and in plane of the hood sash.
6. With survey personnel standing well clear of the measurement area, record velocities on evenly spaced grid pattern with a maximum of 6 inches between test points. Test instrument shall record directional flow to ensure reverse flow conditions do not occur.

### 3.10 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Complete air balance prior to hydronic systems balancing.
- B. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed ranges given in article, Tolerances.
- C. Prepare schematic diagrams of systems' "as-built" piping layouts.
- D. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
  1. Open all manual valves for maximum flow.
  2. Check liquid level in expansion tank.
  3. Check makeup water-station pressure gage for adequate pressure for highest vent.
  4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
  5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
  6. Set system controls so automatic valves are wide open to heat exchangers.
  7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
  8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

### 3.11 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
  1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
    - a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Architect and comply with requirements in Section 23 21 23 "Hydronic Pumps."
  2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
    - a. Monitor motor performance during procedures and do not operate motors in overload conditions.

3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
  4. Report flow rates that are not within ranges given in article, Tolerances.
- B. Venturies and calibrated orifices with portable or permanent flow meters shall be used to balance the water flows. When such components have not been installed, measure temperature differential across coils or other elements and balance accordingly.
  - C. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
  - D. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
  - E. Set calibrated balancing valves, if installed, at calculated presetsings.
  - F. Measure flow at all stations and adjust, where necessary, to obtain first balance.
    1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
  - G. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
  - H. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
    1. Determine the balancing station with the highest percentage over indicated flow.
    2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
    3. Record settings and mark balancing devices.
  - I. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
  - J. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
  - K. Check settings and operation of each safety valve. Record settings.
- 3.12 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS
- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.
- 3.13 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS
- A. Balance the primary circuit flow first and then balance the secondary circuits.
- 3.14 PROCEDURES FOR HEAT EXCHANGERS
- A. Measure water flow through all circuits.

- B. Adjust water flow to within specified tolerances.
- C. Measure inlet and outlet water temperatures.
- D. Measure inlet steam pressure.
- E. Check settings and operation of safety and relief valves. Record settings.

### 3.15 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
  - 1. Manufacturer's name, model number, and serial number.
  - 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 manufacturer's name, model number, size, type, and thermal-protection-element rating.
    - a. Starter strip heater size, type, and rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

### 3.16 PROCEDURES FOR CHILLERS

- A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
  - 1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
  - 2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
  - 3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
  - 4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
  - 5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
  - 6. Capacity: Calculate in tons of cooling.
  - 7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.



### 3.17 PROCEDURES FOR COOLING TOWERS

- A. Shut off makeup water for the duration of the test, and verify that makeup and blowdown systems are fully operational after tests and before leaving the equipment. Perform the following tests and record the results:
  - 1. Measure condenser-water flow to each cell of the cooling tower.
  - 2. Measure entering- and leaving-water temperatures.
  - 3. Measure wet- and dry-bulb temperatures of entering air.
  - 4. Measure wet- and dry-bulb temperatures of leaving air.
  - 5. Measure condenser-water flow rate recirculating through the cooling tower.
  - 6. Measure cooling-tower spray pump discharge pressure.
  - 7. Adjust water level and feed rate of makeup water system.
  - 8. Measure flow through bypass.

### 3.18 PROCEDURES FOR CONDENSING UNITS

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

### 3.19 PROCEDURES FOR BOILERS

- A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

### 3.20 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each water coil:
  - 1. Entering- and leaving-water temperature.
  - 2. Water flow rate.
  - 3. Water pressure drop.
  - 4. Dry-bulb temperature of entering and leaving air.
  - 5. Wet-bulb temperature of entering and leaving air for cooling coils.
  - 6. Airflow.
  - 7. Air pressure drop.
- B. Measure, adjust, and record the following data for each electric heating coil:
  - 1. Nameplate data.
  - 2. Airflow.
  - 3. Entering- and leaving-air temperature at full load.
  - 4. Voltage and amperage input of each phase at full load and at each incremental stage.
  - 5. Calculated kilowatt at full load.
  - 6. Fuse or circuit-breaker rating for overload protection.
- C. Measure, adjust, and record the following data for each refrigerant 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.

### 3.21 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
  1. Measure and record the operating speed, airflow, and static pressure of each fan.
  2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
  3. Check the condition of filters.
  4. Check the condition of coils.
  5. Check the operation of the drain pan and condensate-drain trap.
  6. Check bearings and other lubricated parts for proper lubrication.
  7. Report on the operating condition of the equipment and the results of the measurements taken. Report conditions requiring correction.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
  1. New filters are installed.
  2. Coils are clean and fins combed.
  3. Drain pans are clean.
  4. Fans are clean.
  5. Bearings and other parts are properly lubricated.
  6. Conditions requiring correction noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
  1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
  2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
  3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
  4. Balance each air outlet.

### 3.22 GENERAL PROCEDURES FOR PLUMBING SYSTEMS

- A. Measure pressure drop across each backflow preventer assembly at design flows.
- B. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
    - a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Architect Owner Construction Manager Commissioning Authority and comply with requirements in Section 22 50 00 "Plumbing Equipment Section 22 11 23 "Domestic Water Pumps."
  2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
    - a. Monitor motor performance during procedures and do not operate motors in overload conditions.
  3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
  4. Report flow rates that are not within range given in article, Tolerances.
- C. Set calibrated balancing valves, if installed, at calculated presettings.
- D. Measure flow at all stations and adjust, where necessary, to obtain first balance.
1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- E. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- F. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
1. Determine the balancing station with the highest percentage over indicated flow.
  2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
  3. Record settings and mark balancing devices.
- G. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- H. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- I. Check settings and operation of each safety valve. Record settings.

### 3.23 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: 10.
2. Air Outlets and Inlets: 10.
3. Multiple outlets within single room: 10 for total airflow within room. Tolerance for individual outlets within a single room having multiple outlets shall be as for "Air Outlets and Inlets".
4. Heating-Water Flow Rate: 10.
5. Cooling-Water Flow Rate: 10.

B. Set plumbing systems water flow rates within plus or minus 10 percent.

### 3.24 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Interim Reports: Prepare periodic lists of conditions requiring correction and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

### 3.25 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing field supervisor. Report shall be co-signed by the Contractor, attesting that he has reviewed the report, and the report has been found to be complete and accurate.
  2. The certification sheet shall be followed by sheet(s) listing items for which balancing objectives could not be achieved. Provide explanation for failure to achieve balancing objectives for each item listed.
  3. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Pump curves.
  2. Fan curves.
  3. Manufacturers' test data.
  4. Field test reports prepared by system and equipment installers.
  5. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
  2. Name and address of the TAB specialist.
  3. Project name.
  4. Project location.

5. Project Performance Guaranty
  6. Architect's name and address.
  7. Engineer's name and address.
  8. Contractor's name and address.
  9. Report date.
  10. Signature of TAB supervisor who certifies the report.
  11. Table of Contents with the total number of pages defined for each section of the report.  
Number each page in the report.
  12. 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.
  13. Nomenclature sheets for each item of equipment.
  14. Data for terminal units, including manufacturer's name, type, size, and fittings.
  15. Test conditions for fans and pump performance forms including the following:
    - a. Settings for outdoor-, 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. Inlet vane settings for variable-air-volume systems.
    - g. Settings for supply-air, static-pressure controller.
    - h. Other system operating conditions that affect performance.
- D. 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 outdoor, supply, return, and exhaust airflows.
  2. Water and steam flow rates.
  3. Duct, outlet, and inlet sizes.
  4. Pipe and valve sizes and locations.
  5. Terminal units.
  6. Balancing stations.
  7. Position of balancing devices.
- E. Air distribution outlets and inlets shall be shown on keyed plans with designation for each outlet and inlet matching designation used in Contract Documents and TAB test reports. Room numbers shall be included in keyed plans and test reports. Where multiple outlets and inlets are installed within a single room, a designation shall be assigned and listed for each outlet and inlet in addition to room number.
- F. Test Reports – General:
1. All test reports containing air or liquid flow data shall record flow values prior to system adjustment in addition to required data listed for each test report.

G. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

- a. Unit identification.
- b. Location.
- c. Make and type.
- d. Model number and unit size.
- e. Manufacturer's serial number.
- f. Unit arrangement and class.
- g. Discharge arrangement.
- h. Sheave make, size in inches, and bore.
- i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
- j. Number, make, and size of belts.
- k. Number, type, and size of filters.

2. Motor Data:

- a. Motor make, and frame type and size.
- b. Horsepower and rpm.
- c. Volts, phase, and hertz.
- d. Full-load amperage and service factor.
- e. Sheave make, size in inches, and bore.
- f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

- a. Total air flow rate in cfm.
- b. Total system static pressure in inches wg.
- c. Fan rpm.
- d. Discharge static pressure in inches wg.
- e. Filter static-pressure differential in inches wg.
- f. Preheat-coil static-pressure differential in inches wg.
- g. Cooling-coil static-pressure differential in inches wg.
- h. Heating-coil static-pressure differential in inches wg.
- i. Outdoor airflow in cfm.
- j. Return airflow in cfm.
- k. Relief airflow in cfm.
- l. Outdoor-air damper position, normal and economizer, power exhaust, or power exhaust economizer modes, as applicable to installed equipment.
- m. Return-air damper position.
- n. Relief-air damper position, normal and economizer, power exhaust, or power exhaust economizer modes, as applicable to installed equipment.
- o. Vortex damper position.

H. Apparatus-Coil Test Reports:

1. Coil Data:

- a. System identification.
- b. Location.
- c. Coil type.
- d. Number of rows.
- e. Fin spacing in fins per inch o.c.
- f. Make and model number.
- g. Face area in sq. ft.
- h. Tube size in NPS.
- i. Tube and fin materials.
- j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

- a. Air flow rate in cfm.
- b. Average face velocity in fpm.
- c. Air pressure drop in inches wg.
- d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
- e. Return-air, wet- and dry-bulb temperatures in deg F.
- f. Entering-air, wet- and dry-bulb temperatures in deg F.
- g. Leaving-air, wet- and dry-bulb temperatures in deg F.
- h. Water flow rate in gpm.
- i. Water pressure differential in feet of head or psig.
- j. Entering-water temperature in deg F.
- k. Leaving-water temperature in deg F.
- l. Refrigerant expansion valve and refrigerant types.

I. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

- a. System identification.
- b. Location.
- c. Make and type.
- d. Model number and unit size.
- e. Manufacturer's serial number.
- f. Fuel type in input data.
- g. Output capacity in Btu/h.
- h. Ignition type.
- i. Burner-control types.
- j. Motor horsepower and rpm.
- k. Motor volts, phase, and hertz.
- l. Motor full-load amperage and service factor.
- m. Sheave make, size in inches, and bore.
- n. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

- a. Total air flow rate in cfm.

- b. Entering-air temperature in deg F.
  - c. Leaving-air temperature in deg F.
  - d. Air temperature differential in deg F.
  - e. Entering-air static pressure in inches wg.
  - f. Leaving-air static pressure in inches wg.
  - g. Air static-pressure differential in inches wg.
  - h. Low-fire fuel input in Btu/h.
  - i. High-fire fuel input in Btu/h.
  - j. Manifold pressure in psig.
  - k. High-temperature-limit setting in deg F.
  - l. Operating set point in Btu/h.
  - m. Motor voltage at each connection.
  - n. Motor amperage for each phase.
  - o. Heating value of fuel in Btu/h.
- J. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
- 1. Unit Data:
    - a. System identification.
    - b. Location.
    - c. Coil identification.
    - d. Capacity in Btu/h.
    - e. Number of stages.
    - f. Connected volts, phase, and hertz.
    - g. Rated amperage.
    - h. Air flow rate in cfm.
    - i. Face area in sq. ft.
    - j. Minimum face velocity in fpm.
  - 2. Test Data (Indicated and Actual Values):
    - a. Heat output in Btu/h.
    - b. Air flow rate in cfm.
    - c. Air velocity in fpm.
    - d. Entering-air temperature in deg F.
    - e. Leaving-air temperature in deg F.
    - f. Voltage at each connection.
    - g. Amperage for each phase.
- K. Fan Test Reports: For supply, return, and exhaust fans, include the following:
- 1. Fan Data:
    - a. System identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and size.



- e. Manufacturer's serial number.
- f. Arrangement and class.
- g. Sheave make, size in inches, and bore.
- h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:

- a. Motor make, and frame type and size.
- b. Horsepower and rpm.
- c. Volts, phase, and hertz.
- d. Full-load amperage and service factor.
- e. Sheave make, size in inches, and bore.
- f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
- g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

- a. Total airflow rate in cfm.
- b. Total system static pressure in inches wg.
- c. Fan rpm.
- d. Discharge static pressure in inches wg.
- e. Suction static pressure in inches wg.

L. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

- a. System and air-handling-unit number.
- b. Location and zone.
- c. Traverse air temperature in deg F.
- d. Duct static pressure in inches wg.
- e. Duct size in inches.
- f. Duct area in sq. ft.
- g. Indicated air flow rate in cfm.
- h. Indicated velocity in fpm.
- i. Actual air flow rate in cfm.
- j. Actual average velocity in fpm.
- k. Barometric pressure in psig.

M. Air-Terminal-Device Reports:

1. Unit Data:

- a. System and air-handling unit identification.
- b. Location and zone.
- c. Apparatus used for test.
- d. Area served.
- e. Make.

- f. Number from system diagram.
- g. Type and model number.
- h. Size.
- i. Effective area in sq. ft.

2. Test Data (Indicated and Actual Values):

- a. Air flow rate in cfm.
- b. Air velocity in fpm.
- c. Preliminary air flow rate as needed in cfm.
- d. Preliminary velocity as needed in fpm.
- e. Final air flow rate in cfm.
- f. Final velocity in fpm.
- g. Space temperature in deg F.

N. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

- a. System and air-handling-unit identification.
- b. Location and zone.
- c. Room or riser served.
- d. Coil make and size.
- e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

- a. Air flow rate in cfm.
- b. Entering-water temperature in deg F.
- c. Leaving-water temperature in deg F.
- d. Water pressure drop in feet of head or psig.
- e. Entering-air temperature in deg F.
- f. Leaving-air temperature in deg F.

O. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

- a. Unit identification.
- b. Location.
- c. Service.
- d. Make and size.
- e. Model number and serial number.
- f. Water flow rate in gpm.
- g. Water pressure differential in feet of head or psig.
- h. Required net positive suction head in feet of head or psig.
- i. Pump rpm.
- j. Impeller diameter in inches.

- k. Motor make and frame size.
- l. Motor horsepower and rpm.
- m. Voltage at each connection.
- n. Amperage for each phase.
- o. Full-load amperage and service factor.
- p. Seal type.

2. Test Data (Indicated and Actual Values):

- a. Static head in feet of head or psig.
- b. Pump shutoff pressure in feet of head or psig.
- c. Actual impeller size in inches.
- d. Full-open flow rate in gpm.
- e. Full-open pressure in feet of head or psig.
- f. Final discharge pressure in feet of head or psig.
- g. Final suction pressure in feet of head or psig.
- h. Final total pressure in feet of head or psig.
- i. Final water flow rate in gpm.
- j. Voltage at each connection.
- k. Amperage for each phase.

P. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

### 3.26 INSPECTIONS

A. Initial Inspection:

- 1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
- 2. Check the following for each system:
  - a. Measure airflow of at least 10 percent of air outlets.
  - b. Measure water flow of at least 5 percent of terminals.
  - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
  - d. Verify that balancing devices are marked with final balance position.
  - e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
  2. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Architect.
  3. Architect shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
  4. If rechecks yield measurements that differ from the measurements documented in the final report by more than 10 percent, the measurements shall be noted as "FAILED."
  5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
  2. If the second final inspection also fails, Owner may contact the TAB specialists' governing organization for remedial action by the governing organization under the workmanship and performance warranty. See article, Warranty.
  3. If remedial action is not provided by the TAB specialists' governing organization in a timely manner, Owner may contract the services of another TAB specialist to complete the TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB specialists' final payment.
- D. Prepare test and inspection reports.

### 3.27 ADDITIONAL TESTS

- A. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 09/30/2022 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Basis of Design will be Johnson Controls Inc.

## SECTION 23 09 23

## ENERGY MANAGEMENT CONTROL SYSTEM

**PART 1 - GENERAL****1.01 DESCRIPTION OF WORK:**

- A. Refer to Basic Mechanical Requirements Section, for general mechanical requirements.
- B. Refer to Mechanical Division for installation of instrument wells, valve bodies, dampers, etc. in mechanical systems.
- C. Provide the following electrical work as work of this Section, complying with requirements of Electrical Division, and as outlined below:
  - 1. All control wiring between field-installed controls, indicating devices, and unit control panels.
  - 2. Interlock wiring between electrically interlocked devices, sensors, and between a hand or auto position of motor starters as indicated.
  - 3. Wiring associated with indicating and alarm panels (remote alarm panels) and connections to their associated field devices.
  - 4. Contractor shall provide and extend low voltage power source wiring required for operation of control devices provided.
  - 5. Wiring for fully complete and functional controls system and as specified.

**1.02 SUBMITTALS: IN ACCORDANCE WITH DIVISION 1**

- A. Product Data: Submit manufacturer's specifications for each control device furnished, including installation instructions and start-up instructions. Submit integrated wiring and electrical diagram to show complete system operation.
- B. All submittals must be received and approved by the Owner prior to the ordering and installation of any equipment by the Contractor.
  - 1. Provide the Owner with a Building Controls submittal with the following:
    - a. System Hardware
    - b. System Architecture
    - c. Complete System Wiring Schematic
- C. Submit shop drawings showing construction and mounting details for review prior to construction. In addition, submit the following for review prior to panel and/or system fabrication and installation:
  - 1. Field wiring diagrams showing wiring external to panel.
  - 2. Panel internal wiring diagrams also showing panel terminal connections for external wiring, properly coordinated and keyed to external wiring diagram.
  - 3. Designation of all switches, pilot lights, etc. and layout of instruments, switches, and nameplates of panel.

**1.03 COORDINATION:**

- A. Automatic temperature control systems work shall be accomplished as outlined below:
1. Control Valves furnished under this section shall be installed as specified in Mechanical Division. .
  2. Control Dampers are provided under the applicable Mechanical Division air distribution or air handling equipment section.
  3. Water Pressure Taps, Thermal Wells, Flow Switches, Flow Meters, that will have wet surfaces furnished under this Section, shall be installed as specified in Mechanical Division.
  4. Controlled Equipment Power Wiring shall be furnished and installed under Electrical Division. Where control involves 120V control devices controlling 120V equipment, the Division 16 Electrical Contractor shall extend power wiring to the equipment and shall extend it from the equipment to the control device.

**1.04 INSTALLING CONTRACTOR QUALIFICATIONS:**

- A. The Building Automation System Control System contractor must have been in business, and licensed as a contractor by the State of California, installing HVAC and building automation controls, and fire/life safety systems, for a minimum of ten (10) years preceding the bid opening.
- B. The Building Automation Control System contractor must have completed no less than one (1) control system installation, within twenty-four (24) months preceding the bid opening, pursuant to a single written contract, valued at no less than three hundred thousand (\$300,000) dollars.
- C. The Building Automation Control System contractor must demonstrate that, from the local office that will service the Owner with a four (4) hour emergency response requirement can logistically be provided.
- D. Controls contractor must have direct access to factory certified instructors to provide training upon request of the district.
- E. Controls contractor must have explicit district approval to interface with district wide server for integration of new controls system.
- F. The Building Automation Control System contractor must have been, for five (5) years preceding the bid opening, a factory branch office, or a factory authorized dealer for the product manufacturer type identified in subsection 2.01, A., under PART 2 – PRODUCTS, of this section. Factory authorized dealer means:
1. Installing Contractor has a contract directly with the factory. Approved installing contractors shall be Johnson Controls (JCI), Emcor, or Intech Mechanical. No others are approved.

**PART 2 - PRODUCTS****2.01 GENERAL:**

- A. Manufacturer: The Building Automation Control System shall be provided by the following:

1. Controls are to be provided by Johnson Controls, Inc., branch office in Folsom, CA to match campus standard.
  2. No other contractors are acceptable or will be considered per Part 1.4, Item F above.
  3. The Building Automation Controls contractor must have been, for ten (10) years preceding the bid opening, a factory branch office. A contract with a distributor is not acceptable.
- B. All new controls material must be fully integrated and graphically represented on existing district building automation controls system on the districts servers. Only district authorized personnel may access this server for controls integration.
- C. All components used shall be serviceable, repairable, and replaceable by qualified temperature control technicians using non-proprietary parts, tools, and instruments.

## 2.02 SUPERVISORY CONTROLLER

### A. NETWORK AUTOMATION ENGINE (NAE) – EXISTING ON SITE

1. The NAE shall perform the function of monitoring all system variables, both from real hardware points, software variables, and controller parameters such as set points.
2. NAE's shall be entirely solid state devices. No rigid disk drives will be permitted in the equipment rooms.
3. The NAE's shall manage and direct all information traffic on the Tier 1 network, between the Tier 1 and Tier2 networks, and to servers.
4. Any NAE on the Tier 1 network shall be equipped with all software necessary to drive the complete user interface including graphics on a browser connected to the NAE via the network or directly via a local port on the node.
5. The operating system of the NAE shall support multi-user access. At minimum four users shall be able to access the same NAE simultaneously.
6. Communication between NAE's shall be per-to-peer via 10/100 Ethernet using the BACnet protocol.
7. The NAE shall be capable of direct connection to multiple field busses using different protocols simultaneously as indicated below. Should the controller not support multiple field busses, install two supervisory controllers side by side.
  - a. An RS-485 serial field bus such as BACnet MSTP or the manufacturer's proprietary field bus – JCI N2.
  - b. A LON field bus for supervision and control of LON based controllers that conform to the Lon Talk standard.
8. The NAE will integrate data from both field busses into a common object structure. Data from both field busses will appear in common displays throughout the user interface in exactly the same format. It shall not be possible to determine which field buss the data originated on without reviewing the system configuration data.
9. The NAE shall be programmable and governed by the requirements of their applicable codes, approvals and regulations.
10. The NAE shall be designed, packaged, installed, programmed and commissioned in consideration of their specific service and prevailing operating conditions. They shall be proven standard product of their original manufacturer and not a custom product for this Project.



11. A failure at an NAE shall not cause failures or non-normal operation at any other system NAE other than the possible loss of active real-time information from the failed NAE.
12. Ancillary NAE equipment, including interfaces and power supplies, shall not be operated at more than 80% of their rated service capacity.
13. The NAE shall comply with FCC Part 15 subpart J class A emission requirements.
14. Each NAE shall be equipped with the necessary un-interruptible power such that it will not cease operation during minor power outages, including those that occur upon transfer to emergency generator or other local power source not provided by the utility.

## 2.03 NETWORKING/COMMUNICATIONS:

- A. The design of the Building Automation Control System shall network operator workstations and Standalone DDC Panels as shown on the attached system configuration drawing. Inherent in the system's design shall be the ability to expand or modify the network(s) either via the local area network, or auto-dial telephone line modem connections, or via a combination of the two networking schemes.
  1. Local Area Network
    - a. Workstation/DDC Panel Support: Operator workstations and DDC panels shall directly reside on a local area network such that communications may be executed directly between controllers, directly between workstations, and between controllers and workstations on a peer-to-peer basis.
    - b. Dynamic Data Access: All operator devices, either network resident or connected via dial-up modems, shall have the ability to access all point status and application report data, or execute control functions for any and all other devices via the local area network. Access to data shall be based upon logical identification of building equipment. Access to system data shall not be restricted by the hardware configuration of the Building Automation Control System. The hardware configuration of the Building Automation Control System network shall be totally transparent to the user when accessing data or developing control programs.
    - c. General Network Design: Network design shall include the following provisions:
      - 1) High-speed data transfer rates for alarm reporting, quick report generation from multiple controllers and upload/download efficiency between network devices. The minimum baud rate shall be one (1) Megabaud.
      - 2) Support of any combination of controllers and operator workstations directly connected to the local area network. A minimum of fifty (50) devices shall be supported on a single local area network.
      - 3) Detection and accommodation of single or multiple failures of either workstations, DDC panels or the network media. The network shall include provisions for automatically reconfiguring itself to allow all operational equipment to perform their designated functions as effectively as possible in the event of single or multiple failures.
      - 4) Message and alarm buffering to prevent information from being lost.
      - 5) Error detection, correction, and retransmission to guarantee data integrity.
      - 6) Default device definition to prevent loss of alarms or data, and ensure alarms are reported as quickly as possible in the event an operator device does not respond.
      - 7) Commonly available, multiple sourced, networking components and protocols shall be used to allow the Building Automation Control System to coexist with other networking

applications such as office automation. MAP, ETHERNET, IBM Token Ring and ARCNET are acceptable technologies.

- 8) Use of an industry standard IEEE 802.x protocol. Communications must be of a deterministic nature to assure calculable performance under worst-case network loading.
- 9) Synchronization of the real-time clocks in all DDC panels shall be provided.

#### 2.04 APPLICATION SPECIFIC CONTROLLERS - HVAC APPLICATIONS:

- A. Each Standalone DDC Controller shall be able to extend its performance and capacity through the use of remote Application Specific Controllers (ASCs).
- B. Each ASC shall operate as a standalone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a microprocessor-based, multi-tasking, real-time digital control processor.
- C. Each ASC shall have sufficient memory to support its own operating system and data base including:
  1. Control Processes
  2. Energy Management Applications
  3. Operator I/O (Portable Service Terminal)
- D. The operator interface to any ASC point data or programs shall be through any network-resident PC workstation, or any PC or portable operator's terminal connected to any DDC panel in the network.
- E. Application Specific Controllers shall directly support the temporary use of a portable service terminal. The capabilities of the portable service terminal shall include but not be limited to the following:
  1. Display temperatures
  2. Display status
  3. Display setpoints
  4. Display control parameters
  5. Override binary output control
  6. Override analog setpoints
  7. Modification of gain and offset constants
- F. Powerfail Protection: All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the controller.
- G. Application Description:
  1. Field Equipment Controller (FEC) – BY JCI
    - a. When indoors - the FEC shall operate as a standard from 32 to 122 degrees Fahrenheit ambient air temperature and 10 to 90% relative humidity.

- b. When outdoors mounted either in unit cabinet or mounted in a steel enclosure – the FEC shall operate from -40 to 158 degrees Fahrenheit ambient air temperature and 10 to 90% relative humidity.
- c. The Field Equipment Controller (FEC) shall be a fully user-programmable, digital controller that communicates via BACnet MS/TP protocol.
- d. The FEC shall employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.
- e. Controllers shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only shall not be acceptable.
- f. The FEC shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
- g. The FEC shall include a removable base to allow pre-wiring without the controller.
- h. The FEC shall include troubleshooting LED indicators to identify the following conditions:
  - 1) Power On
  - 2) Power Off
  - 3) Download or Startup in progress, not ready for normal operation
  - 4) No Faults
  - 5) Device Fault
  - 6) Field Controller Bus - Normal Data Transmission
  - 7) Field Controller Bus - No Data Transmission
  - 8) Field Controller Bus - No Communication
  - 9) Sensor-Actuator Bus - Normal Data Transmission
  - 10) Sensor-Actuator Bus - No Data Transmission
  - 11) Sensor-Actuator Bus - No Communication
- i. The FEC shall accommodate the direct wiring of analog and binary I/O field points.
- j. The FEC shall support the following types of inputs and outputs:
  - 1) Universal Inputs - shall be configured to monitor any of the following:
    - a) Analog Input, Voltage Mode
    - b) Analog Input, Current Mode
    - c) Analog Input, Resistive Mode
    - d) Binary Input, Dry Contact Maintained Mode
    - e) Binary Input, Pulse Counter Mode
  - 2) Binary Inputs - shall be configured to monitor either of the following:
    - a) Dry Contact Maintained Mode
    - b) Pulse Counter Mode
  - 3) Analog Outputs - shall be configured to output either of the following
    - a) Analog Output, Voltage Mode

- b) Analog Output, current Mode
- 4) Binary Outputs - shall output the following:
  - a) 24 VAC Triac
- 5) Configurable Outputs - shall be capable of the following:
  - a) Analog Output, Voltage Mode
  - b) Binary Output Mode
- k. The FEC shall have the ability to reside on a Field Controller Bus (FC Bus).
  - 1) The FC Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
  - 2) The FC Bus shall support communications between the FECs and the NAE.
  - 3) The FC Bus shall also support Input/Output Module (IOM) communications with the FEC and with the NAE.
  - 4) The FC Bus shall support a minimum of 100 IOMs and FEC in any combination.
  - 5) The FC Bus shall operate at a maximum distance of 15,000 ft. between the FEC and the furthest connected device.
- l. The FEC shall have the ability to monitor and control a network of sensors and actuators over a Sensor-Actuator Bus (SA Bus).
  - 1) The SA Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
  - 2) The SA Bus shall support a minimum of 10 devices per trunk.
  - 3) The SA Bus shall operate at a maximum distance of 1,200 ft. between the FEC and the furthest connected device.
- m. The FEC shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over the FC Bus or the SA Bus.
- n. The FEC shall support, but not be limited to, the following:
  - 1) Hot water, chilled water/central plant applications
  - 2) Built-up air handling units for special applications
  - 3) Terminal units
  - 4) Special programs as required for systems control

#### H. Field Devices

- 1. Input/Output Module (IOM) – BY JCI
  - a. The IOM shall operate as a standard from 32 to 122 degrees Fahrenheit ambient air temperature and 10 to 90% relative humidity
  - b. The Input/Output Module (IOM) provides additional inputs and outputs for use in the FEC.

- c. The IOM shall communicate with the FEC over either the FC Bus or the SA Bus using BACnet Standard protocol SSPC-135, Clause 9.
  - d. The IOM shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
  - e. The IOM shall have a minimum of 4 points to a maximum of 17 points.
  - f. The IOM shall support the following types of inputs and outputs:
    - 1) Universal Inputs - shall be configured to monitor any of the following:
      - a) Analog Input, Voltage Mode
      - b) Analog Input, Current Mode
      - c) Analog Input, Resistive Mode
      - d) Binary Input, Dry Contact Maintained Mode
      - e) Binary Input, Pulse Counter Mode
    - 2) Binary Inputs - shall be configured to monitor either of the following:
      - a) Dry Contact Maintained Mode
      - b) Pulse Counter Mode
    - 3) Analog Outputs - shall be configured to output either of the following:
      - a) Analog Output, Voltage Mode
      - b) Analog Output, current Mode
    - 4) Binary Outputs - shall output the following:
      - a) 24 VAC Triac
    - 5) Configurable Outputs - shall be capable of the following:
      - a) Analog Output, Voltage Mode
      - b) Binary Output Mode
  - g. The IOM shall include troubleshooting LED indicators to identify the following conditions:
    - 1) Power On
    - 2) Power Off
    - 3) Download or Startup in progress, not ready for normal operation
    - 4) No Faults
    - 5) Device Fault
    - 6) Normal Data Transmission
    - 7) No Data Transmission
    - 8) No Communication
2. Network Sensors (NS)
- a. The Network Sensors (NS) shall have the ability to monitor the following variables as required by the systems sequence of operations:

- 1) Zone Temperature
  - 2) Zone humidity
  - 3) Zone setpoint
- b. The NS shall transmit the zone information back to the controller on the Sensor-Actuator Bus (SA Bus) using BACnet Standard protocol SSPC-135, Clause 9.
  - c. The Network Sensors shall include the following items:
    - 1) A backlit Liquid Crystal Display (LCD) to indicate the Temperature, Humidity and Setpoint.
    - 2) An LED to indicate the status of the Override feature.
    - 3) A button to toggle the temperature display between Fahrenheit and Celsius.
    - 4) A button to initiate a timed override command
  - d. The NS shall be available with either screw terminals or phone jack.
  - e. The NS shall be available in either surface mount or wall mount styles.

## 2.05 TEMPERATURE CONTROL MATERIAL:

### A. PANEL DEVICES

| PART #       | DESCRIPTION                 | MFTR  |
|--------------|-----------------------------|-------|
| DCP-1.5-W    | 1.5 AMP POWER SUPPLY        | KELE  |
| DPT2640-005D | PRESSURE SENS, DP, 0-5"WC   | SETRA |
| RH2B-UAC24-L | DPDT, 10A, HC=24 VAC, W/LED | IDEC  |
| SH2B-05      | DPDT RELAY BASE FOR RH2B    | IDEC  |
| RH4B-UAC24V  | 4PDT, 10A, HC=24 VAC        | IDEC  |
| SH4B-05      | 4PDT RELAY BASE FOR RH4B    | IDEC  |
| PXPLX01S     | DP TRANSDUCER, AIR, 0-1"    | VERIS |
| 1900-5MR     | HIGH STATIC PRESS. SWITCH   | DWYER |
| BAM2         | TB END STOP                 | KELE  |
| FEM6         | TB END STOP SECTION         | KELE  |
| M4/6         | TERMINAL BLOCK              | KELE  |
| RC610B       | TB BLANK MARKING STRIPS     | KELE  |
| Y65A13-0     | 120VAC/24VAC, FOOT, 40VA    | JCI   |
| Y65A21-0     | 120VAC/24VAC, PLATE, 40VA   | JCI   |

### B. TRANSDUCERS

| PART #       | DESCRIPTION                      | MFTR  |
|--------------|----------------------------------|-------|
| A-306        | OUTDOOR AIR STATIC               | KELE  |
| DPT-2015-1   | DIFF PRESS TRANSMITTER           | JCI   |
| DPT2090-250G | PRESS SENS, GAGE, 250 PSI, VDC   | SETRA |
| DPT2640-0R1B | PRESS SENS, DP, -0.1-0.1"WC, VDC | SETRA |
| DPT2640-2R5D | PRESS SENS, DP, 0-2.5"WC, VDC    | SETRA |
| FTG18A-600R  | REMOTE MTD PROBE                 | JCI   |
| PWLX03S      | DIFF PRESS, WATER, 0-25PSI       | VERIS |

## C. SENSORS

| PART #       | DESCRIPTION                    | MFTR |
|--------------|--------------------------------|------|
| TE-6000-1    | SENSOR, T-NI, 1.0%, STRAP-ON   | JCI  |
| TE-6001-3    | KIT, MTG BOX FOR WZ-1000 WELL  | JCI  |
| TE-6313P-1   | SENSOR, T-NI 0.1%, 3IN OAT     | JCI  |
| TE-6316P-1   | SENSOR, T-NI, 0.1%, 17FT AVG   | JCI  |
| TE-6311V-2   | DUCT PROBE TEMP. SEN. 1K       | JCI  |
| TE-67NP-0N00 | SENSOR, RM, 1K, NI, PHONE JACK | JCI  |
| TE-67NT-0N00 | TEMP SENSOR 1K NICKEL          | JCI  |
| NS-BTP7002-0 | ZONE TEMP SENSOR/SETPT         | JCI  |
| NS-BTP7003-0 | ADDRESSABLE ZONE TEMP          | JCI  |
| NS-BCN7004-0 | CO2 SENSOR                     | JCI  |
| A/1KHT-2W-RP | REMOTE PROBE,-40-842, PT, 1K   | ACI  |
| A11A-1C      | PLN, MLT, SP=35-45 F, STG=1    | JCI  |
| TEC-2601-4   | 1 HEAT/1 COOL BACnet STAT      | JCI  |
| LX-24        | CEILING MOUNT OCC SENSOR       | KELE |
| ST-S63-XH    | S.S ZONE TEMP WITH OCC OVR     | KELE |

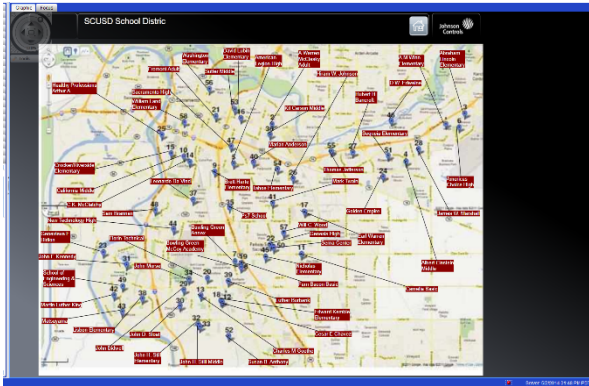
## D. FIELD DEVICES

| PART #         | DESCRIPTION                       | MFTR  |
|----------------|-----------------------------------|-------|
| H922           | CURRENT SENSOR, SPLIT             | VERIS |
| ST-S63-XM      | STAINLESS STEEL ZONE TEMP         | KELE  |
| TS-400-24-W    | DIGITAL TIME SWITCH               | KELE  |
| TS-470         | END SWITCH, NO                    | KELE  |
| WZ-1000-5      | WELL, BRASS, 2-3/8 IN, 1/2 IN NPT | JCI   |
| M9104-AGS-2N   | ELEC, INCR, NSR, TQ=35            | JCI   |
| M9220-BGA-3    | DAMPER ACTUATOR 20 NM SR          | JCI   |
| MS-FEC2611-0ET | OUTDOOR FEC                       | JCI   |
| MS-FEC2611     | INDOOR FEC                        | JCI   |
| MS-NAE4510-2   | MEDIUM CAPACITY NAE               | JCI   |
| MS-NAE5510-2   | HIGH CAPACITY NAE                 | JCI   |

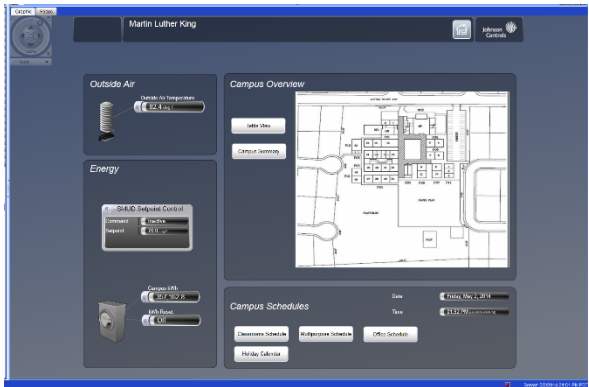
- E. Motorized Control Dampers: Shall be parallel blade for two-position control and opposed blade for proportional control applications. Dampers shall have an enamel finish or be galvanized, with nylon bearings. Blade edge and tip seals shall be included for all dampers. Blade shall be double piece 22 gauge minimum and 8" wide maximum and frame shall be welded channel iron.
- F. Temperature control panels (TCP): Shall be of NEMA code gauge steel with locking doors for mounting all devices as shown. They shall meet all applicable requirements of Title 24, California Code of Regulations. All controllers, relays, switches, etc. for equipment located in mechanical equipment rooms shall be mounted in a TCP as shown on the drawings. Temperature settings, adjustments and calibration shall be done at the TCP. Any required UCMC Campus Data networks connection for this panel shall be installed inside the panel. All electric devices within a control panel shall be factory pre-piped and wired. Provide engraved laminated plastic nameplates identifying all devices mounted on the face of the control panels. A complete set of related "as-builts" control drawings shall be furnished in each control panel.

2.06 GRAPHIC INTERFACE

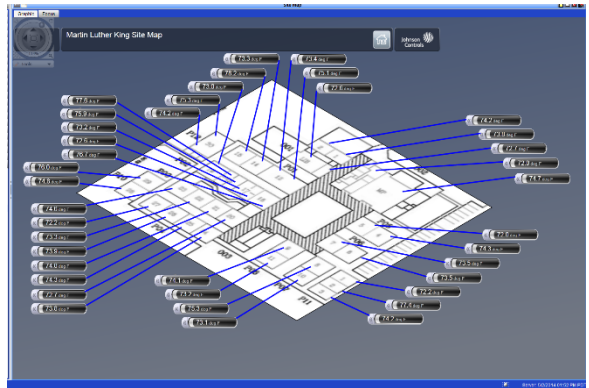
- A. The following are examples of the district wide standard for the graphical interface of the controls system. The new controls system must be graphically represented according to the following templates
1. District Map View



2. School Overview

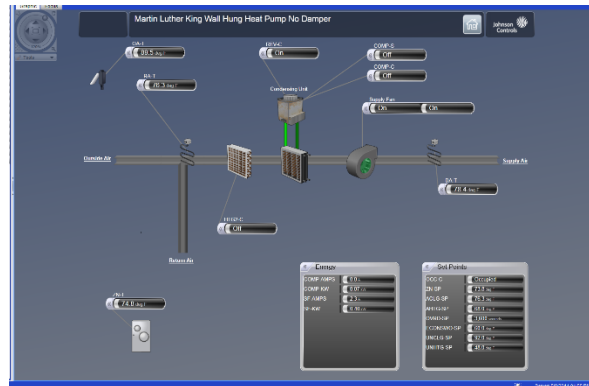


3. Zone Overview





#### 4. Equipment Overview



#### 2.07 CONSULTATIVE SUPPORT

- A. For this project, the manufacturer shall provide at a minimum 8 hours of consultative support services to review and provide recommendations and enhancements to the system, which may include:
  1. Review of critical programming loops and adjustments as necessary
  2. Adjustments to improve building system operation, reduce energy consumption and/or improve environmental control
  3. Implementation or enhancement of functionality in the system

#### 2.08 MISCELLANEOUS DEVICES

- A. Moisture Sensors:
  1. Moisture sensors shall be used to detect water in elevator sumps and chilled water fan coil unit overflow drain pans and where otherwise indicated on the Drawings using George Risk Industries Model GRI 2650, Veris MX Series, or equal.
  2. The sensor shall be floor mounted operating at 24 VAC with SPDT relay for the output signal with automatic reset.

### PART 3 - EXECUTION

#### 3.01 GENERAL:

- A. Furnish all labor, materials, equipment, and service necessary for a complete and operating Direct Digital Control Building Automation Control System, as shown on the drawings and described herein.
- B. All labor, material, equipment, and software necessary to meet the functional intent of the Building Automation Control System as specified herein and as shown on the drawings shall be included.
- C. Drawings are diagrammatic only. Equipment and labor not specifically referred to herein, or on the plans, that are required to meet the functional intent of the Building Automation Control System, shall be provided without additional cost to Sac City Unified School District.

- D. Equipment furnished by Electrical and/or Mechanical Contractor that is normally wired before installation shall be furnished completely wired. Wiring normally performed in field shall be furnished and installed by the Building Automation Control System contractor.
- E. Control equipment having electrical connections only, which are furnished under this work, shall be installed and connected by the Building Automation Control System contractor. Electrical devices requiring wet side piping connections shall be installed by the Mechanical Contractor.
- F. Clearly identify and label equipment and controls, such as starters, switches, relays, as to function and position with permanently engraved plastic nameplates.
- G. Wiring of control equipment in accordance with wiring diagrams and functional operation of the control system shall be the responsibility of the Building Automation Control System contractor.
- H. Final Adjustment of Equipment: After completion of installation, adjust temperature sensors, control valves, actuators, motors, and similar equipment provided under the scope of work of this section. Cooperate with the air balance contractor as required.
- I. Perform final adjustment by specially trained personnel in direct employ by the manufacturer of the primary Building Automation Control System.
- J. Connect control valves with threaded connections with sufficient unions to permit valves to be readily removed from their installed locations for servicing, without disturbing adjacent piping. In no case shall this be less than three unions for three-way valves and one union for two-way valves.
- K. Wiring and raceways included with the BACS scope of works includes but is not limited to the following:
  - 1. Power wiring for all controllers, sensors, relays and other equipment shall be taken from the local HVAC controls panels except equipment provided with dedicated supplies provided by Division 16.
  - 2. Controls wiring shall be routed from the local HVAC controls panels.
  - 3. Conduit shall be used for the following:
    - a. All exposed and concealed low voltage wiring in all areas below 8 feet above floor level.
    - b. All mechanical and equipment rooms, exterior locations and any other areas where physical protection and/or access is required as defined elsewhere in the contract documents.
    - c. All in-wall drops to equipment monitoring and/or control points including but not limited to medical equipment, kitchen service equipment, elevator sump and other moisture sensors, water flow meters, equipment mounted alarms, etc.
    - d. All areas where specifically indicated on the Drawings.
  - 4. J-Hooks and or designated LV raceway shall be used for the following:
    - a. All low voltage wiring above 8 feet above floor level in open and accessible areas where conduit is not required, to cable trays or other conduits.
    - b. All areas where specifically indicated on the Drawings.

5. Conduit and J-Hook materials and installation requirements shall comply with the applicable sections of Division 16 unless specifically indicated otherwise on the Drawings.

3.02 WARRANTY:

- A. The Building Automation Control System contractor shall provide a one-year warranty covering the Building Automation Control System, and all associated components installed by the Building Automation Control System contractor. Any manufacturing or installation defects arising during this warranty period shall be corrected without cost to the Owner. The Building Automation Control System contractor shall respond to the job site within a four (4) hour period for any emergency relating to the control system and associated components installed by the Building Automation Control System contractor. Warranty period shall commence after all operator instruction is completed and the entire system has been accepted by the Owner.

3.03 CARE AND CLEANING:

- A. Repair or replace broken, damaged, or otherwise defective parts, materials, and work. Leave entire work in condition satisfactory to Owner's Representative. At completion, carefully clean and adjust equipment, fixtures, and trim installed as part of this work. Leave systems and equipment in satisfactory operating condition.

3.04 OPERATION TEST/SYSTEM COMMISSIONING:

- A. Each piece of equipment shall be tested by the Building Automation Control System contractor to show that it will operate in accordance with designed requirements, and provide written documentation of this test. Control system commissioning shall consist of a point per point conformation and system operational demonstration conducted jointly by the Building Automation Control System contractor and the University's Representative.
- B. The mechanical contractor and BACS contractor/vendor will conduct two levels of Quality Assurance to verify that the required installation and performance of the Building Automation Control System as been met.
  1. Static Commissioning:
    - a. A point to point examination and documentation of the successful installation of the BACS system and its components in its entirety.
    - b. The start up of all HVAC equipment and associated systems will not commence until this work has been completed and the documentation received by the Owner.
  2. Dynamic Commissioning:
    - a. A point by point demonstration and documentation of the successful performance of the BACS system and its components in its entirety.
    - b. The verification demonstrations of all HVAC equipment and associated systems will not commence until this work has been completed and the documentation received by the Owner.
- C. All new controller programming shall be backed up into the districts existing database.

- D. As part of the operational test's the controls contractor shall demonstrate integration of new controls system into the existing server and BACS.
- E. In General the Commissioning process will comprise the following:
  - 1. Review of points list and documentation.
  - 2. Installation compliance with project plans and specifications.
  - 3. Point-to-point check.
  - 4. Control devices calibration and operation.
  - 5. System programming and documentation.
  - 6. System endurance test.
  - 7. Control loop trends.
  - 8. Reports and alarms.
  - 9. Analog input calibration.
  - 10. Analog output check and spring ranges.
  - 11. Digital input range set points.
  - 12. Digital output in autolog.
  - 13. Point by point performance verification.
  - 14. O & M training and documentation.
  - 15. Opposite season verification and documentation.
  - 16. Review and document system architecture.
- F. Prior to job closing, the controls contractor must provide and present drawings showing the physical location of the new Field Control bus routing around the campus. This will be reviewed by district HVAC personnel.

### 3.05 OPERATOR INSTRUCTION:

- A. During system commissioning and at such time acceptable performance of the Building Automation Control System hardware and software has been established, the Control Contractor shall schedule with the Owner's Representative and provide eight (8) hours of on site, or off site, operator instruction to the Owner's operating personnel. Operator instruction during normal working hours shall be performed by a competent representative familiar with the systems hardware, software, and accessories

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 09/30/2022 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Kitchen Makeup Air System shall use 100% OSA DX cooling/electric heating systems as a Basis of Design, Evaporative Cooling Style Systems are not acceptable.
- Wall type split system shall only be use in IDF/MDF rooms, all other Split Systems shall be above ceiling cassette style units with provisions for outside air connections.

## SECTION 23 80 00

## HEATING, VENTILATING AND AIR CONDITIONING

**PART 1 - GENERAL****1.01 SUMMARY****A. Section Includes:**

1. Roof mounted air conditioning units.
2. Roof mounted heat pump units.
3. Heating and ventilating units.
4. Split system heat pump units.
5. Split system air conditioning units.
6. Variable Refrigerant Flow - Split system heat pump units.
7. High efficiency furnace units.
8. Air cooled condensing units.
9. Cooling coils.
10. Refrigerant piping and fittings.
11. Electric radiant ceiling panels.
12. Fans.
13. Kitchen exhaust hood – type 1.
14. Kitchen exhaust hood – type 2.
15. Kiln exhaust hood system.
16. Welding exhaust system.
17. Relief and intake vents.
18. Louvers.
19. Air inlets and outlets.
20. Terminal Units.
21. Filters.
22. Dampers.
23. Ductwork.
24. Hydronic Piping.
25. Hydronic pumps.
26. Hydronic Piping Specialties.
27. Expansion loops.
28. Valves.
29. Valve boxes.
30. Insulation.
31. Thermal hanger shield inserts.

**1.02 RELATED REQUIREMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 23 00 50, Basic HVAC Materials and Methods.

C. Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

D. Section 23 09 23, Energy Management Control System.

#### 1.03 ADMINISTRATIVE REQUIREMENTS

##### A. Preinstallation Meetings:

1. Variable Refrigerant Flow System Conference: Installing contractor's foreman shall attend conference at Project site with design Engineer and equipment manufacturer's representative, to comply with requirements of this Section and manufacturer's installation requirements including but not limited to, the following:
  - a. Proposed deviations from system as shown and described in Contract Documents, including location of system components and impacts to refrigerant pipe sizing.
    - 1) Provide Coordinated Layouts as required by this Section for use in discussion.
  - b. Refrigerant piping assembly practices.
  - c. General discussion, question and answer period.
  - d. Walk site with equipment manufacturer's representative to identify conditions affecting installation of system as designed.

#### 1.04 ACTION SUBMITTALS

- A. For additional requirements, refer to Section 23 00 50, Basic HVAC Materials and Methods.
- B. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, dimensions, weight, corner or mounting point weights, furnished specialties and accessories; and installation and start-up instructions. Product data shall include applicable product listings and standards. Refer to Section 23 00 50, Basic HVAC Material and Methods for additional requirements.
  1. Upon approval of submittal, provide manufacturer's installation and operating instructions to the Project inspector for the following:
    - a. Fire dampers, smoke dampers, and combination smoke-fire dampers.
    - b. Type 1 kitchen exhaust field applied grease duct enclosures.
- C. VRF Systems: Submit system documentation for a fully engineered system, including shop drawings, and wiring and control diagrams, showing location of required manufactured system components, component model numbers and capacities, and size and location of all field-installed components, including piping, required seismic and thermal expansion loops, and wiring. Identify proposed deviations from system as shown in Contract Documents.
- D. Engineering Data: Submit fan curves and sound power level data for each fan unit. Data shall be at the scheduled capacity. Data shall include the name of the rating agency or independent laboratory.

**1.05 INFORMATIONAL SUBMITTALS**

- A. For additional requirements, refer to Section 23 00 50, Basic HVAC Materials and Methods.
- B. Roof Curb Data: For roof mounted equipment where combined weight of equipment unit and roof curb or rail exceeds 400 pounds, submit calculations from manufacturer for roof curbs proving compliance with the seismic requirements of the California Building Code, and ASCE 7-10. Manufacturer shall certify that roof curbs are suitable for use indicated on Drawings and in Specifications for the seismic design category indicated in structural Contract Documents. Calculations shall be stamped and signed by a State of California registered structural engineer.
- C. Economizer Fault Detection and Diagnostics (FDD) System Data: For all air-cooled unitary direct-expansion units equipped with an economizer, provide data for third-party supplied California Energy Commission certified FDD controller, documenting compliance with the requirements of California Building Energy Efficiency Standards. Provide evidence of certification.
- D. Record of pre-installation meeting.
- E. Training Certificates of Completion: Submit certificate from equipment manufacturer, indicating attendance and successful completion of manufacturer's training program for variable refrigerant flow systems installation and service. Training shall include manufacturer's preferred methods for assembling and insulating refrigerant piping and accessories.
- F. Coordinated Layouts: Submit coordinated layouts. For requirements refer to article, Coordinated Layouts, in this Section.

**1.06 CLOSEOUT SUBMITTALS**

- A. For additional requirements, refer to Section 23 00 50, Basic HVAC Materials and Methods.
- B. Maintenance Data: Submit maintenance data and parts list for each piece of equipment, control, and accessory; including "trouble-shooting guide," in Operation and Maintenance Manual.
- C. Record Drawings: Submit Record Drawings of installed ductwork, duct accessories, and outlets and inlets in accordance with requirements of Division 01.

**1.07 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Belts: One set(s) for each belt-driven unit.
  - 2. Provide one complete set(s) of MERV-13 filters for each 4" filter bank.

**1.08 COORDINATED LAYOUT**

- A. Coordinated layouts are required to amplify, expand and coordinate the information contained in the Contract Documents.



- B. Provide minimum 1/4 inch equals one foot scaled coordinated layout drawings showing plan and pertinent section or elevation views of piping, ductwork, equipment, accessories, and electrical systems. Drawings shall be reproducible and work of each trade represented shall be fully coordinated with structure, other disciplines, and finished surfaces. Drawings shall be presented on a single size sheet. Coordinated layout drawings shall have title block, key plan, north arrow and sufficient grid lines to provide cross-reference to design Drawings.
1. Provide a stamp or title block on each drawing with locations for signatures from all contractors involved, including but not limited to the General, HVAC, Plumbing, Fire Protection, and Electrical contractors. Include statement for signature that the contractor has reviewed the coordinated layout drawings in detail and has coordinated the work of his trade.
  2. Show on drawings the intended elevation of all ductwork in accordance with the following example:
    - a. B.O.D. = 9'-0"  
OFFSET UP 6"  
B.O.D. = 9'-6"
  3. Highlight, encircle or otherwise indicate deviations from the Contract Documents on the coordinated layouts. Architect will not be responsible for identifying deviations from the original Contract Documents.
- C. Since scale of contract drawings is small and all offsets and fittings are not shown, Contractor shall make allowances in bid for additional coordination time, detailing, fittings, offsets, hangers and the like to achieve a fully coordinated installation. If changes in duct size are required, equivalent area shall be maintained and the aspect ratio shall not be in excess of 2 to 1 unless approved by the engineer. Drawings shall be submitted for review prior to fabrication and installation. Drawings may be submitted in packages representing at least one quarter of the building ductwork.
- D. Check routing on all ductwork before fabricating. Report any discrepancies to Architect. No extra cost will be allowed for failure to conform to above.

#### 1.09 QUALITY ASSURANCE

A. Design Criteria:

1. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture.
  2. Supply all equipment and accessories in accordance with requirements of applicable national, state and local codes.
  3. All items of a given type shall be products of the same manufacturer.
  4. Scheduled equipment performance is minimum capacity required.
  5. Scheduled electrical capacity shall be considered as maximum available.
- B. Pump types and sizes regulated by the US Department of Energy's "Energy Conservation Standards for Pumps" 10 CRF Parts 429 and 431 shall be marked with a compliant  $PEI_{CL}$  or  $PEI_{VL}$  (Pump Energy Index, constant or variable load) value, basic model number, and RPM on the nameplate. Regulated pumps shall be listed in the Hydraulic Institute (HI) Energy Rating database ([er.pumps.org](http://er.pumps.org)) and be assigned an Energy Rating as defined in the HI 40.5 program guide.

- C. Variable Refrigerant Flow Split-System Heat Pump Installer Training: Installing contractor shall have completed training in installation and service of VRF system, by equipment manufacturer.
  - 1. Installing contractor shall obtain, at his own cost, equipment manufacturer's VRF system service tool, unless service tool is normally resident on controller specified for this Project.

#### 1.10 FIELD CONDITIONS

- A. Interruption of Existing Services: Do not interrupt services to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary services according to requirements indicated:
  - 1. Notify Architect no fewer than two days in advance of proposed interruption of services.
  - 2. Do not interrupt services without Architect's written permission.

#### 1.11 WARRANTY

- A. Air Conditioning Unit, Roof-Mounted:
  - 1. Compressor shall have a five-year warranty.
  - 2. Standard heat exchanger shall have a ten-year warranty.
- B. Heat Pump Unit, Roof-Mounted: Compressor shall have a five-year warranty.
- C. Heating and Ventilating Unit: Heat exchanger shall have minimum 10-year warranty.
- D. High Efficiency Furnace Unit:
  - 1. Heat exchangers shall have a 20-year warranty.
  - 2. Entire unit shall have a 5-year warranty.
- E. Air Cooled Condensing Unit: Unit shall have 5-year limited compressor warranty.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS

- A. Insulation products, including insulation, insulation facings, jackets, adhesives, sealants and coatings shall not contain polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations in amounts greater than 0.1 percent (by mass).

#### 2.02 AIR CONDITIONING UNIT, ROOF-MOUNTED

- A. Provide factory assembled single packaged outdoor rooftop mounted, electrically controlled gas heating and electric cooling unit, rated in accordance with ARI Standards 210/240 or 340/360, and ETL or UL listed and labeled, classified in accordance with UL 1995. Provide refrigerant charge R-410A, all internal wiring, piping, controls, and special features required prior to field startup. Design unit to conform to the following:
  - 1. California NOx emission requirements.
  - 2. ASHRAE 15.

3. ASHRAE 90.1.
  4. Insulation, adhesive, and all materials exposed to air stream shall meet NFPA 90A requirements for flame spread and smoke generation.
  5. Unit casing shall be capable of withstanding 500-hour salt spray exposure per ASTM B117 (scribed specimen).
- B. Unit shall be rated in accordance with ARI sound standards 270 or 370.
- C. Unit shall be ETL or UL tested and certified in accordance with ANSI Z21.47 Standards as a total package.
- D. Roof curb shall be designed to conform to NRCA Standards.
- E. Unit shall be designed and manufactured in accordance with ISO 9001.
- F. For unit sizes applicable to Energy Star program, units shall be Energy Star qualified.
- G. Cabinet:
1. Provide galvanized steel unit cabinet, bonderized and coated with a baked enamel finish.
  2. All airstream interior surfaces shall be insulated with a minimum 1/2 inch thick, 1.5 lb density cleanable insulation. Insulation shall be encapsulated with panel design or have sealed edges.
  3. Cabinet panels shall be hinged with integrated non-corrosive hinges. Provide hinged access panels for the filter, compressors, evaporator fan, and control box/ heat section areas. Each panel shall have multiple latches and handles. Each external hinged access panel shall be permanently attached to the rooftop unit.
  4. Return air filters shall be accessible through a dedicated hinged access panel.
  5. Fork lift slots and rigging holes shall be provided in unit base rails. Base rails shall be minimum 16 gauge.
  6. Unit shall have an integral sloped condensate drain pan, providing minimum 3/4 in.-14 NPT connections for horizontal drain configuration. Provide unit with alternate vertical thru-the-bottom drain connection when furnished as standard for units sizes scheduled on Drawings. See Drawings for drain configuration. Pan shall be removable for cleaning and maintenance. All drain pans shall conform to ASHRAE 62.1 self-draining provisions.
  7. Unit shall have standard side and alternate field or factory installed thru-the-bottom power and control wiring connection capability. Thru-the-bottom electrical connections shall use manufacturer's approved water-tight connection method.
  8. Unit shall be field convertible to, or factory furnished with, horizontal air discharge, as applicable for unit sizes as scheduled on Drawings.
- H. Fans:
1. Centrifugal supply air blower (evaporator fan) shall have sealed, permanently lubricated ball bearings, or rigid pillow block bearings, as supplied as standard equipment for unit sizes scheduled on Drawings. Units supplied with pillow block bearings shall be furnished with accessible lubricant fittings. Provide belt-driven double inlet fan wheel, centrifugal type with forward curved blades and adjustable sheaves. Multiple speed direct drive motors may be utilized when supplied as standard equipment for efficiency and electrical requirements as

scheduled on the Drawings. Fan wheel shall be steel, with corrosion resistant finish, dynamically balanced.

2. Condenser fans shall be of the direct-driven propeller type, with corrosion-resistant aluminum blades. Fans shall be dynamically balanced and discharge air upwards. Induced-draft blower shall be of the direct-driven, single inlet, forward-curved, centrifugal type, made from aluminized steel with a corrosion-resistant finish and shall be dynamically balanced.
3. Induced draft fan shall be of the direct driven, single inlet, forward-curved centrifugal type. Fan wheel shall be steel, with corrosion resistant finish, dynamically balanced.

I. Motors:

1. Compressor motors shall be cooled by refrigerant gas passing through motor windings and shall have line break thermal and current overload protection.
2. Evaporator fan motor shall have permanently lubricated, sealed bearings and inherent automatic-reset thermal overload protection or manual reset calibrated circuit breakers.
3. Totally enclosed condenser-fan motor shall have permanently lubricated, sealed bearings, and inherent automatic-reset thermal overload protection.
4. Induced-draft motor shall have permanently lubricated sealed bearings and inherent automatic-reset thermal overload protection.
5. For single-phase fan motors sized larger than 1/12 hp and smaller than 1 hp, refer to Article, Electric Motors, in Section 23 00 50, Basic HVAC Materials and Methods.

J. Compressor:

1. Fully hermetic, scroll type with internal high-pressure and temperature protection.
2. Factory installed rubber shock mounted and internally spring mounted for vibration isolation.
3. Compressor Anti-Recycle Timer: Compressor shall be prevented from restarting for a minimum of five minutes after shutdown, with manufacturers installed compressor cycle delay.

K. Coils:

1. Standard evaporator and condenser coils shall have aluminum plate fins mechanically bonded to seamless internally finned copper tubes with all joints brazed.
2. Units shall have face-split type evaporator coils.
3. For units with single compressor, condenser coils shall be single slab, single pass design. For dual compressor units, condenser coils shall be single slab, 2 pass design.
4. Evaporator coils shall be leak tested at minimum 150 psig, and pressure tested at minimum 450 psig.
5. Condenser coils shall be leak tested at minimum 150 psig, and pressure tested at minimum 650 psig.

L. Heating Section:

1. Induced-draft combustion type with direct-spark ignition system and redundant main gas valve with 2-stage capability on all 3-phase units.
2. Heat Exchanger:
  - a. The standard aluminized heat exchanger shall be of the tubular-section type constructed of minimum 20-gage aluminized steel.

3. Burners shall be of the in-shot type constructed of aluminum-coated steel.
4. All gas piping shall enter the unit at a single location. Gas entry shall be through side or bottom of unit. See Drawings for gas entry location. When bottom gas entry is utilized, unit shall be furnished with field installed conversion kit, arranged so that gas shut-off valve is accessible from the roof.
5. All factory-installed orifices are for operation up to 2,000 feet of altitude. For altitudes between 2,000 feet and 7,000 feet, a factory certified kit shall be furnished for field installation.
6. Units shall be suitable for use with natural gas or propane. Provide field-installed propane conversion kit as required, see schedule on Drawings.
7. The integrated gas controller board shall include gas heat operation fault notification using an LED (light-emitting diode).
8. Unit shall be equipped with anti-cycle protection with one short cycle on unit flame rollout switch or 4 continuous short cycles on the high-temperature limit switch. Fault indication shall be made using an LED.
9. The integrated gas controller board shall contain algorithms that modify evaporator-fan operation to prevent future cycling on high-temperature limit switch.
10. The LED shall be visible without removal of control box access panel.
11. Gas burner tray shall be removable for maintenance.
12. Heating section shall be insulated with foil-faced fiberglass insulation.

M. Refrigerant Components:

1. Each refrigerant circuit shall include:
  - a. Balanced port thermostatic expansion valve (TXV) with removable power element.
  - b. Solid core refrigerant filter driers with pressure ports.
  - c. Refrigerant pressure gage ports and connections on suction, discharge, and liquid lines.

N. Filter Section:

1. Standard filter section shall accommodate 4 inch deep filters. Filters shall conform to the "Air Filters" Article in this Specification Section.
2. Filter section shall use standard size filters.

O. Controls:

1. Unit shall be complete with self-contained low voltage fuse protected control circuit. Refer to Section 25 50 00, if included, and equipment schedule, sequence of operation and control diagram on Drawings for additional requirements.
2. When third party direct digital controls with an Energy Management System will be utilized, provide electro-mechanical controls with 24V thermostat interface.
3. When stand-alone thermostat operation is utilized, provide electro-mechanical controls with 24V thermostat interface or provide microprocessor controls.
4. When stand-alone thermostat operation is utilized for single-zone VAV units, provide microprocessor controls. Units shall have factory mounted supply fan variable frequency drives.
5. When third party direct digital controls with an Energy Management System will be utilized for single zone VAV units, provide microprocessor controls with BACnet or LON interface. Units shall have factory mounted supply fan variable frequency drives.
6. Electro-mechanical controls shall include the following, as a minimum:

- a. Service run test capability.
- b. Provide compressor minimum run time (3 minutes) and minimum off time (5 minutes).
- c. Economizer control.
- d. Unit shall have 35° F low ambient cooling operation.
- e. Time delay relay.

7. Microprocessor controls shall include the following, as a minimum:

- a. User diagnostic interface.
- b. Unit control with standard suction pressure transducers and condensing temperature thermistors.
- c. Shall provide a 5° F temperature difference between cooling and heating set points to meet ASHRAE 90.1 energy standard.
- d. Service run test capability.
- e. Shall accept input from a CO2 sensor (indoor).
- f. Configurable alarm light shall be provided which activates when certain types of alarms occur.
- g. Provide compressor minimum run time (3 minutes) and minimum off time (5 minutes).
- h. Service diagnostic mode.
- i. Economizer control.
- j. Unit shall have 0° F low ambient cooling operation.
- k. Time delay relay.

P. Safeties:

- 1. Unit shall incorporate a solid-state compressor lockout that provides optional reset capability at the space thermostat, should any of the following safety devices trip and shut off compressor:
  - a. Compressor lockout protection provided for either internal or external overload.
  - b. Low-pressure protection.
  - c. Freeze protection (evaporator coil).
  - d. High-pressure protection (high pressure switch or internal).
  - e. Compressor reverse rotation protection.
  - f. Loss of charge protection.
  - g. Start assist on single-phase units.
- 2. Supply-air sensor shall be located in the unit and detect both heating and cooling operation.
- 3. Induced draft heating section shall be provided with the following minimum protections:
  - a. High-temperature limit switch.
  - b. Induced-draft motor speed sensor.
  - c. Flame rollout switch.
  - d. Flame proving controls.
  - e. Redundant gas valve.
- 4. Phase Protection: Provide unit-mounted "SymCom," or equal, Motor Saver three phase voltage monitor, model 201A or equal, adjustable voltage range for each unit, install per manufacturer's recommendations, mount in NEMA 3R enclosure if exposed to the weather.

a. Units shall provide the following features:

- 1) Low voltage fault trip and reset.
- 2) Voltage unbalance/phasing fault trip and reset.
- 3) High voltage fault trip and reset.
- 4) Transient Protection (Internal).
- 5) Automatic restart.

b. Provide each unit with 600V socket, "SymCom" model OT08, or equal.

Q. Operating Characteristics:

1. Unit shall be capable of starting and running at 125° F ambient outdoor temperature per maximum load criteria of ARI Standards 210 or 360.
2. Unit will operate in cooling down to an outdoor ambient temperature of 35° F.
3. Unit shall be provided with fan time delay to prevent cold air delivery in heating mode.

R. Electrical Requirements:

1. All unit power wiring shall enter unit cabinet at a single location. Both unit side and bottom power entry provisions shall be provided. Refer to Drawings schedule for thru-the-bottom power wiring requirement.

S. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

1. Carrier Corporation.
2. York, Johnson Controls, Inc.
3. Lennox
4. AAON

T. Provide the following additional features and equipment:

1. Roof Curb: Formed galvanized steel with wood nailer strip capable of supporting entire unit weight. Provide 3 inch wide bottom flange.
2. Provide heavy-duty 18 gauge expanded metal coil guard grille to protect all surfaces of the condensing coil. Coil guard by Micrometl, Canfab, or equal.
3. Modulating Power Exhaust Economizer: Micrometl, Canfab, or equal. Integrated type capable of simultaneous economizer and compressor operation.
  - a. Provide self-contained outdoor rooftop system, mounted directly to the return air compartment of the HVAC packaged equipment. Provide differential dry bulb economizer control system and a factory programmed, fully programmable variable frequency drive package controlled by a differential pressure transmitter, mounted directly to the return air compartment of the HVAC packaged equipment. Design the system to continuously maintain space pressure, and provide capability of introducing up to 100 percent outdoor air.

- 1) Economizer control system shall be certified as meeting the requirements for Fault Detection and Diagnostics (FDD) in the California Building Energy and Efficiency Standards.
- b. Provide outside differential pressure tubing termination with hex style pneumatic filter-muffler, minimum filtration 40 microns, 53 SCFM maximum at 100 psi, as manufactured by McMaster-Carr, or equal.
- c. Provide hinged cabinet access doors and include latches to provide a tool-less entry for servicing.
- d. Provide door lock on the power exhaust cabinet to meet ETL safety requirements.
- e. Outdoor air intake dampers shall be low leak not to exceed 3 percent at 1 inch wg pressure differential and include stainless steel side seal and neoprene edge seal. Arrange dampers to close upon loss of power.
- f. Provide belt driven exhaust blowers, double inlet, forward-curved centrifugal type. Provide gravity backdraft damper at fan outlet.
- g. Provide fully programmable factory programmed variable frequency drive (VFD) package for each fan, driven by 4 to 20 mA signal from a differential pressure transmitter. Pressure transmitters shall measure 0 - 0.1 in wg. Install room sensor tubing with sensor tube termination installed within the room.
- 1) Where direct digital controls are utilized, provide Belimo, or equal, damper actuator, complete with spring return and all controls required to make the system fully operational.
- 2) Where stand-alone controls are utilized, provide Belimo, or equal, damper actuator, complete with spring return and all controls, including logic module, required to make the system fully operational.
4. Gas Flue Extensions:
  - a. Provide at all locations where gas flue outlet will be within 10 feet of an adjacent building forced air inlet, or mechanical unit air intake, and where indicated on Drawings.
5. Other features, accessories, and equipment scheduled on Drawings.
- U. Replenish for a period of one year without cost to the Owner all refrigerant and oil required to maintain the proper levels.
- V. Owner Training: Manufacturer shall provide two initial on-site 4-hour training sessions for Owners' maintenance personnel. Manufacturer shall provide one 4-hour follow-up training session to be scheduled by Owner within one year of the date of the final initial training session. Training session agenda shall be as follows:
  1. First session: Equipment.
  2. Second session: Controls.
  3. Follow-up session: Agenda by Owner.



**2.03 HEAT PUMP UNIT, ROOF-MOUNTED**

- A. Provide factory assembled single packaged outdoor rooftop mounted, electrically controlled electric cooling and heating unit, rated in accordance with ARI Standards 210/240 or 340/360, and ETL or UL listed and labeled, classified in accordance with UL 1995. Provide refrigerant charge R-410A, all internal wiring, piping, controls, and special features required prior to field startup. Design unit to conform to the following:
  - 1. ASHRAE 15.
  - 2. ASHRAE 90.1.
  - 3. Insulation, adhesive, and all materials exposed to air stream shall meet NFPA 90A requirements for flame spread and smoke generation.
  - 4. Unit casing shall be capable of withstanding 500-hour salt spray exposure per ASTM B117 (scribed specimen).
- B. Unit shall be rated in accordance with ARI sound standards 270.
- C. Unit shall be ETL or UL tested and certified in accordance with ANSI Z21.47 Standards as a total package.
- D. Roof curb shall be designed to conform to NRCA Standards.
- E. Unit shall be manufactured in a facility registered to ISO 9001:2000.
- F. Unit shall be Energy Star qualified.
- G. Cabinet:
  - 1. Provide galvanized steel unit cabinet, bonderized and coated with a baked enamel finish.
  - 2. All airstream interior surfaces shall be insulated with a minimum 1/2 inch thick, 1 lb density cleanable insulation. Heat compartment for optional electric heater shall be insulated with minimum 1/2 inch thick, 1 lb. density foil-faced insulation.
  - 3. Cabinet panels shall be removable. Provide access panels for the filter, compressors, evaporator fan, and control box. Each external hinged access panel shall be insulated, with insulation encapsulated with panel or with sealed edges.
  - 4. Return air filters shall be accessible through a dedicated tool-less removable access panel.
  - 5. Fork lift slots shall be provided in unit base rail. Base rail shall be minimum 16 gauge.
  - 6. Unit shall have a factory-installed internally sloped condensate drain pan, providing minimum 3/4 inch-14 NPT connections for both horizontal and alternate vertical drain configuration. See Drawings for drain configuration. Pan shall be removable for cleaning and maintenance. All drain pans shall conform to ASHRAE 62.1 self-draining provisions.
  - 7. Unit shall have standard side and alternate field or factory installed thru-the-bottom power and control wiring connection capability.
  - 8. Unit shall be field or factory convertible to horizontal air discharge.
- H. Fans:
  - 1. Centrifugal supply air blower (evaporator fan) shall have permanently lubricated bearings. Provide belt-driven double inlet fan wheel, centrifugal type with forward curved blades and

adjustable sheaves. Fan wheel shall be steel, with corrosion resistant finish, dynamically balanced.

2. Evaporator-fan motors shall be continuous operation, open drip-proof, and thermally protected. Bearings shall be sealed, permanently lubricated ball-bearing type.
3. Condenser fans shall be of the direct-driven propeller type, with corrosion-resistant aluminum blades. Fans shall be dynamically balanced and discharge air upwards. Condenser-fan motors shall be totally enclosed and thermally protected.

I. Compressor:

1. Fully hermetic, scroll type with internal high-pressure and temperature protection. Furnish with crankcase heater when normally supplied as standard equipment for model size scheduled on Drawings.
2. Factory installed rubber shock mounted and internally spring mounted for vibration isolation.
3. Compressor Anti-Recycle Timer: Compressor shall be prevented from restarting for a minimum of five minutes after shutdown, with manufacturers installed compressor cycle delay.

J. Coils:

1. Standard evaporator and condenser coils shall have aluminum plate fins mechanically bonded to seamless internally finned copper tubes with all joints brazed.
2. Condenser coils shall be single slab, single pass design. Single slab, 2 pass design may be utilized when supplied as standard equipment for unit size as scheduled on the Drawings.
3. Coils shall be leak tested at minimum 150 psig and pressure tested at minimum 450 psig.

K. Refrigerant Components:

1. Each refrigerant circuit shall include:
  - a. Fixed orifice metering device.
  - b. Solid core refrigerant filter driers with pressure ports.
  - c. Refrigerant pressure gage ports and connections on suction, and discharge lines.
  - d. Suction line accumulator.
  - e. Reversing valve.

L. Filter Section:

1. Standard filter section shall accommodate 4 inch deep filters. Filters shall conform to the "Air Filters" Article in this Specification Section.
2. Filter section shall use standard size filters.

M. Controls:

1. Unit shall be complete with self-contained low voltage fuse protected control circuit. Refer to Section 25 50 00, if included, and equipment schedule, sequence of operation and control diagram on Drawings for additional requirements.
2. When third party direct digital controls with an Energy Management System will be utilized, provide electro-mechanical controls with 24V thermostat interface.

3. When stand-alone thermostat operation is utilized, provide electro-mechanical controls with 24V thermostat interface or provide microprocessor controls.
4. When stand-alone thermostat operation is utilized for single-zone VAV units, provide microprocessor controls. Units shall have factory mounted supply fan variable frequency drives.
5. When third party direct digital controls with an Energy Management System will be utilized for single zone VAV units, provide microprocessor controls with BACnet or LON interface. Units shall have factory mounted supply fan variable frequency drives.
6. Electro-mechanical controls shall include the following, as a minimum:
  - a. Provide compressor minimum off time (5 minutes).
  - b. Economizer control.
  - c. Time delay relay.
  - d. Integrated adjustable defrost cycle.
7. Microprocessor controls shall be ASHRAE 62.1 compliant and include the following, as a minimum:
  - a. User diagnostic interface.
  - b. Unit control with standard suction pressure transducers and condensing temperature thermistors.
  - c. Shall provide a 5° F temperature difference between cooling and heating set points to meet ASHRAE 90.1 Energy Standard.
  - d. Service run test capability.
  - e. Shall accept input from a CO2 sensor (indoor) and provide demand ventilation control.
  - f. Provide compressor minimum off time (5 minutes).
  - g. Service diagnostic mode.
  - h. Economizer control.
  - i. Time delay relay.
  - j. Integrated adjustable defrost cycle.

N. Safeties:

1. Unit shall incorporate a solid-state compressor lockout that provides optional reset capability at the space thermostat, should any of the following safety devices trip and shut off compressor:
  - a. Compressor lockout protection provided for either internal or external overload.
  - b. Low-pressure protection.
  - c. Freeze protection (evaporator coil).
  - d. High-pressure protection (high pressure switch or internal).
  - e. Compressor reverse rotation protection.
  - f. Loss of charge protection.
  - g. Start assist on single-phase units.
2. Supply-air sensor shall be located in the unit and detect both heating and cooling operation.
3. Phase Protection: Provide unit-mounted "SymCom," or equal, Motor Saver three phase voltage monitor, model 201A or equal, adjustable voltage range for each unit, install per manufacturer's recommendations, mount in NEMA 3R enclosure if exposed to the weather.
  - a. Units shall provide the following features:

- 1) Low voltage fault trip and reset.
- 2) Voltage unbalance/phasing fault trip and reset.
- 3) High voltage fault trip and reset.
- 4) Transient Protection (Internal).
- 5) Automatic restart.

b. Provide each unit with 600V socket, "SymCom" model OT08, or equal.

O. Operating Characteristics:

1. Unit shall be capable of starting and running at 115° F ambient outdoor temperature per maximum load criteria of ARI Standards 210/240 or 340/360.
2. Unit with microprocessor or electro-mechanical controls shall operate in cooling down to an outdoor ambient temperature of 25° F.
3. Unit shall be provided with fan time delay to prevent cold air delivery in heating mode.

P. Electrical Requirements:

1. All unit power wiring shall enter unit cabinet at a single location. Both unit side and bottom power entry provisions shall be provided. Refer to Drawings schedule for thru-the-bottom power wiring requirement.

Q. Motors:

1. Compressor motors shall be cooled by refrigerant gas passing through motor windings and shall have line break thermal and current overload protection.
2. Evaporator fan motor shall have permanently lubricated, sealed bearings and inherent automatic-reset thermal overload protection or manual reset calibrated circuit breakers.
3. Totally enclosed condenser-fan motor shall have permanently lubricated, sealed bearings, and inherent automatic-reset thermal overload protection.
4. For single-phase fan motors sized larger than 1/12 hp and smaller than 1 hp, refer to Article, Electric Motors, in Section 23 00 50, Basic HVAC Materials and Methods.

R. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

1. Carrier Corporation.
2. York – Johnson Controls
3. Lennox
4. AAON

S. Provide the following additional features and equipment:

1. Roof Curb: formed galvanized steel with wood nailer strip capable of supporting entire unit weight. Provide 3 inch wide bottom flange.
2. Provide heavy-duty 18 gauge expanded metal coil guard grille to protect all surfaces of the condensing coil. Coil guard to be Micrometl, Canfab, or equal.
3. Modulating Power Exhaust Economizer: Micrometl, Canfab, or equal. Integrated type capable of simultaneous economizer and compressor operation.

- a. Provide self-contained outdoor rooftop system, mounted directly to the return air compartment of the HVAC packaged equipment. Provide differential dry bulb economizer control system and a factory programmed, fully programmable variable frequency drive package controlled by a differential pressure transmitter, mounted directly to the return air compartment of the HVAC packaged equipment. Design the system to continuously maintain space pressure, and provide capability of introducing up to 100 percent outdoor air.
  - 1) Economizer control system shall be certified as meeting the requirements for Fault Detection and Diagnostics (FDD) in the California Building Energy and Efficiency Standards.
- b. Provide outside differential pressure tubing termination with hex style pneumatic filter-muffler, minimum filtration 40 microns, 53 SCFM maximum at 100 psi, as manufactured by McMaster-Carr, or equal.
- c. Provide hinged cabinet access doors and include latches to provide a tool-less entry for servicing.
- d. Provide door lock on the power exhaust cabinet to meet ETL safety requirements.
- e. Outdoor air intake dampers shall be low leak not to exceed 3 percent at 1 inch wg pressure differential and include stainless steel side seal and neoprene edge seal. Arrange dampers to close upon loss of power.
- f. Provide belt driven exhaust blowers, double inlet, forward-curved centrifugal type. Provide gravity backdraft damper at fan outlet.
- g. Provide fully programmable factory programmed variable frequency drive (VFD) package for each fan, driven by 4 to 20 mA signal from a differential pressure transmitter. Pressure transmitters shall measure 0 - 0.1 in wg. Install room sensor tubing with sensor tube termination installed within the room.
  - 1) Where direct digital controls are utilized, provide Belimo, or equal, damper actuator, complete with spring return and all controls required to make the system fully operational.
  - 2) Where stand-alone controls are utilized, provide Belimo, or equal, damper actuator, complete with spring return and all controls, including logic module, required to make the system fully operational.
- T. Replenish for a period of one year without cost to the Owner all refrigerant and oil required to maintain the proper levels.
- U. Owner Training: Manufacturer shall provide two initial on-site 4-hour training sessions for Owners' maintenance personnel. Manufacturer shall provide one 4-hour follow-up training session to be scheduled by Owner within one year of the date of the final initial training session. Training session agenda shall be as follows:
  - 1. First session: Equipment.
  - 2. Second session: Controls.
  - 3. Follow-up session: Agenda by Owner.

## 2.04 SPLIT SYSTEM HEAT PUMPS

- A. General: Furnish and install split system air-to-air heat pump system, with R410A refrigerant, and complete with automatic controls. Equipment shall be shipped factory assembled, wired, tested, and ready for field connections.
- B. Quality Assurance:
  - 1. Unit shall be ETL or UL listed and labeled.
  - 2. Unit shall be manufactured in a facility registered to ISO 9001:2000.
  - 3. Unit shall be rated in accordance with ARI standard 210.
- C. Delivery, Storage and Handling: Follow manufacturer's recommendations.
- D. Heating/Cooling System: The total certified heating/cooling capacity shall not be less than scheduled. The compressor power input shall not exceed that of the unit specified.
- E. Indoor Section: Wall mounted, ceiling surface mounted, or ceiling recessed mounted, as indicated on Drawings.
  - 1. Cabinet:
    - a. Wall mounted: Molded white high strength plastic.
      - 1) Provide wall mounted unit with factory mounting plate.
    - b. Ceiling surface mounted: Molded white high strength plastic with provision for outside air duct connection.
    - c. Ceiling recessed mounted: galvanized steel with provision for outside air duct connection.
  - 2. Fans: Double inlet, forward curved, statically and dynamically balanced.
  - 3. Fan Motor: Direct drive, permanently lubricated, with two or 4 speed operation for unit size scheduled on Drawings.
    - a. For single-phase fan motors sized larger than 1/12 hp and smaller than 1 hp, refer to Article, Electric Motors, in Section 23 00 50, Basic HVAC Materials and Methods.
  - 4. Air Outlet: With motorized horizontal and vertical vanes.
    - a. Wall and ceiling surface mounted units: Horizontal vane shall close air outlet upon unit shut-down.
  - 5. Evaporator Coil: Aluminum fins mechanically bonded to copper tubes. Coils shall be pressure leak tested.
  - 6. Insulation: Interior surfaces exposed to the airstream shall be fully insulated.
- F. Outdoor Section:
  - 1. Casing: Galvanized steel plate, powder coated with acrylic or polyester.
  - 2. Condenser Fan Grille: ABS plastic.

3. Fan and fan motor: Direct drive, totally enclosed, propeller type, permanently lubricated, horizontal discharge.
  4. Compressor: Variable speed rotary type, with crankcase heater and accumulator. Compressor shall be capable of operating at 0 degrees F. Compressor mounted on vibration isolator pads.
  5. Coil: Aluminum fins mechanically bonded to copper tubes. Coils shall be pressure leak tested. Provide coil with integral metal guard.
- G. Controls: Hard wired, microprocessor based, wall mounted controller with LCD display shall provide the following functions, as a minimum:
1. 7-day programmable timer.
  2. Test and check functions.
  3. Diagnostic functions.
  4. Vane position control.
  5. Fan speed adjustment.
  6. Temperature adjustment.
  7. Automatic restart.
  8. Mode selection, including heat/auto/cool/dry/fan.
- a. Provide lockable enclosure for wall mounted controller.
- H. Safeties: Shall include the following, as a minimum:
1. Five minute compressor anti-recycle timer.
  2. High pressure protection.
  3. Current and temperature sensing motor overload protection.
- I. Filters: Provide manufacturers washable filters for indoor unit. Provide sufficient filters for four complete changes for each unit.
- J. Service Access: All components, wiring, and inspection areas shall be completely accessible through removable panels.
- K. Refrigerant Piping:
1. Provide factory pre-charged and sealed line set piping, length to suit the location of equipment. Tubing sizes shall be in accordance with manufacturers written instructions.
  2. Provide refrigeration piping in accordance with Article, Refrigerant Piping, in this Section.
- L. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
1. Mitsubishi Electric Corporation
  2. Carrier / Toshiba Corporation.
  3. Daikin
- M. Owner Training: Manufacturer shall provide one on-site 2-hour training session for Owners' maintenance personnel.

**2.05 SPLIT SYSTEM AC UNIT**

- A. General: Furnish and install split system air conditioner, with R410A refrigerant, and complete with automatic controls. Equipment shall be shipped factory assembled, wired, tested, and ready for field connections.
- B. Quality Assurance:
  - 1. Unit shall be ETL or UL listed and labeled.
  - 2. Unit shall be manufactured in a facility registered to ISO 9001:2000.
  - 3. Unit shall be rated in accordance with ARI standard 210.
- C. Delivery, Storage and Handling: Follow manufacturer's recommendations.
- D. Cooling System: The total certified cooling capacity shall not be less than scheduled. The compressor power input shall not exceed that of the unit specified.
- E. Indoor Section: Wall mounted, ceiling surface mounted, or ceiling recessed mounted, as indicated on Drawings.
  - 1. Cabinet:
    - a. Wall mounted: Molded white high strength plastic.
      - 1) Provide wall mounted unit with factory mounting plate.
    - b. Ceiling surface mounted: Molded white high strength plastic with provision for outside air duct connection.
    - c. Ceiling recessed mounted: galvanized steel with provision for outside air duct connection.
  - 2. Fans: Double inlet, forward curved, statically and dynamically balanced.
  - 3. Fan Motor: Direct drive, permanently lubricated, with two or 4 speed operation for unit size scheduled on Drawings.
    - a. For single-phase fan motors sized larger than 1/12 hp and smaller than 1 hp, refer to Article, Electric Motors, in Section 23 00 50, Basic HVAC Materials and Methods.
  - 4. Air Outlet: With motorized horizontal and vertical vanes.
    - a. Wall and ceiling surface mounted units: Horizontal vane shall close air outlet upon unit shut-down.
  - 5. Evaporator Coil: Aluminum fins mechanically bonded to copper tubes. Coils shall be pressure leak tested.
  - 6. Insulation: Interior surfaces exposed to the airstream shall be fully insulated.
- F. Outdoor Section:
  - 1. Casing: Galvanized steel plate, powder coated with acrylic or polyester.
  - 2. Condenser Fan Grille: ABS plastic.



3. Fan and fan motor: Direct drive, totally enclosed, propeller type, permanently lubricated, horizontal discharge.
  4. Compressor: Variable speed rotary type, with crankcase heater and accumulator. Compressor shall be capable of operating at 0 degrees F. Compressor mounted on vibration isolator pads.
  5. Coil: Aluminum fins mechanically bonded to copper tubes. Coils shall be pressure leak tested. Provide coil with integral metal guard.
- G. Controls: Hard wired, microprocessor based, wall mounted controller with LCD display shall provide the following functions, as a minimum:
1. 7-day programmable timer.
  2. Test and check functions.
  3. Diagnostic functions.
  4. Vane position control.
  5. Fan speed adjustment.
  6. Temperature adjustment.
  7. Automatic restart.
  8. Mode selection, including cool/dry/fan.
- a. Provide lockable enclosure for wall mounted controller.
- H. Safeties: Shall include the following, as a minimum:
1. Five minute compressor anti-recycle timer.
  2. High pressure protection.
  3. Current and temperature sensing motor overload protection.
- I. Filters: Provide 1 inch thick fiberglass throwaway filters with cardboard holding frames for indoor unit. Provide sufficient filters for four complete changes for each unit.
- J. Service Access: All components, wiring, and inspection areas shall be completely accessible through removable panels.
- K. Refrigerant Piping:
1. Provide factory pre-charged and sealed line set piping, length to suit the location of equipment. Tubing sizes shall be in accordance with manufacturers written instructions.
  2. Provide refrigeration piping in accordance with Article, Refrigerant Piping, in this Section.
- L. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
1. Mitsubishi Electric Corporation.
  2. Carrier Corporation.
- M. Owner Training: Manufacturer shall provide one on-site 2-hour training session for Owners' maintenance personnel.

**2.06 VARIABLE REFRIGERANT FLOW - SPLIT SYSTEM HEAT PUMPS – HEAT RECOVERY TYPE**

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

1. Mitsubishi w/diamond panel integration (Basis of Design) w/BACnet integration to Johnson Controls via Diamond Panel Integration.
2. Daikin w/BACnet integration to Johnson Controls
3. Hitachi w/BACnet integration to Johnson Controls

B. Indoor Units

1. General:

- a. Galvanized steel casing.
- b. Ducted, ceiling-recessed, or in-room units per Drawings schedule. Available styles shall include:
  - 1) Concealed (ducted) units:
    - a) Horizontal/Vertical air handling unit for closet or above-ceiling installation.
    - b) Ceiling concealed.
    - c) Ceiling concealed, with high-static option.
  - 2) Recessed Units:
    - a) Ceiling-recessed units: One-, two-, and four-way throw configurations.
    - b) Floor-standing, recessed.
  - 3) In-room units:
    - a) Ceiling-suspended.
    - b) Wall-mounted.
    - c) Floor-standing.
- c. Factory assembled and tested with factory wiring, piping, expansion valve, control circuit board, and fan motor. Units shall have, as a minimum, the following functions:
  - 1) Self-diagnostic function.
  - 2) Auto restart function.
  - 3) Auto changeover function.
  - 4) Emergency operation function.
  - 5) 3-minute time delay shall provide minimum 3 minute run time for cooling and heating.
- d. Indoor unit and refrigerant pipes shall be charged with dehydrated air prior to shipment from the factory.
- e. The indoor units shall be equipped with a return air thermistor.

2. Unit Cabinet:

- a. The cabinet shall be insulated with foamed polystyrene and polyethylene insulation.

3. Fan:

- a. The fan shall be direct-drive type, statically and dynamically balanced impeller with multiple high and low fan speeds. Auto fan setting shall automatically adjust fan speed.
- b. The fan motor shall be thermally protected.
- c. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings.
- d. For single-phase fan motors sized larger than 1/12 hp and smaller than 1 hp, refer to Article, Electric Motors, in Section 23 00 50, Basic HVAC Materials and Methods.
- e. Ceiling recessed and wall-mounted units shall have motorized louvers to direct airflow in up and down directions, and manually adjusted vanes for side-to-side adjustment of airflow direction.
- f. Ceiling suspended units shall have motorized guide vanes to vary airflow direction.
- g. All units shall be provided with a condensate drain pan below the coil. Drain pans shall have primary and overflow drains.
- h. Ceiling recessed units shall have an integral condensate pump. Refer to Drawings schedule for additional condensate pump requirements.

4. Coil:

- a. Coils shall be aluminum fins bonded to internally grooved copper tubes. Fins shall have corrosion-resistant coating.
- b. The coils shall be pressure tested at the factory.
- c. Unit shall be provided with ball-type refrigerant service valves at each refrigerant piping connection.
- d. A condensate pan and drain connections shall be provided under the coil. Provide overflow cutoff switch to disable unit during overflow condition.

5. Filters:

- a. Provide indoor units manufactured to accept washable filter media with two sets for each unit.
- b. Refer to Drawings schedule, and article, Filters, in this Section for filter requirements for ducted, above-ceiling units incorporating mixing boxes.

6. Controls:

- a. Units shall have controls provided by the manufacturer to perform input functions necessary to operate the system.
- b. Operating modes shall include Auto Changeover (heat recovery systems only), Heating, Cooling, Dry, and Fan Only.
- c. Units shall be compatible with a BMS system via optional LonWorks or BACnet gateways.
- d. Units incorporating mixing boxes for economizer operation shall be furnished with economizer control system certified as meeting the requirements for Fault Detection and Diagnostics (FDD) in the California Building Energy and Efficiency Standards.

C. Outdoor Condensing Units:

1. General:

- a. Condensing unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves (when required by manufacturer), 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and refrigerant accumulator and regulator.
- b. The following safety devices shall be included as part of the condensing unit; high pressure sensor and switch, low pressure sensor, control circuit fuses, over- and under-current protection, phase failure and phase reversal protection, fusible plug or pressure relief valve, and crankcase heater..
- c. All refrigerant lines shall be individually insulated between the condensing units and indoor units. .
- d. The system will automatically restart operation after a power failure without loss of settings.
- e. The condensing units shall be modular in design and allow for side-by-side installation with minimum spacing. Provide kit for field piping between connected condensing units. Refer to Drawings schedules and diagrams for connected units.
- f. To ensure the liquid refrigerant does not flash when supplying to indoor units, the circuit shall be provided with a sub-cooling feature.
- g. Oil recovery cycle shall be automatic occurring 2 hours after start of operation, and thereafter every 8 hours of operation. Each system shall maintain continuous heating during oil return operation. Reverse cycle (cooling mode) oil return during heating operation shall not be permitted due to the potential reduction in space temperature.
- h. The condensing unit shall be capable of heating operation at 0°F dry bulb ambient temperature without additional low ambient controls or an auxiliary heat source.
  - 1) Provide condensing unit with low ambient kit when scheduled on Drawings. Low ambient kit components shall be furnished with NEMA 4x rated control box for outdoor installation.

2. Unit Cabinet:

- a. The condensing unit cabinet shall be weatherproof and corrosion resistant. The unit shall be constructed from rust-proofed galvanized steel panels coated with a baked enamel or powder coat finish.

3. Fan:

- a. The condensing unit shall consist of one or more direct-drive, vertical discharge propeller fans with blades constructed of thermoplastic polymer material.
- b. The condensing unit fan motor shall be variable-speed digitally commutating (DC) type. Fan motor dipswitch shall allow increase of external static pressure setting.
- c. The fan motor shall have inherent protection and permanently lubricated bearings and be mounted on vibration isolators.
- d. The fan motor shall be provided with a fan guard to prevent contact with moving parts.

4. Condenser Coil:

- a. Coils shall be aluminum fins bonded to internally grooved copper tubes. Fins shall have corrosion-resistant coating.
  - b. The coils shall be pressure tested at the factory.
  - c. Unit shall be provided with ball-type refrigerant service valves at each refrigerant piping connection.
  - d. Condensing unit cabinet shall be provided with metal coil guard.
5. Compressor:
- a. The scroll compressors shall be variable speed pulse-width inverter (PVM inverter) controlled type, hermetically sealed, which shall vary the compressor speed to follow fluctuations in total cooling and heating load, determined by the suction gas pressure as measured in the condensing unit.
    - 1) The inverter driven compressor motor in each condensing unit shall be the reluctance DC (digitally commutating) type.
  - b. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.
  - c. Oil separators shall be provided as part of the compressor module together with an intelligent oil management system.
  - d. The compressor shall be isolated to avoid the transmission of vibration.
  - e. In the event of compressor failure the remaining compressors shall continue to operate and provide heating or cooling as required at a proportionally reduced capacity.
  - f. Multiple compressor operation sequencing: When multiple condenser modules are combined, operation hours of each compressor shall be balanced by means of a duty cycling function, enabling sequential starting of each module at each start/stop cycle, completion of oil return, and completion of defrost, or every 8 hours.
  - g. Refrigerant shall be R410a.
- D. Indoor Heat Recovery Controllers: Two- or three-pipe refrigerant control units to match outdoor condensing unit configuration. Heat recovery units shall be installed between outdoor condensing units and indoor zone-conditioning units. Indoor heat recovery unit shall operate to remove heat from zones requiring cooling, and distribute that heat to zones requiring heating. Refer to Drawings for unit locations. Refer to Drawings schedules and details for unit configuration and electrical requirements.
- E. Refrigerant Piping:
- F. All refrigerant lines shall be individually insulated between the condensing units and indoor units.
- 1. For interconnecting piping between outdoor and indoor equipment, refer to Article, Refrigeration Pipe and Fittings, in this Section.
- G. System Controls:
- 1. General: The controls network shall be capable of supporting remote controllers, schedule timers, system controllers, centralized controllers, an integrated web based interface, graphical

- user workstation, and system integration to a Building Management Systems via BACnet® and/or LonWorks®.
2. For additional information, Refer to Section 23 09 23, Direct Digital Control System for HVAC.
  3. Programmable Local Remote Controller: The programmable local remote controller shall be capable of controlling a minimum of 16 indoor units serving a single zone, and of operation with or without a central controller. Controller shall have the following minimum functions:
    - a. On/Off.
    - b. Operating mode (cool, heat, auto, dry, and fan, depending on selected system type).
    - c. Temperature setting.
    - d. Fan speed setting.
    - e. Air swing settings.
    - f. Room temperature and humidity display.
    - g. Occupancy sensor capable.
    - h. Schedule operations.
    - i. Allow/Prohibit local remote control functions.
    - j. Unit level error code display.
    - k. Test run.
    - l. Set temperature range limit.
    - m. Override of scheduled functions for indoor unit groups.
    - n. Lock out of On/Off, Mode, Set Temp., Hold-button, and Air Direction.
  4. Centralized Controller: The controller shall support system configuration, daily/weekly scheduling, monitoring of operation status, error email notification, online maintenance tool and malfunction monitoring. The controller shall have basic operation controls which can be applied to an individual indoor unit, a group of indoor units, or all indoor units. (cool, heat, auto, dry, and fan)The central controller shall be able to enable or disable operation of local remote controllers via a PC. Controller shall have the following minimum functions:
    - a. On/Off.
    - b. Operating mode (cool, heat, auto, dry, and fan, depending on selected system type).
    - c. Temperature setting.
    - d. Fan speed setting.
    - e. Air swing settings.
    - f. Room temperature display.
    - g. Schedule operations.
    - h. Morning warm-up/cool-down.
    - i. Night setback setting.
    - j. Allow/Prohibit local remote control functions.
    - k. Unit level error code display.
    - l. External input/output.
    - m. PC data back-up.
  5. BACnet® and/or LonWorks® Gateway: Gateway to allow connection to Energy Management Systems shall allow changes to the following, as a minimum:
    - a. On/Off.
    - b. Temperature setting.

- c. Alarm.
    - d. Operating mode.
    - e. Fan speed setting.
    - f. Allow/Prohibit local remote control functions.
    - g. High/Low limit setback temperature (heat recovery systems only).
    - h. Air direction/swing settings.
  - 6. Web browser: The controls network shall allow multiple individual users to monitor and control user defined zones via a network PC web browser.
  - H. Owner Training: Manufacturer shall provide one on-site 8-hour training session for Owners' maintenance personnel. 8-hour training shall include instruction in use of equipment manufacturer's service tool.
- 2.07 HIGH EFFICIENCY FURNACE UNIT (only allowed on modernization replacement project).
- A. Provide high efficiency multiple-speed condensing furnace/blower unit for upflow, downflow or horizontal application as indicated on the Drawings. Design unit to conform to the following:
    - 1. California Air Quality Management District emission requirements.
    - 2. ANSI Z 21.47/CSA 2.3 design standard for gas-fired central furnaces.
    - 3. When installed in Classrooms use "TeamAir" Enclosures with fully lined panels, Closure Panels to match roof angles, and Sound Attenuators.
  - B. Furnace unit shall have the following certifications:
    - 1. Third party certification by CSA International to current ANSI Z 21.47/CSA 2.3 design standard for gas-fired central furnaces.
    - 2. CSA Blue Star® and Blue Flame® labeled.
    - 3. Efficiency testing per current DOE test procedure as listed in the Federal Register.
    - 4. Federal Trade Commission Energy Guide efficiency labeled.
    - 5. GAMA Consumers' Directory of Certified Efficiency Ratings listed.
  - C. Unit shall be manufactured in a facility registered to ISO 9001:2000.
  - D. Cabinet:
    - 1. Pre-painted galvanized steel, minimum .030 inches thickness.
    - 2. Acoustically insulated blower section.
    - 3. Removable bottom closure panel for bottom return air configuration.
  - E. Fans and Motors:
    - 1. Centrifugal supply air blower shall be constructed of galvanized steel, statically and dynamically balanced.
    - 2. Blower motor shall be direct drive variable speed ECM type, with sealed permanently lubricated ball bearings.
    - 3. Inducer motor shall be direct drive variable speed ECM type, with sealed permanently lubricated ball bearings.

F. Heating Section:

1. Primary heat exchanger shall be 20 gauge corrosion resistant aluminized steel of fold-and-crimp sectional design, with Monoport inshot burners and redundant gas valve.
2. Secondary heat exchanger shall be polypropylene laminated steel of fold-and-crimp design.
3. Heat exchanger section shall be insulated with foil-faced insulation.
4. Line voltage ignitor.
5. Sealed combustion system.

G. Filters:

1. Standard filter section shall accommodate 4 inch deep filters, MERV 13 filters. Filters shall conform to the "Air Filters" Article in this Specification Section.
2. When Drawings indicate contractor-fabricated plenum containing filters, plenum shall accommodate 4 inch deep filters. Filters shall conform to the "Air Filters" Article in this Specification Section.
3. Filter section shall use standard size filters.

H. Controls:

1. Fused microprocessor based control board with diagnostic LED and self-test capability.
2. Unit blower shall operate at continuous speed only, adjust to achieve the airflow scheduled on the Drawings. Other blower speed settings shall be locked out.

I. Safeties:

1. Provide pressure switch for proving flow of flue products and manual reset over-temperature switch.
2. Provide with blower access panel safety interlock switch.

J. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

1. Carrier Corporation.
2. York – Johnson Controls
3. Lennox

K. Provide with mixed air plenum with filter rack and return and outside air dampers, arranged as indicated on Drawings.

1. Where economizer operation is indicated on Drawings, provide differential dry-bulb economizer control system, certified as meeting the requirements for Fault Detection and Diagnostics (FDD) in the California Building Energy and Efficiency Standards.

L. Provide condensate pump, arranged as indicated on Drawings, for removal of condensate from furnace units.

M. Owner Training: Manufacturer shall provide one on-site 1-hour training session for Owners' maintenance personnel.



**2.08 AIR COOLED CONDENSING UNIT**

- A. Provide outdoor-mounted, factory assembled, single piece, air-cooled, split-system air conditioner unit suitable for ground or rooftop installation, rated in accordance with ARI Standard 210, and UL or ETL listed and labeled. Provide refrigerant charge R-410A, all internal wiring, piping, controls, compressor, and special features required prior to field start-up. Design unit to conform to the following:
  - 1. ANSI/ASHRAE latest edition.
  - 2. NEC latest edition.
  - 3. Unit cabinet to be capable of withstanding Federal Test Method Standard No. 141 (Method 6061) 500-hr salt spray test.
  - 4. Unit shall be constructed in accordance with UL standards.
- B. Unit shall be certified for capacity and efficiency, and listed in the latest ARI directory.
- C. Unit shall be manufactured in a facility registered to ISO 9001:2000.
- D. Unit shall be Energy Star Qualified.
- E. Provide unit with 5 year limited parts warranty.
- F. Cabinet:
  - 1. Unit cabinet constructed of galvanized steel, bonderized, and coated with powder coat paint.
- G. Fans:
  - 1. Direct-drive propeller type condenser fan, discharging air vertically.
  - 2. Totally enclosed condenser fan motors, 1-phase type with Class B insulation and permanently lubricated bearings, and corrosion resistant shafts.
  - 3. Condenser fan openings equipped with PVC-coated steel wire safety guards.
  - 4. Statically and dynamically balanced fan blades.
- H. Compressor:
  - 1. Hermetically sealed compressor mounted on rubber vibration isolators.
  - 2. Compressor with sound insulator.
- I. Refrigeration Components:
  - 1. Refrigerant circuit to include liquid and vapor line shut-off valves with sweat connections.
  - 2. System charge of R-410A refrigerant and compressor oil.
  - 3. Unit to be equipped with factory-supplied high-pressure switch, low pressure switch, and filter drier.
  - 4. Provide unit with manufacturer's refrigerant line set.
  - 5. Provide refrigeration piping in accordance with Article, Refrigerant Piping, in this Section.
- J. Condenser Coil:

1. Air-cooled condenser coil constructed of aluminum fins mechanically bonded to copper tubes.
2. Coils shall be leak and pressure tested.

K. Electrical Requirements:

1. Unit shall have single point power connection.
2. Provide unit with 24V control circuit.

L. Operating Characteristics:

1. Unit shall be capable of starting and running a 115 degrees F ambient outdoor temperature per maximum load criteria of ARI Standard 210.
2. Compressor with standard controls shall be capable of operation down to 55 degrees F ambient outdoor temperature.

M. Provide the following additional components and features:

1. Provide evaporator freeze thermostat, winter start control, compressor start assist capacitor and relay, low ambient controller, and ball bearing fan motor.
2. Provide expanded metal coil guard for all sides of the air-cooled condensing unit. Coil guard shall be as manufactured by MicroMetl, Can-Fab, or equal.

N. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

1. Carrier Corporation.
2. Lennox

O. Owner Training: Manufacturer shall provide one on-site 1-hour training sessions for Owners' maintenance personnel.

## 2.09 COOLING COIL

A. Provide direct expansion encased cooling coil.

1. Install encased coil to operate properly in vertical or horizontal position as required. Construct coil with aluminum plate fins mechanically bonded in non-ferrous tubing with all joints brazed ultrasonically. Coil shall have factory-installed refrigerant metering device, refrigerant line fittings which permit mechanical connections, and condensate pan with primary and auxiliary drain connections.
2. Construct casings of galvaneal steel, bonderize, insulate, and finish with baked enamel.

## 2.10 REFRIGERATION PIPE AND FITTINGS

- A. Refrigeration gas and liquid piping shall be type ACR hard drawn copper tubing, cleaned and capped in accordance with ASTM B280, with wrought copper fittings. All joints shall be brazed with Sil-fos under nitrogen purge. Relief valve discharge piping shall be full size of relief discharge port.
1. Manufactured, pre-charged and pre-insulated refrigerant line-set refrigerant piping may be utilized at Contractor's discretion.

- a. VRF Systems: Use of manufactured, pre-charged and pre-insulated refrigerant line-set refrigerant piping between outdoor condensing units and indoor heat recovery controllers, or distribution headers and tees is not allowed. When system manufacturer's installation instructions allow use of refrigerant line-set piping between indoor heat recovery controllers, or distribution headers and tees, and air terminal devices, follow instructions for allowable pipe size range and support to avoid forming traps in the piping.
- B. Variable Refrigerant Flow Heat Pump Systems Fittings:
  - 1. For systems manufacturers requiring engineered, pre-assembled headers and branch fittings, Contractor shall obtain such fittings from system manufacturer. Fittings shall be suitable for system type and configuration.
  - 2. For systems manufacturers not requiring engineered, pre-assembled headers and branch fittings, Contractor shall furnish fittings complying with manufacturer's requirements.
- C. Refrigeration Piping Specialties: Furnish and install Superior, Sporlan, Alco, Henry, or equal, stop valves, solenoid valves, adjustable thermal expansion valves, sight glass, flexible connection, charging valve, and drier with valve bypass in the liquid lines and Superior DFN shell and cartridge suction line filter sized 2-1/2 times tonnage.
  - 1. Install only those refrigeration piping specialties recommended by manufacturer of specific installed equipment.

#### 2.11 REFRIGERANT ACCESS VALVE LOCKING CAPS

- A. Each refrigerant circuit access valve located outside buildings, including valves located on roofs, shall be provided with a locking cap. Caps shall be of metal construction, with threaded brass inserts. Caps shall be color-coded according to ASHRAE standards for R22 and R410A refrigerant gasses, universal color for other refrigerant gasses. Caps shall be removable only with cap manufacturer's handheld tool.
  - 1. Provide minimum of two (2) cap removal tools for every ten (10) air conditioning units or other systems containing refrigerant installed under this Project.

#### 2.12 ELECTRIC RADIANT CEILING PANELS

- A. Provide radiant ceiling panels in locations as indicated and with capacities, style, and accessories as scheduled. The panels shall be UL or ETL listed.
- B. Construct panels using 24 gauge galvanized steel back overlapping and riveted to a 22 gauge galvanized steel front. Provide carbon (graphite) element and provide surface of multi-faceted crystalline type which will demonstrate a watt density of 1.00 watt per square foot at a distance of six feet down from the center of the panel, with a rated input of 95 watts per square foot with an average surface temperature of not more than 200 degrees F.
- C. Panels shall come with a five year warranty.
- D. Provide an extruded aluminum support frame, with 0.070 inch thick support brackets. Install brackets, frame and panels in accordance with manufacturers printed instructions.

- E. Provide a heavy-duty double line break thermostat, modified with blank front panel and 50 degrees F to 90 degrees F range.
- F. Provide locking cover for each thermostat.
- G. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
  - 1. Aztec Radiant Heating.

## 2.13 FANS

- A. All fans shall be Air Moving and Control Association Inc. (AMCA) labeled.
- B. Provide self-aligning, enclosed ball bearings, accessible for lubrication unless specified otherwise.
- C. Provide variable speed switch for all direct drive fans.
- D. Roof Mounted:
  - 1. Direct or V-belt Drive: Provide one-piece heavy-duty ventilator housings, one piece heavy gauge spun aluminum construction, with weatherproof assembly and integral weather shield. Mount ventilators on curbs furnished by the fan manufacturer. Install with fan assembly level.
  - 2. Fan wheels shall be centrifugal design, statically and dynamically balanced. Tip speed, rpm and motor horsepower shall not exceed listing in manufacturer's catalog for unit specified.
  - 3. Fans shall have integral factory formed base and one piece spinning without welding. Housings shall be provided with wiring channel and are to be of the direct discharge design. Motor and fan assembly shall be on vibration isolating mounts. Fans shall have capacity, speeds and motor sizes as shown.
  - 4. Provide the following accessories:
    - a. Gravity backdraft dampers.
    - b. Aluminum bird screen with a minimum of 85 percent free area.
    - c. Adjustable motor pulley.
    - d. Laboratory fume hood exhaust fans shall be Keysite coated.
    - e. Provide grease collection tray for kitchen exhaust fans.
    - f. Provide ventilated roof curb for kitchen exhaust fans where exhaust duct is mounted within rated shaft.
    - g. Provide hinge kit for kitchen hood exhaust fans.
- E. In-Line Propeller Fans:
  - 1. Heavy-duty propeller type with belt or direct drive as specified. Blades shall be individually mounted to wheel.
  - 2. Provide sloped roof or flat roof type roof cap, or wall cap to suit the location indicated on the Drawings.
- F. In-Line Centrifugal Fans:

1. Centrifugal fan with airfoil blades, aluminum or steel housing, externally mounted belt-drive motor, external lube tubes, integral support brackets.
2. Provide sloped roof or flat roof type roof cap, or wall cap to suit the location indicated on the Drawings.

G. Ceiling Mounted Fans:

1. Acoustic lined cabinet, built-in back draft damper, vibration isolated fan and motor, variable speed switch.
2. Provide sloped roof or flat roof type roof cap, or wall cap to suit the location indicated on the Drawings.

H. Fan Drives:

1. Drive Design: The design horsepower rating of each drive shall be at least 1.5 times, single belt drives 2 times, the nameplate rating of the motor with proper allowances for sheave diameters, speed ratio, arcs of contact and belt length.
2. Provide variable speed drives, Dayco, Browning, Woods, or equal. Allow for replacement of fan and motor drives and belts as required to suit the balance requirements of the project.
3. Select variable speed drives to allow an increase or decrease of minimum of ten percent of design fan speed.

I. Motors:

1. Motors of 25 HP and less shall have adjustable pitch sheaves; sheaves on motors above 25 HP may be non-adjustable. Change, at no extra cost to Owner, the non-adjustable sheaves to obtain desired air quantities.
2. For single-phase fan motors sized larger than 1/12 hp and smaller than 1 hp, refer to Article, Electric Motors, in Section 23 00 50, Basic HVAC Materials and Methods.

J. Sheaves: Sheaves shall be cast or fabricated, bored to size or bushed with fully split tapered bushings to fit properly on the shafts. All sheaves shall be secured with keys and set screws.

K. Belts:

1. All belts shall be furnished in matched sets.
2. Belts shall be within 1 degree 30 minutes of true alignment in all cases.

L. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

1. Greenheck Fan Corporation.
2. Loren Cook Company.
3. PennBarry.

M. Fly Fan (Air Curtain)

1. Manufacturer's standard, high velocity, non-recirculating type. Units for kitchens or food storage shall comply with NSF 37.

2. Casing: Sheet metal or polycarbonate plastic. Provide internal or external vibration isolation to effectively prevent transmission of vibration and noise from units to building structure. Units shall completely house all parts and have manufacturer's standard finish coating.
  3. Fans: Ruggedly constructed, statically and dynamically balanced. Noise level shall not exceed 77 dBA measured at 5 feet distance.
  4. Air Discharge Outlet Nozzle: Cover full width of door opening. Fan discharge ducts, plenum, flow control vanes and nozzles shall provide a uniform distribution of air over entire length of door. Provide adjustable volume and directional control.
  5. Heating Coil: Provide electric heating coil. Maximum discharge air temperature shall be 120 degrees F.
  6. Controls: Provide on-off door operated switch. The "on-off" switch circuit shall close to start fan motors when door starts to open and open when the door reaches closed position. A local disconnect switch for each fan motor shall be provided and shall be mounted to be accessible without use of ladder.
  7. Motors: Provide heavy-duty totally enclosed fan motor, sealed ball bearings, resilient mounting, automatic thermal overload switch, UL listed. Provide weather protection for motor and electrical equipment.
  8. Available Manufacturers: Subject to compliance with requirements, manufacturers offering air doors / fly fans which may be incorporated in the work include the following, or equal:
    - a. Mars Air Products; Mars Air Door Division.
    - b. Berner International.
    - c. Fantech.
- N. Owner Training: Manufacturer shall provide one on-site 1-hour training session for Owners' maintenance personnel.

#### 2.14 KITCHEN EXHAUST HOOD – TYPE 1

- A. Furnish packaged pre-manufactured ventilator, constructed of stainless steel, complete with baffles and lights. Unit shall be equal to that specified in equipment schedule.
- B. Each ventilator shall be a high velocity type grease extractor.
  1. Centrifugal grease extraction efficiency of 90 percent to be accomplished without the use of filters, cartridges, or constant running water. (Verify with hood selected)
- C. Compensating ventilators shall not be of the short-circuiting type. Furnish integral front face discharge for up to 80 percent make-up air of the exhausted air.
- D. Construction: The ventilator shall be of all stainless steel construction not less than 18 gauge, Type 304, number 4 finish. The assembly at joints and seams shall be liquid tight and all exposed external welds shall be ground and polished to match the original finish of the metal. All unexposed surfaces shall be constructed of minimum 18 gauge galvanized steel, including but not limited to duct, plenums, framing and brackets. Provide stainless steel closure panels as required for a complete finish, satisfactory to the Architect.
- E. Filters: Grease Filters shall be manufactured in accordance with UL 1046.

- F. Approvals: Ventilators to be listed or recognized by ICBO (refer to Research Report 2064), NSF, UL and in accordance with all recommendations of NFPA's Standard #96.
- G. Fire Suppression System:
  - 1. Fire suppression system shall be listed and labeled as conforming to NFPA 17A and UL 300, current edition.
  - 2. Furnish wet chemical system to protect the hood, exhaust duct and cooking appliances against fire. The system shall be installed by an authorized distributor in accordance with NFPA 96, NFPA 17A, UL listings, and the requirements of authorities having jurisdiction.
  - 3. The system shall be manually operable at the release. The system shall contain a fusible link series detector system for automatic actuation of the system. Actuation of the system shall provide automatic mechanical gas valve line shutoff. Provide manual operation, with local actuation at the tank enclosure.
  - 4. System shall consist of suppressant, pressurizing cartridge, Schedule 40 piping and nozzles. Provide system with fresh cartridge. Provide stainless steel enclosure for cartridge, regulated release mechanism, regulator and all other material required for operation of the system.
  - 5. System shall be Ansul R102, Kidde, or equal. Provide multiple system if required.
  - 6. Upon completion of the installation of the fire suppression system a test of the system shall be conducted in the presence of the enforcing agency.
- H. Owner Training: Manufacturer shall provide one on-site 1-hour training session for Owners' maintenance personnel.

#### 2.15 KITCHEN EXHAUST HOOD – TYPE 2

- A. General:
  - 1. Furnish ventilator hood of size and qualities as indicated on plans, the ventilator shall be of all stainless steel construction not less than 18 gauge, Type 304, Number 4 finish.
  - 2. Furnish condensate hoods with full perimeter welded condensate collecting gutter with 1/2 inch NPT stainless steel drain fitting.
- B. Approvals: Ventilators to be listed or recognized by ICBO (Research Report 2064), NSF, UL, and in accordance with all recommendations of NFPA-96.
- C. Owner Training: Manufacturer shall provide one on-site 1-hour training session for Owners' maintenance personnel.

#### 2.16 KILN EXHAUST HOOD SYSTEM

- A. Furnish Vent-A-Kiln, or equal, overhead, adjustable fume exhaust system at each kiln, with size as indicated on drawings, and as recommended by manufacturer. Unit shall be furnished with two speed motor and blower, spun aluminum hood, overhead counterweight pulley system, venting kit with flexible hose, and all clamps and mounting plates required for complete system operation.
- B. Provide three year warranty on all parts of the system.

**2.17 WELDING EXHAUST SYSTEM**

- A. Furnish Plymovent, Car-Mon, Nederman, or equal welding exhaust system with weld proof flexible tubing and receptors. Exhaust fan and exhaust apparatus to be by same manufacturer. Ductwork shall be United McGill Corp Sheet Metal Division, Air Systems, Inc., or equal.
- B. Owner Training: Manufacturer shall provide one on-site 4-hour training session for Owners' maintenance personnel.

**2.18 RELIEF AND INTAKE VENTS**

- A. Galvanized steel housing with 1/2 inch mesh screen, counterbalanced backdraft damper and matching prefabricated curb. Omit backdraft damper on intake vents. Provide pitched roof curb for relief vents, and install with backdraft damper level.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
  - 1. Greenheck Fan Corporation.
  - 2. Lauren Cook Company.
  - 3. PennBarry.
  - 4. American Coolair Corporation.

**2.19 LOUVERS**

- A. Louvers shall be minimum 16 gauge steel with Bonderite and Epon gray primer and 1/2 inch square mesh, 16 gauge galvanized steel screen on the inside. Louvers shall be Airolite #609, Arrow United Industries, or equal, with 4 inch louver depth.

**2.20 AIR INLETS AND OUTLETS**

- A. Except as otherwise indicated, provide manufacturer's standard inlets and outlets where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.
- B. Ceiling, wall or floor Compatibility: Provide inlets and outlets with border styles that are compatible with adjacent ceiling, wall or floor systems, and that are specifically manufactured to fit into ceiling, wall or floor module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems that will contain each type of air outlet and inlet.
- C. Refer to Schedule on Mechanical Drawings for details of inlets and outlets to be used.

**2.21 AIR TERMINAL UNITS**

- A. Shutoff, Single-Duct Air Terminal Units:
  - 1. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
  - 2. Casing: 0.034-inch-thick galvanized steel, single wall.



- a. Casing liner: Fibrous-glass duct liner, complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
  - 1) Minimum Thickness: 1/2 inch
  - 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) 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.
  - 4) Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
    - a) Adhesive VOC Content: 80 g/L or less.
    - b) Adhesive shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
    - c)
3. Inlets and Outlets: Air inlet shall be round or rectangular stub connection or S-slip and drive connections for duct attachment. Air outlet shall be S-slip and drive connections, size matching inlet size.
4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
6. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
  - a. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at 3-inch wg 6-inch wg inlet static pressure.
7. Hydronic Heating Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.
8. Controls:
  - a. Air terminal units shall be furnished with damper and multipoint velocity sensor. Damper actuator, pressure-independent, variable-air-volume (VAV) or constant-air-volume (CAV) controller with electronic airflow transducer, and room sensor are specified in Section 23 09 23 "Direct Digital Control (DDC) System for HVAC.
  - b. Control devices shall be compatible with temperature controls system
    - 1) Electronic Damper Actuator: 24 V, powered open, spring return.
    - 2) Terminal Unit Controller: Pressure-independent, variable-air-volume (VAV) or constant-air-volume (CAV) controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:
      - a) Occupied and unoccupied operating mode.
      - b) Remote reset of airflow or temperature set points.
      - c) Adjusting and monitoring with portable terminal.

- d) Communication with temperature-control system.
- 3) Room Sensor: Wall mounted, with the following features:
  - a) Digital display of sensed temperature.
  - b) Local temperature setpoint adjustment. Capable of manual override through control system operator.
  - c) Local override to turn HVAC on. Capable of manual override through control system operator.
  - d) Access for connection of portable operator terminal.
- 9. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Price Limited.
  - b. Titus.
  - c. Johnson Controls, Inc.

## 2.22 AIR FILTERS

- A. Provide MERV 13 disposable pleated media type. Refer to specific equipment Articles for filter depth and for exceptions to this specification. Filters shall conform to the following:
  - 1. Standards:
    - a. ASHRAE Standard 52.2-2007.
    - b. Underwriters Laboratories: U.L. 900, Class 2.
  - 2. Construction:
    - a. Media: Synthetic or cotton-synthetic blend with radial pleats.
    - b. Media Frame: High wet-strength beverage board.
    - c. Media Support: Welded wire or expanded metal grid bonded to air leaving side of the media.
  - 3. Performance: 4" deep filter shall have a maximum initial air resistance of 0.31 inches w.g.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
  - 1. Camfil Farr, Inc., model 30/30.
  - 2. Flanders Corporation, model 40 LPD.
- C. Temporary (Construction Period) Filters:
  - 1. Install new temporary filters in all units that have filter systems installed. Temporary filters shall match the permanent filters that are specified for the units. Replace filters as needed, in accordance with manufacturer's directions, in order to provide protection for the unit prior to occupancy by the Owner.

2. If air handling units are operated during construction of the project, install temporary filters directly over each return air inlet. Filters shall match the permanent filters that are specified for the units. Select size of filter to completely cover the frame of the return air inlet, and tape filters firmly in place to eliminate any construction debris from entering the duct system or unit. Remove the temporary filters upon completion of the work, and repair all damaged paintwork.

D. Spare Filters:

1. Furnish two new, complete sets of filter cartridges for each filter bank on completion and acceptance of the work. Install one set of filters in units (prior to final air balance). Provide units designed to accommodate washable, permanent filters with one washable, permanent filter.

## 2.23 DAMPERS

A. Backdraft Dampers: Ruskin CBD2, counterbalanced, Nailer Industries, or equal.

B. Manual Air and Balance Dampers: Provide dampers of single blade type or multi-blade type constructed in accordance with SMACNA, "HVAC Duct Construction Standards," except as noted herein.

1. Rectangular Ductwork:

- a. Single damper blades may be used in ducts up to 10 inches in height. Dampers shall be 16 gauge minimum. Provide self-locking regulators, equal to Ventlok 641. Provide end bearings equal to Ventlok 607 at each damper. Provide continuous solid 3/8 inch square shafts.
- b. Multiple blade dampers shall be equal to Ruskin CD35 Standard Control Damper. Maximum width for multiple damper blades for use in rectangular duct shall not exceed 6 inches.
- c. Where duct velocity may be expected to exceed 1500 fpm, provide Ruskin CD-50, or equal, low leakage dampers with airfoil blades.

2. Round Ductwork:

- a. Single damper blades may be used in ducts up to 12 inches in diameter. Provide multiple blade opposed blade dampers, with connected linkage, for ductwork larger than 12 inches in diameter.
- b. Damper blades for round ductwork shall be 20 gauge steel for ducts up to 12 inches diameter and 16 gauge steel for dampers larger than 12 inches diameter. Provide self-locking regulators, equal to Ventlok 641, Durodyne, or equal for operation of dampers. Provide end bearings equal to Ventlok 607 and provide continuous solid 3/8 inch square shafts.

3. Where ductwork is externally insulated, provide self-locking regulators equal to Ventlok 644, Durodyne, or equal for rectangular ductwork, and Ventlok 637, Durodyne, or equal for round ducts.

C. Fire Dampers and Combination Fire/Smoke Dampers:

1. Fire dampers and combination fire/smoke dampers shall be listed and approved by the California State Fire Marshal. Installation shall conform to the manufacturer's UL approved installation instructions.

- a. Fire dampers shall be UL 555 classified and labeled as dynamic fire dampers approved for wall and floor installation. They shall ship from the manufacturer as an assembly with a minimum 20-gauge factory installed sleeve. Sleeve length shall suit the requirements of the wall construction. Each dynamic fire damper/sleeve assembly shall ship complete with factory "roll formed" one-piece angles with pre-punched holes for easy installation. Dynamic fire dampers for vertical installation must consist of a single section on sizes up to 33" x 36" and a single section on sizes up to 24" x 24" for horizontal installation. 1-1/2 hour dynamic fire dampers shall be Ruskin DIBD20, Pottorff, or equal. 3 hour dynamic fire dampers shall be Ruskin DIBD230, Pottorff, or equal.
- b. Fire dampers for high pressure/velocity systems where velocities exceed 2000 fpm and/or 4" w.g. pressure fire damper shall be Ruskin FD60, Pottorff, or equal.
- c. Fire dampers for ceiling installation shall be UL 555C classified and labeled as ceiling dampers. They shall be provided with a thermal insulating blanket to fit the inlet or outlet condition if required by the application. Ceiling dampers shall be Ruskin CFD 2, 3, 4 or 5. Ceiling dampers for ceilings constructed of wood shall have UL tested in design L501 and shall be Ruskin CFD7, Pottorff, or equal.
- d. Combination fire/smoke dampers. Dampers shall be UL classified and labeled as Leakage Class I Smoke Dampers in accordance with the latest version of UL 555S. Dampers shall be warranted to be free from defects in material and workmanship for a period of 5 years after date of shipment. Damper/actuator assembly shall be tested to full open and full close at minimum 2000 fpm 250° F heated air and 4" w.g. with airflow in both directions. (Specified select: 250° / 350°, 2000 fpm/3000 fpm). Each damper shall be equipped with "controlled closure" quick detect heat actuated release device to prevent duct and HVAC component damage resulting from instantaneous damper closure. Release device shall be EFL type and shall allow reset from outside the sleeve after moderate temperature exposure. (Replacement type fusible links not acceptable.)
- e. Two position combination fire smoke dampers shall be equipped with one or more factory installed, direct coupled, 120 volt, single phase, electric actuator for energize open – fail close operation. Dampers with multiple actuators shall be factory wired with single point connection at the EFL heat release device for connection to power. Damper actuator shall include minimum one-year energized hold open (no cycles) and spring return (fail) close reliability. Damper/actuator shall include minimum 20,000 full open-full close cycle performances.
- f. Modulating combination fire smoke dampers shall be equipped with one or more factory installed contact for modulating signal connection. Damper/actuator shall include minimum 100,000 full open-full close cycle performances with spring return (fail) close on loss of power.
- g. Round combination fire smoke dampers up to 24" diameter shall be true round type with minimum 20 gauge galvanized steel designed for lowest pressure drop and noise performance. Bearings shall be stainless steel sleeve turning in an extruded hole in the frame. Blade seals shall be silicone edge designed to withstand 450° F and galvanized steel mechanically locked in to the blade edge (adhesive type seals are not acceptable). Each damper shall be equipped with a factory-installed sleeve of 17 inches minimum length and factory "roll formed" one-piece angles with pre-punched holes. Dampers shall be Ruskin FSDR25, Pottorff, or equal.
- h. Round (larger than 24" diameter) or rectangular combination fire smoke dampers shall include roll-formed structural hat channel frame, reinforced at the corners, formed from a

single piece of minimum 16 gauge equivalent thickness formed from single piece galvanized steel. Bearings shall be stainless steel turning in an extruded hole in the frame. Blade edge seals shall be silicone rubber designed to withstand 450° F and galvanized steel mechanically locked in to the blade edge (adhesive type seals are not acceptable). Each damper shall be equipped with a factory-installed sleeve of 17" minimum length and factory "roll formed" one-piece angles with pre-punched holes for easy installation. Dampers shall be Ruskin FSD60, Pottorff, or equal.

- i. 3-hour rated combination fire smoke dampers shall be Ruskin model FSD60-3, Pottorff, or equal.
- j. All FSD60 type dampers shall be AMCA licensed and shall bear the AMCA Seal for Air Performance. AMCA certified testing shall verify pressure drop does not exceed .03" w.g. at a face velocity of 1,000 fpm on a 24" x 24" damper.
- k. Wall type fire/smoke damper:
  - 1) Combination fire/smoke dampers for use in the wall of exit corridors shall be classified and labeled as Leakage Class II Smoke Dampers in accordance with the latest version of UL 555S. Dampers shall meet the requirements for combination fire/smoke dampers in paragraph 3 above except AMCA certified testing shall verify pressure drop does not exceed .07" w.g. at a face velocity of 1,000 fpm on a 24" x 24" damper and blades shall be single skin galvanized steel 10 gauge minimum with 3 longitudinal grooves for reinforcement. Dampers shall be Ruskin FSD36, Pottorff, or equal.
  - 2) Front access combination fire/smoke dampers shall meet all the requirements for combination fire/smoke dampers in paragraph 3 above except pressure drop requirement. In addition the dampers shall be constructed so that actuators and all accessories are accessible from the grille side. Actuators and accessories shall be housed within an integral cabinet on the side of the damper frame and shall not be installed in the air stream in front of the damper. The damper sleeve shall be minimum 14" and flanged to accept a steel framed grille. The sleeve shall be covered with fire resistant material. Dampers shall be Ruskin FSD60FA, Pottorff, or equal.
- l. Ceiling type fire/smoke damper for tunnel type corridor construction: Combination fire/smoke dampers for use in the corridor ceiling of tunnel type corridor construction shall be UL classified and labeled as Corridor Damper. Dampers shall meet the requirements of paragraph 4a above except pressure drop testing does not require AMCA certification. Dampers shall be Ruskin FSD36C, Pottorff, or equal.
- m. Fusible links shall have temperature rating approximately 50° F above normal maximum operating temperature of the heat producing appliance.
  - 1) If project requires re-openable fire/smoke dampers, provide Ruskin 165 ° F / 350° F TS150, NCA or equal. The TS150 firestat replaces the EFL and allows the damper to be re-opened from remote location up to 350 ° F. TS150 shall include full open and full closed damper position contacts for interface with remote position indication panel.
  - 2) Each fire/smoke damper shall be equipped with "controlled closure" quick detect heat actuated release device to prevent duct and HVAC component damage. Release device shall allow easy reset after moderate temperature rise outside the sleeve. Heat release device shall be the Ruskin EFL, NCA or equal.
  - 3) Unless the system is using a validation control system, each fire/smoke damper shall be equipped with a control panel including blade position indicator lights and a key

operated switch. The panel cover shall be oversized for flush mount into the wall or ceiling and shall have a brushed look. Control panel shall be Ruskin MCP2, Pottorff, or equal.

2. All actuators used for smoke dampers or combination fire/smoke dampers shall have a cycle time requirement of not more than every twelve months and shall be rated for continuous "On" duty and shall be provided with internal spring return. Actuators shall be equipped with pilot light, remote key test switch, end switch and circuitry to activate pilot light on remote key (test) switch located in corridor ceiling adjacent to damper. Electric motors shall be Invensys MA-250, MA-253, Honeywell H2000, or equal.
- D. Where required to suit the size of damper required, provide manufacturers standard UL Classified mullions, arranged to support multiple dampers. Assembly shall be of minimum 16 gauge galvanized steel, complete with all accessory caps and framing members required for installation.

## 2.24 DUCTWORK

- A. Construct and install sheet metal ductwork in accordance with the California Mechanical Code for 2 inches static pressure for supply air, and 2 inches minimum for return and exhaust air unless otherwise noted on Drawings.
  1. Where not in conflict with the California Mechanical Code, construct and install all sheet metal ductwork in accordance with SMACNA HVAC Duct Construction Standards (Metal and Flexible). Where applicable for HVAC work, construct and install sheet metal work in accordance with SMACNA Architectural Sheet Metal Manual.
  2. Provide variations in duct size, and additional duct fittings as required to clear obstructions and maintain clearances as approved by the Architect at no extra cost to the Owner.
  3. Gauges, joints and bracing shall be in accordance with the California Mechanical Code.
  4. Provide beading or cross breaking for all ductwork inside building. Provide cross breaking for ductwork exposed to weather.
  5. At the contractor's option, ductwork may be fabricated using the Ductmate, Nexus, Quickduct, Transverse Duct Connection (TDC), Pyramid-Loc duct connection systems, or equal. Fabricate in strict conformance with manufacturer's written installation instructions and in accordance with California Mechanical Code.
    - a. Seal flanged ends with pressure sensitive high density, closed cell neoprene or polyethylene tape gasket, Thermo 440, or equal.
    - b. Provide metal clips for duct connections, except at breakaway connections for fire dampers and fire smoke dampers. Provide corner clips at each corner of duct, through bolted, at all locations except at breakaway connections for fire dampers and fire smoke dampers. Where used on locations exposed to weather, provide continuous metal clip at top and sides of duct, with 1 inch overhang for top side.
- B. Design and installation standards:
  1. SMACNA Compliance: Comply with applicable portions of Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) for all work in this section.

2. NFPA Compliance: Comply with ANSI/NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," and ANSI/NFPA 90B, "Standard for the Installation of Warm Air Heating and Air Conditioning Systems."
  3. California Mechanical Code.
- C. Duct sizes indicated are external sizes.
- D. Galvanized Sheet Steel: Lock-forming quality, ASTM A924 and ASTM A653, Coating Designation G 90. Provide mill phosphatized finish for exposed surfaces of ducts exposed to view.
1. Provide mill certification for galvanized material at request of the Project Inspector.
- E. Duct Sealants:
1. Sealant shall have a VOC content of 250 g/L or less.
  2. Sealant shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
  3. Provide one part, non-sag, synthetic latex sealant, formulated with a minimum of 68 percent solids. Sealant shall comply with ASTM E84, Surface Burning Characteristics.
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
      - 1) Design Polymerics, model DP1010.
      - 2) Polymer Adhesive Sealant Systems Inc, model Airseal #11.
      - 3) McGill Airseal, LLC.
- F. Duct Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, straps, trim, and angles for support of ductwork.
- G. Rectangular Duct Fabrication:
1. Shop fabricate ductwork of gauges and reinforcement complying with the more stringent of the following standards, except as noted herein.
    - a. SMACNA HVAC Duct Construction Standards
    - b. California Mechanical Code
  2. Fabricate ducts for 2 inch pressure class with minimum duct gauges and reinforcement as follows, except as otherwise noted:

| <u>Table A</u>        |                      |                                    |
|-----------------------|----------------------|------------------------------------|
| <u>Duct Dimension</u> | <u>Minimum Gauge</u> | <u>Joint Reinforcement Per CMC</u> |
| Through 12"           | 26                   | Not Required                       |
| 13" through 18"       | 24                   | Not Required                       |
| 19" through 30"       | 24                   | C/4                                |
| 31" through 42"       | 22                   | E/4                                |
| 43" through 54"       | 22                   | F/2                                |
| 55" through 60"       | 20                   | G/4                                |
| 61" through 84"       | 20                   | I/2                                |
| 85" through 96"       | 20                   | J/2                                |
| Over 96"              | 18                   | K/2                                |

3. Fabricate duct fittings to match adjoining ducts and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to 1.5 times associated duct width. Fabricate to include single thickness turning vane in elbows where space does not permit the above radius or where square elbows are shown. Limit angular tapers to 30 degrees for contracting tapers and 20 degrees for expanding tapers. Turning vanes shall be E-Z Rail II, Durodyne, or equal.
4. Fabricate round supply connections at rectangular, plenum type fittings using spin-in type fittings, complete with extractor and volume control damper. Refer to Paragraph "DAMPERS" for damper requirements.
5. Provide drive slip or equivalent flat seams for ducts exposed in the conditioned space or where necessary due to space limitations. On ducts with flat seams, provide standard reinforcing on inside of duct. Duct connection to outlet on exposed duct shall be full size of outer perimeter of outlet flange.
6. Ducts exposed in the conditioned space shall be free of dents and blemishes and be mounted tight against adjacent surface with flat hangers. Remove all fabrication labels from ductwork.
7. Provide 20 gauge minimum for ductwork exposed within occupied spaces.

H. Rectangular Internally Insulated Duct Fabrication:

1. Provide internal duct lining where indicated on the Drawings, with a minimum of 10'-0" length in each direction from the fan, fan casing, or unit casing. Line all transfer ducts.



- a. Where ductwork is exposed to weather or outside the building insulation envelope, provide 2 inch thick, 1-1/2 pound density internal lining with matte facing, with an R-Value of 8.0 minimum.
- b. Where ductwork is within the building insulation envelope, lining shall be 1" thick, 1-1/2 pound density, with R-value of 4.2 minimum.
- c. Ducts exposed in the conditioned space shall be free of dents and blemishes and be mounted tight against adjacent surface with flat hangers. Remove all fabrication labels from ductwork.
- d. Where installed exposed in the conditioned space, duct shall be minimum 20 gauge with 1 inch insulation layer (minimum R-value – R-4.2).
- e. Cement duct liner in place with nonflammable, non-hardening duct adhesive. Seal all raw edges of insulation inside ductwork with adhesive, including longitudinal liner edges.
- f. Provide metal nosing at all locations where liner is preceded by unlined metal.
- g. Provide sheet metal weld pins and washers or clinch pins and washers on all ductwork on 12 inch intervals with the first row within 3 inches of the leading edge of each piece of insulation and within 4 inches of corners. No use of adhesive mounted pins will be considered.
  - 1) Install clinched pin fasteners with properly adjusted automatic fastening equipment. Manual installation will not be considered.
  - 2) Install weld pins with properly adjusted automatic fastening equipment. Installation shall not damage the galvanized coating on the outside of the duct.
- h. All ductwork, adhesives, lining, sealant, flex duct and the like shall have a flame spread of 25 or less and developed smoke rating of 50 or less when tested in accordance with one of the following test methods: NFPA 255, ASTM E84, or UL 723.
- i. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

| <u>Manufacturer:</u>    | <u>Product:</u> |
|-------------------------|-----------------|
| Johns Manville          | Linacoustic RC  |
| CertainTeed Corporation | ToughGard       |
| Fosters Adhesive        | 85-62           |
| Swifts Adhesive         | 7336            |

I. Round and Oval Ductwork Fabrication:

1. Round and oval duct and fittings shall be spiral lockseam or longitudinal seam as indicated in table below. Provide couplings to join each length of duct.

- a. At contractors' option, round or oval ductwork may be utilized in place of rectangular ductwork shown on Drawings, provided available space allows installation of round or oval ductwork without compromising space required for installation of products and systems of other trades.
- 1) Round or oval ductwork utilized in place of rectangular ductwork shown on Drawings shall be sized to have a static pressure loss equivalent to rectangular duct shown on Drawings.
  - 2) Unlined round or oval duct shall not be utilized in place of rectangular internally lined ductwork shown on Drawings.
2. Fabricate duct fittings to match adjoining ducts and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to 1.5 times associated duct width. Provide two-piece, die-stamped, 45-degree to 90-degree elbows for sizes up to 12 inches; five-piece, 90-degree elbows for sizes 12 inches and above; conical tees; and conical laterals. All reducers shall be placed after a tap has been made on the duct main. Reducers shall be long-taper style.
3. Round Ductwork: Construct of galvanized sheet steel complying with ANSI/ASTM A 653 by the following methods and in minimum gauges listed.

| <u>Diameter</u> | <u>Minimum Gauge</u> | <u>Method of Manufacture</u> |
|-----------------|----------------------|------------------------------|
| Up to 14"       | 26                   | Spiral Lockseam              |
| 15" to 23"      | 24                   | Spiral Lockseam              |
| 24" to 36"      | 22                   | Spiral Lockseam              |
| 37" to 50"      | 20                   | Spiral Lockseam              |
| 51" to 60"      | 18                   | Spiral Lockseam              |
| Over 60"        | 14                   | Longitudinal Seam            |

4. Provide locked seams for spiral duct; fusion welded butt seam for longitudinal seam duct.
5. Fittings and Couplings: Construct of minimum gauges listed. Provide continuous welds along seams at exposed ducts. Provide spot weld bonded seams at concealed ducts.

| <u>Diameter</u> | <u>Minimum Gauge</u> |
|-----------------|----------------------|
| 3" to 36"       | 20                   |
| 38" to 50"      | 18                   |
| Over 50"        | 16                   |

6. Ducts exposed in the conditioned space shall be free of dents and blemishes and be mounted tight against adjacent surface with flat hangers. Remove all fabrication labels from ductwork.
  7. Provide 20 gauge minimum for ductwork exposed within occupied spaces.
- J. Round Internally Insulated Duct and Fittings: Where ductwork is exposed to weather or outside the building insulation envelope, construct with outer pressure shell, 2 inch thick (Minimum R-value = R-8) insulation layer, and perforated inner liner. Where ductwork is within the building insulation envelope, construct with outer pressure shell, 1 inch thick (minimum R-value = R4.2) insulation layer, and perforated inner liner. Construct shell and liner of galvanized sheet steel complying with ANSI/ASTM A 653, of spiral lockseam construction (use longitudinal seam for over 59 inches), in minimum gauges listed in table below. Where installed exposed in the conditioned space: duct and fitting outer pressure shell shall be minimum 20 gauge with 1 inch insulation layer (minimum R-value = R-4.2), and perforated inner liner.

| <u>Nominal Duct Diameter</u> | <u>Outer Shell</u> | <u>Inner Liner</u> |
|------------------------------|--------------------|--------------------|
| 3" TO 12"                    | 26 gauge           | 24 gauge           |
| 13" TO 24"                   | 24 gauge           | 24 gauge           |
| 25" to 34"                   | 22 gauge           | 24 gauge           |
| 35" to 48"                   | 20 gauge           | 24 gauge           |
| 49" to 58"                   | 18 gauge           | 24 gauge           |
| Over 59"                     | 16 gauge           | 20 gauge           |

1. Fittings and Couplings: Construct of minimum gauges listed. Provide continuous weld along seams of outer shell at exposed ducts. Provide spot weld bonded seams at concealed ducts.

| <u>Nominal Duct Diameter</u> | <u>Outer Shell</u> | <u>Inner Liner</u> |
|------------------------------|--------------------|--------------------|
| 3" to 34"                    | 20 gauge           | 24 gauge           |
| 36" to 48"                   | 18 gauge           | 24 gauge           |
| Over 48"                     | 16 gauge           | 24 gauge           |

2. Inner Liner: Perforate with 3/32 inch holes for 22 percent open area. Provide metal spacers welded in position to maintain spacing and concentricity.
3. Ducts exposed in the conditioned space shall be free of dents and blemishes and be mounted tight against adjacent surface with flat hangers. Remove all fabrication labels from ductwork.
4. Where installed exposed in the conditioned space, duct shall be minimum 20 gauge with 1 inch insulation layer (minimum R-value – R-4.2).

5. All ductwork, adhesives, lining, sealant, flex duct and the like shall have a flame spread of 25 or less and developed smoke rating of 50 or less when tested in accordance with one of the following test methods: NFPA 255, ASTM E84, or UL 723.
  6. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. Sheet Metal Div., McGill AirFlow, LLC., Acousti-k27
    - b. Semco Duct and Acoustical Products, Inc.
    - c. Air Systems Manufacturing, Inc. - Las Vegas
- K. Duct Access Doors:
1. Duct Access: Provide hinged access door in rectangular ducts for access to fire dampers, control equipment, etc. Access door size shall be duct diameter wide by duct diameter high for all ducts under 24 inches. Ducts over 24 inches in diameter shall have 24-inch by 18-inch access doors. Minimum size access doors shall be 6 inches by 6 inches.
  2. Provide hinged style access doors for round ductwork, NCA Manufacturing, Inc., Model AD-RD-87, Pottorff Series 60, or equal. Access doors shall be 16 gauge galvanized steel with continuous piano hinge. Locks shall be plated steel strike and catch. Provide 1" x 3/8" Polyethylene "Perma Stik" gasket all around door.
- L. Flexible Air Ducts:
1. Provide exterior reinforced laminated vapor barrier, fiberglass insulation, encapsulated spring steel wire Helix, and impervious, smooth, non-perforated interior vinyl liner. Individual lengths of flexible ducts shall contain factory fabricated steel connection collars.
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
      - 1) C.A. Schroeder, Inc., Cal Flex model 2PMJ.
      - 2) ThermaFlex model M KC.
  2. Factory made air ducts shall be approved for the use intended and shall conform to the requirements of UL 181 and NFPA 90A. Each portion of a factory-made air duct system shall be identified by the manufacturer with a label or other suitable identification indicating compliance with UL 181, Class 1. Ducts shall be UL listed Class 1, maximum 25/50 smoke and flame spread and shall be installed in accordance with the terms of their listing and the requirements of SMACNA HVAC Duct Construction Standards (Metal and Flexible). Factory-made air ducts shall have the following minimum R-values: R-6.0 for ductwork installed within the building insulation envelope, R-8.0 for ductwork installed outside the building insulation envelope.
  3. Flexible ductwork shall be maximum of 5 feet long, and shall be extended to the fullest possible length, in order to minimize pressure drop in the duct.
  4. Flexible ducts shall be selected for minimum of 6 inch positive static pressure and minimum of 1 inch negative static pressure.
- M. Fabric Duct Air Dispersion System:

1. Duct: Fabric duct shall be constructed of inherently fire resistant polyester fabric complying with flame spread and smoke development index requirements of NFPA 90A when evaluated in accordance with UL 723 or other standard acceptable to authorities having jurisdiction. Treated or laminated fabric is not acceptable. Fabric shall be classified according to ICC AC167 and UL 2518. Fabric weight shall be minimum 6.75 oz./sq. yd. as tested per ASTM D3776. Duct shall be designed for inlet static pressure range of 0.25-3.0 in. wg. Fabric shall withstand without damage temperature range of 0-180 degrees F. Fabric air permeability shall be 0.5 CFM per sq. ft. when tested according to the requirements of ASTM D737.
  - a. Linear vent shall consist of round, open orifices in duct fabric, sized and spaced per Drawings, or as recommended by the manufacturer.
  - b. Duct color shall be selected by Architect from among manufacturers' available colors.
2. Duct Shape Retention System: Provide duct with shape retention system consisting of removable, round, 360 degree hoops, placed inside duct and spaced at 5 ft. o.c., or as recommended by fabric duct system manufacturer.
3. Duct Connections: Provide fabric duct system with hardware for duct inlet connection to metal duct. Inlet connection shall include zipper for removal or maintenance of duct. Duct sections and end caps shall be provided with zippers for connection, removal, and maintenance, number and location as normally provided by the manufacturer for the size and arrangement of duct as shown on Drawings.
4. Provide system with airflow, pressure control, and balancing devices as shown on Drawings and Drawing schedules.
5. Mounting: Provide fabric duct system with hardware for galvanized cable suspension system detailed on Drawings. Provide hanger attachment points on fabric duct, with locations compatible with duct suspension system detailed on Drawings.
6. Warranty: Provide with manufacturers' minimum 10 year warranty.
7. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
  - a. DurkeeSox.
  - b. DuctSox.

N. Kitchen Exhaust Ducts (Type 1):

1. Fabricate kitchen exhaust ducts and supports used for removal of smoke and grease-laden air from cooking equipment of 16 gauge minimum black steel where concealed and of 18 gauge minimum Type 304 stainless steel where exposed. At Contractor's option, 18 gauge minimum Type 304 stainless steel may be used where concealed. Finish exposed stainless steel with Number 4 finish. All ductwork shall be of welded construction in accordance with Section 510 of California Mechanical Code. For duct construction, comply with SMACNA "HVAC Duct Construction Standards" and ANSI/NFPA 96 "Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations."
2. Kitchen Exhaust Duct Access Panels:
  - a. Provide listed duct access panel assembly of the same material and gauge used for the duct. Duct access panels shall conform to the following:

- 1) Fasteners: Black steel or stainless steel to match material used for the duct. Panel fasteners shall not penetrate duct wall.
      - 2) Gasket: Comply with NFPA 96, grease-tight, high temperature ceramic fiber, rated for minimum 1500 °F.
      - 3) Minimum Pressure rating: 10 inches wg., positive or negative.
    - b. Available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      - 1) Ductmate Industries, Inc.
      - 2) 3M.
      - 3) Flame Gard, Inc.
  3. Field-Applied Grease Duct Enclosure:
    - a. Thermal Ceramics Firemaster FastWrap XL, or equal, field-applied grease duct enclosure listed in accordance with ASTM E 2336.
- O. Kitchen Exhaust Ducts (Type 2):
1. Cooking Equipment Exhaust Ducts:
    - a. Fabricate kitchen exhaust ducts and supports used for removal of vapor, heat and odors from cooking equipment of 16 gauge minimum black steel where concealed and of 18 gauge minimum Type 304 stainless steel where exposed. At Contractor's option, 18 gauge minimum Type 304 stainless steel may be used where concealed. Finish exposed stainless steel with Number 4 finish. All ductwork shall be of welded construction in accordance with Section 510 of California Mechanical Code. For duct construction, comply with SMACNA "HVAC Duct Construction Standards" and ANSI/NFPA 96 "Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations."
  2. Dishwasher Exhaust Ducts:
    - a. Fabricate dishwasher exhaust ducts and supports used for steam removal from dishwasher of 18 gauge minimum 304 stainless steel. All ductwork shall be of welded construction in accordance with Section 510 of California Mechanical Code. For duct construction, comply with California Mechanical Code, SMACNA "HVAC Duct Construction Standards," and ANSI/NFPA 96 "Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations."
  3. Duct Access Panels:
    - a. Provide duct access panel assembly of the same material and gauge used for the duct. Duct access panels shall conform to the following:
      - 1) Fasteners: Black steel or stainless steel to match material used for the duct. Panel fasteners shall not penetrate duct wall.
      - 2) Gasket: Comply with NFPA 96, grease-tight, high temperature ceramic fiber, rated for minimum 1500 °F.

- P. Type 1 Clothes Dryer Exhaust Ducts: Provide aluminum duct and fittings in wall and ceiling as indicated on Drawings.
- Q. Type 2 Clothes Dryer Exhaust Ducts:
1. Fabricate ducts and supports of 18 gauge minimum, Type 304, stainless steel. All duct seams and joints shall be welded. Finish exposed stainless steel with Number 4 finish.
- R. Shower exhaust ducts: Provide ducts and supports from stainless steel for a length of 20 feet from exhaust grille or register.
- S. Fume Hood Exhaust Ducts:
1. Round Ductwork:
    - a. Provide 18 gauge 304 stainless steel duct with spiral lockseam and welded joints. Fittings shall be 304 stainless steel, solid welded.
  2. Rectangular Duct:
    - a. Provide 18 gauge 304 stainless steel duct with Pittsburgh lockseam and welded joints. Fittings shall be 304 stainless steel, solid welded.
  3. Duct Finish: Where exposed to view, Number 4 finish.
  4. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. McGill Airflow, Inc.
    - b. SEMCO LLC.
- T. Flexible Connectors:
1. Materials: Flame-retardant or noncombustible fabrics. Coatings and adhesives shall comply with UL 181, Class 1, with flame spread index of 25 or less, and smoke-developed index of 50 or less.
  2. Metal-Edged Connectors: Factory fabricated with a fabric strip 3 inches wide attached to two strips of 3-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.
  3. Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
    - a. Minimum Weight: 26 oz./sq. yd.
    - b. Tensile Strength: Minimum 475 lbf/inch in the warp and minimum 375 lbf/inch in the filling.
    - c. Service Temperature: Minus 50 to plus 200 deg F.
  4. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. Ductmate Industries, Inc., model Proflex.
    - b. Ventfabrics, Inc., model Ventlon.

## 2.25 HYDRONIC PIPING

- A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Provide materials and products complying with California Mechanical Code. Where more than one type of material or product is indicated, selection from materials or products specified is Contractor's option.
- B. Chilled Water, Heating Hot Water, and Condenser Water Piping:
  - 1. Copper Tube and Fittings Aboveground:
    - a. Copper Tube and Fittings Aboveground: ASTM B88, Type L, drawn-temper, 150 psig minimum working pressure at 200 deg. F. Provide wrought-copper fittings and unions, ASTM B16.22, with full solder cup. Capped outlets shall be Schedule 40 screwed brass.
  - 2. Steel Pipe and Fittings Aboveground:
    - a. 2 inches and smaller: ASTM A 53/A 53M, Schedule 40 black steel with plain ends, 150 psig minimum working pressure at 200 deg. F. Provide malleable-iron threaded fittings, ASTM B16.3, Class 150, and unions, ASTM B16.39, Class 150, and cast-iron flanges and flange fittings, and threaded joints.
    - b. 2-1/2 inches and larger: ASTM A 53/A 53M, Schedule 40 black steel with plain ends, 150 psig minimum working pressure at 200 deg. F. Provide wrought-steel fittings, ASTM A 234/A 234M, and wrought-cast or forged-steel flanges and flange fittings, ASME B16.5, material group 1.1, with butt welding end connections and raised face.
  - 3. Underground Hydronic Piping:
    - a. Refer to Section 23 21 13.13, Underground Hydronic Piping.

## 2.26 HYDRONIC PUMPS

- A. Close-Coupled, End Suction Centrifugal Pumps
  - 1. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, cast iron, bronze-fitted, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally.
  - 2. Pump Construction:
    - a. Casing: Radially split, cast iron, drain plug at bottom and air vent at top of volute, threaded gage tappings at inlet and outlet, and flanged connections.
    - b. Impeller: ASTM B 584, cast bronze or cast brass; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
    - c. Pump Shaft: Steel, with copper-alloy shaft sleeve.
    - d. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.
    - e. Pump Bearings: Permanently lubricated or grease lubricated ball bearings as normally furnished for pump size scheduled on Drawings.



3. Motor: Single speed and rigidly mounted to pump casing with integral pump support.
    - a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
      - 1) Enclosure: Open, dripproof
      - 2) Enclosure Materials: Rolled steel.
      - 3) Motor Bearings: Permanently lubricated or grease-lubricated ball bearings as normally furnished for pump size scheduled on Drawings.
      - 4) Efficiency: Premium efficient.
  4. 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. ITT Corporation; Bell & Gossett.
    - b. Armstrong Pumps Inc.
    - c. PACO Pumps.
    - d. TACO Incorporated.
- B. Separately Coupled, Base-Mounted, End-Suction Centrifugal Pumps
1. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, cast iron, bronze-fitted, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal.
  2. Pump Construction:
    - a. Casing: Radially split, cast iron, drain plug at bottom and air vent at top of volute, threaded gage tappings at inlet and outlet, and flanged connections.
    - b. Impeller: ASTM B 584, cast bronze or cast brass; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
    - c. Pump Shaft: Steel, with copper-alloy shaft sleeve.
    - d. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.
    - e. Pump Bearings: Permanently lubricated or grease lubricated ball bearings as normally furnished for pump size scheduled on Drawings.
  3. Shaft Coupling: Replaceable molded-rubber insert and interlocking spider capable of absorbing vibration. Provide EPDM coupling sleeve for variable-speed applications.
  4. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.
  5. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.
  6. Motor: Single speed and secured to mounting frame, with adjustable alignment.
    - a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- 1) Enclosure: Open, dripproof.
  - 2) Enclosure Materials: Rolled steel.
  - 3) Motor Bearings: Permanently lubricated or grease-lubricated ball bearings as normally furnished for pump size scheduled on Drawings.
  - 4) Efficiency: Premium efficient.
7. 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. ITT Corporation; Bell & Gossett.
  - b. Armstrong Pumps Inc.
  - c. PACO Pumps.
  - d. TACO Incorporated.

C. Close-Coupled, In-Line Centrifugal Pumps

1. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, cast-iron, bronze fitted in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically.
2. Pump Construction:
  - a. Casing: Radially split, cast iron, drain plug at bottom and air vent at top of volute, threaded gage tapings at inlet and outlet, and flanged connections.
  - b. Impeller: ASTM B 584, cast bronze or cast brass; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
  - c. Pump Shaft: Steel, with copper-alloy shaft sleeve.
  - d. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.
  - e. Pump Bearings: Permanently lubricated or grease lubricated ball bearings as normally furnished for pump size scheduled on Drawings.
3. Motor: Single speed and rigidly mounted to pump casing.
  - a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
    - 1) Enclosure: Open, dripproof.
    - 2) Enclosure Materials: Rolled steel.
    - 3) Motor Bearings: Permanently lubricated or grease-lubricated ball bearings as normally furnished for pump size scheduled on Drawings.
    - 4) Efficiency: Premium efficient.
4. 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. ITT Corporation; Bell & Gossett.
  - b. Armstrong Pumps Inc.
  - c. PACO Pumps.

d. TACO Incorporated.

#### D. Separately Coupled, Horizontally Mounted Centrifugal In-Line Pumps

1. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, cast-iron, bronze fitted in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally.
2. Pump Construction:
  - a. Casing: Radially split, cast iron, drain plug at bottom and air vent at top of volute, threaded gage tappings at inlet and outlet, and flanged connections.
  - b. Impeller: ASTM B 584, cast bronze or cast brass; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
  - c. Pump Shaft: Steel, with copper-alloy shaft sleeve.
  - d. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket.
  - e. Pump Bearings: Permanently lubricated ball bearings.
3. Shaft Coupling: Replaceable molded-rubber insert with interlocking spider.
4. Motor: Single speed and resiliently mounted to pump casing.
  - a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
    - 1) Enclosure: Open, dripproof.
    - 2) Enclosure Materials: Rolled steel.
    - 3) Motor Bearings: Permanently lubricated or grease-lubricated ball bearings as normally furnished for pump size scheduled on Drawings.
    - 4) Efficiency: Premium efficient.
5. 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. ITT Corporation; Bell & Gossett.
  - b. Armstrong Pumps Inc.
  - c. PACO Pumps.
  - d. TACO Incorporated.

## 2.27 HYDRONIC PIPING SPECIALTIES

### A. Bladder-Type Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
  - a. AMTROL, Inc.
  - b. Armstrong Pumps, Inc.
  - c. Bell & Gossett; a Xylem brand.

- d. TACO Comfort Solutions, Inc.
  - 2. Tank: Welded steel, rated for 125-psig (860-kPa) working pressure and 375 deg F (191 deg C) maximum operating temperature. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
  - 3. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
  - 4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.
- B. Tangential-Type Air Separators:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. AMTROL, Inc.
    - b. Armstrong Pumps, Inc.
    - c. Bell & Gossett; a Xylem brand.
    - d. TACO Comfort Solutions, Inc.
  - 2. Tank: Welded steel; ASME constructed and labeled for 125-psig (860-kPa) minimum working pressure and 375 deg F (191 deg C) maximum operating temperature.
  - 3. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
  - 4. Tangential Inlet and Outlet Connections: Threaded for NPS 2 (DN 50) and smaller; flanged connections for NPS 2-1/2 (DN 65) and larger.
  - 5. Blowdown Connection: Threaded.
  - 6. Size: Match system flow capacity.
- C. Calibrated Balance Valves (Symbol CBV): Provide globe style valves for precision regulation and control rated 175 psi for sizes 2-1/2 inches through 12 inches and rated 240 psi for bronze sizes 2 inches and smaller. Each valve shall have two metering/test ports with internal check valves and protective caps. All valves shall be equipped with visual position readout and concealed memory stops for repeatable regulation and control.
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. Bell & Gossett Circuit Setter Plus.
    - b. Armstrong CBV.
    - c. Flow Design Inc. Accusetter.
    - d. Tour & Andersson.
    - e. Circuit Sensor with butterfly valve above 3 inches.
    - f. Illinois Series 5000 through 2 inches.
- D. Pressure Independent Flow Limiting Balancing Valves:
- 1. Ball Valve Type:
    - a. Body: Dezincification resistant brass.

- b. Cartridge: Removable, interchangeable, differential pressure regulating. Removable orifice plate to restrict maximum flow. Stainless steel spring. EPDM diaphragm.
- c. Ball: Plated brass or stainless steel.
- d. End Connections: Threaded or socket.
- e. Temperature/Pressure Gage Test Ports: Integral seals for portable testing instruments.
- f. Handle Style: Lever.
- g. Blowdown port with field-installed drain valve with hose-end connection.
- h. Provide valves with field-installed test port and operating handle extensions for insulated services.
- i. CWP Rating: Minimum 400 psig.
- j. Maximum Operating Temperature: 210 deg F.

2. Wafer Valve Type:

- a. Body: Ductile Iron.
- b. Cartridge: Single or multiple cartridges, removable, interchangeable, differential pressure regulating. Removable orifice plate to restrict maximum flow. Stainless steel spring. EPDM diaphragm.
- c. End Connections: Flanged.
- d. Temperature/Pressure Gage Test Ports: Integral seals for portable testing instruments. Provide valves with field-installed test port extensions for insulated services.
- e. CWP Rating: Minimum 250 psig.
- f. Maximum Operating Temperature: 230 deg F.

3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

a. Ball Valve Type:

- 1) Bell & Gossett; a Xylem Brand, model Circuit Sentry.
- 2) Griswold Controls, model Isolator "R".
- 3) Caleffi North America, Inc, model Flocal.

b. Wafer Valve Type:

- 1) Bell & Gossett; a Xylem Brand, model Circuit Sentry Wafer Valve.
- 2) Griswold Controls, model Wafer AHU.

E. Air Vent Valves:

- 1. Provide Armstrong #1AV, Hoffman Model 78, Metraflex Model MV-15A, or equal, where automatic type air vent is shown.

2.28 THERMAL AND SEISMIC EXPANSION LOOPS

- A. Manufactured assembly consisting of inlet and outlet elbow fittings, two sections of flexible metal hose and braid, and 180-degree return bend. Return bend section shall have support lug and plugged FPT drain. Flexible hose shall consist of corrugated metal inner hose and braided metal outer sheath. Assemblies shall be constructed from materials compatible with the fluid or gas being

conveyed and shall be suitable for the system operating pressure and temperature. Provide assembly selected for 4 inches of movement.

- B. Basis-of-Design Product: Subject to compliance with requirements, provide Metraflex Inc., Metraloop series, or comparable product by one of the following, or equal:

1. Flexicraft Industries.

## 2.29 PIPE JOINING MATERIALS

- A. Refer to Division 22 and 23 piping sections for special joining materials not listed below.

- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated
  - a. Full-Face Type: For flat-face, Class 125, cast iron and cast bronze flanges.
  - b. Narrow-Face Type: For raised-face, Class 250, cast iron and steel flanges.
2. AWWA C111, rubber, flat face, 1/8-inch (3.2mm) thick, unless otherwise indicated; and full-face or ring type, unless other indicated.
3. Flange Bolts and Nuts: AWWA C111, carbon steel, unless otherwise indicated.

- C. Brazing Filler Metals:

1. General Duty: AWS A5.8, BCup-5 Series, copper-phosphorus unless otherwise indicated. Sil-Fos 15, or equal.
2. Refrigerant Piping:
  - a. Joining copper to copper: AWS A5.8, BCup-5 Series, copper-phosphorus unless otherwise indicated. Sil-Fos 15, or equal.
  - b. Joining copper to bronze or steel: AWS A5.8, Bag-1, silver alloy unless otherwise indicated.

- D. Welding Filler Metals: Comply with ASME B31.1 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

## 2.30 VALVES

- A. Gate Valves:

1. 2-1/2 inches and smaller: Class150, bronze body, union bonnet, rising stem, solid wedge, threaded or solder ends, conforming to MSS SP-80. Hammond IB641, IB648, Nibco T-134, S-134, Milwaukee 1151, 1169, or equal.
2. 3 inches and larger: Class 125, iron body, bronze mounted, bolted bonnet, non-rising stem, solid wedge, flanged ends, conforming to MSS SP-70. Hammond IR-1138, Nibco F619, Milwaukee F2882A, Stockham G-612, or equal.

3. Underground valves 2 inches thru 12 inches: 250 psi, iron body, Non-rising stem, bolted bonnet, resilient wedge valves, conforming to AWWA C509, equipped with operating nuts, Mueller Series 2360, Nibco F-619-RW-SON, or equal.
  - a. Underground valves 3 inches and smaller may be furnished with operating nuts or hand-wheels, and with Ring-Tite joint ends.
  - b. Furnish and deliver to Owner one wrench of each size required for operating underground valves.
- B. Ball Valves:
  1. 2 inches and smaller: 600 psi CWP, 150 psi SWP, cast bronze body, full port, two piece, threaded ends, and reinforced PTFE seal, conforming to MSS SP-110. Nibco T585-70, Milwaukee BA-400, Stockham T-285, or equal.
  2. 2-1/2 inches and larger: Class 150, carbon steel body, full port, two piece, stainless steel vented ball, flanged ends, and reinforced PTFE seal, conforming to MSS SP-72. Nibco F-515-CS-F-66-FS, Milwaukee F20-CS-15-F-02-GO-VB, or equal.
- C. Swing Check Valves: Class 125 or 150, bronze body, suitable for regrinding, threaded ends, conforming to MSS SP-80. Stockham B-321, Milwaukee 509, or equal.
- D. Butterfly Valves:
  1. General: Tight closing, full lug type, with resilient seat suitable for minimum working pressure of 200 psig, conforming to MSS SP-67. Bi-direction dead end service with downstream flange removed.
  2. Provide valves with the following:
    - a. Seats: Suitable for 40 degrees F for cold water service and 250 degrees F for hot water service. Seats shall cover inside surface of body and extend over body ends.
    - b. Bodies: Ductile iron or cast iron.
    - c. Discs: Bronze or stainless steel.
    - d. Stems or Shafts: Stainless steel.
    - e. Control Handles: Suitable for locking in any position or with 10 degree or 15 degree notched throttling plates to hold valve in selected position. Provide extended necks to compensate for insulation thickness. Provide gear operator for valves 5 inches and larger.
  3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. 2 through 12 inches: Milwaukee Valve, CL series, Nibco, Inc., model LD2000-3, or equal.
- E. Silent Check Valves (for use on pump discharge):
  1. General: Provide spring loaded check valves at pump discharge of all pumps.
    - a. 2 inches and smaller: 250 psi CWP, bronze body, Nibco Model T-480, Milwaukee 548-T, or equal.

- b. 2-1/2 inches and larger: Class 250, cast iron body, wafer style, suitable for regrinding. Nibco Model F960, Milwaukee 1400, Mueller 103MAP, or equal.

## 2.31 VALVE BOXES

### A. General:

1. Where several valves or other equipment are grouped together, provide larger boxes of rectangular "vault" type adequately sized for condition and similar in construction to those specified above.
  2. Provide valve box extensions as required to set bottom of valve box tight up to top of piping in which valve is installed.
  3. Provide a tee handle wrench for each size, Alhambra Foundry Co. #A-3008, or equal.
- B. Valve Boxes in Traffic Areas: Provide Christy No. G5 traffic valve box, Brooks, or approved equal, 10-3/8 inches inside diameter with extensions to suit conditions, with cast iron locking cover. Provide Owner with set of special wrenches or tools as required for operation of valves.
- C. Valve Boxes in Non-Traffic Areas: Provide Christy No. F22, Brooks, or approved equal, 8 inches inside diameter by 30 inches long, with cast iron locking cover. Provide Owner with set of special wrenches or tools as required for operation of valves. Cut bottom of plastic body for operation of valves.
- D. Valve Box (Rectangular Vault Type): Precast concrete or cast iron with cast iron locking type covers lettered to suit service – Brooks No. 3-TL, Christy No. B3, Fraser No. 3, Alhambra A-3004 or A-3005, Alhambra E-2202, or E-2702, or approved equal, with extension to suit conditions.

## 2.32 INSULATION MATERIALS

### A. General:

1. Insulation products, including insulation, insulation facings, jackets, adhesives, sealants and coatings shall not contain polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations in amounts greater than 0.1 percent (by mass).
2. Products shall not contain asbestos, lead, mercury, or mercury compounds.
3. 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.
4. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
5. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
6. Test insulation, jackets and lap-seal adhesives as a composite product and confirm flame spread of not more than 25 and a smoke developed rating of not more than 50 when tested in accordance with UL723 or ASTM E84.
7. Adhesives and sealants shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.

### B. Insulation Materials:



1. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
  - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - 1) Aeroflex USA, Inc.
    - 2) Armacell LLC.
    - 3) K-Flex USA.
2. Mineral-Fiber, Preformed Pipe Insulation:
  - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - 1) Johns Manville; a Berkshire Hathaway company.
    - 2) Knauf Insulation.
    - 3) Manson Insulation Inc.
    - 4) Owens Corning.
  - b. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL.
3. 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. Provide 2-inch wide stapling and taping flange.
  - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - 1) CertainTeed Corporation.
    - 2) Johns Manville.
    - 3) Knauf Insulation.
    - 4) Owens Corning.
4. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket.
  - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - 1) CertainTeed Corporation.
    - 2) Johns Manville.
    - 3) Knauf Insulation.
    - 4) Owens Corning.
5. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5

lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less.

- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

- 1) CertainTeed Corporation.
- 2) Johns Manville; a Berkshire Hathaway company.
- 3) Knauf Insulation.
- 4) Owens Corning.

C. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

- a. Design Polymerics.
- b. Foster Brand; H. B. Fuller Construction Products.
- c. Knauf Insulation.

2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

- a. Design Polymerics.
- b. Childers Brand; H. B. Fuller Construction Products.
- c. Foster Brand; H. B. Fuller Construction Products.

2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

- a. Design Polymerics.
- b. Childers Brand; H. B. Fuller Construction Products.
- c. Foster Brand; H. B. Fuller Construction Products.
- d. Knauf Insulation.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

## F. Field Applied Jackets:

1. PVC Jacket and Factory Fabricated Fitting Covers: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming.
  - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - 1) Johns Manville, model Zeston, with Zeston 2000 fitting covers.
    - 2) Proto Corporation, model LoSmoke.
2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
  - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - 1) Childers Brand; H. B. Fuller Construction Products.
    - 2) ITW Insulation Systems; Illinois Tool Works, Inc.
    - 3) RPR Products, Inc.
  - b. Finish and thickness are indicated in field-applied jacket schedules.
  - c. Moisture Barrier for Outdoor Applications: 2.5-mil- thick polysurlyn.
  - d. Factory-Fabricated Fitting Covers:
    - 1) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    - 2) Tee covers.
    - 3) Flange and union covers.
    - 4) End caps.
    - 5) Beveled collars.
    - 6) Valve covers.
    - 7) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

## 2.33 THERMAL HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
  1. Buckaroos, Inc.
  2. Carpenter & Paterson, Inc.
  3. Clement Support Services.
  4. Rilco Manufacturing Co., Inc.
- B. Flame-spread index of 25 or less and smoke-developed index of 50 or less as tested by ASTM E 84.
- C. Insulation-Insert Material for Cold or Hot Piping, from Minus 40 to Plus 275 Deg F: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength or ASTM C 1126, Type III rigid phenolic foam and vapor barrier.
  1. Phenolic:

- a. NPS 10 and Smaller: 3.75-lb/cu. Ft. minimum compressive strength.
- b. NPS 12 to NPS 30: 5.0-lb/cu. ft. minimum compressive strength.
- D. Insulation-Insert Material for Piping Above 275 Deg F: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig or ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength.
- E. Insulation Protection Shields: Galvanized metal, G90 coating designation, complying with ASTM A 653/A 653M, 180-degree saddle.
- F. Heavy Duty Insulation Protection Shields: Galvanized metal, 12-gage, G90 coating designation, complying with ASTM A 653/A 653M, 180-degree saddle. Structural steel plate welded to bottom of galvanized shield for sizes NPS 6 and larger.
- G. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- H. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- I. Insert Length: Extend minimum 1-1/2 inches beyond sheet metal shield.

## 2.34 TEMPERATURE CONTROL SYSTEM

- A. Refer to Section 23 09 23, Direct Digital Control System for HVAC.

## PART 3 - EXECUTION

### 3.01 ROOF MOUNTED EQUIPMENT INSTALLATION

- A. Mount and anchor equipment in strict compliance with Drawings details. Alternate anchorage methods will not be considered for roof mounted equipment.
- B. Examine rough-in for roof mounted equipment to verify actual locations of piping and duct connections prior to final equipment installation.
- C. Verify that piping to be installed adjacent to roof mounted equipment allows service and maintenance.
- D. Verify that gas piping will be installed with sufficient clearance for burner removal and service.
- E. Install gas flue extensions. Attach gas flue extensions to unit according to unit manufacturers' installation instructions. Terminate gas flue extensions with lowest discharge opening at height compliant with requirements of California Mechanical Code, based on final unit location.
- F. Install ducts to termination at top of roof curb and install heavy duty rubber gaskets on supply and return openings and on full perimeter of curb, or as required for an airtight installation, prior to setting unit on curb.
- G. Cover roof inside each roof mounted air conditioning unit, heat pump unit, and heating and ventilating unit roof curb with 2 inch thick, 3 pound density fiberglass insulation board.

- H. Connect supply and return air ducts to horizontal discharge roof mounted equipment with flexible duct connectors. Provide G 90 galvanized steel weather hood over flexible connections exposed to the weather. Weather hood minimum gauge shall be per PART 2 article, Ductwork, Table A.
- I. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.

### 3.02 SPLIT SYSTEM AC, HEAT PUMP, AND VRF SYSTEMS INSTALLATION

#### A. General:

1. Install units level and plumb.
2. Install evaporator-fan components as detailed on Drawings.
3. Install ground or roof- mounted condensing units as detailed on Drawings.
4. Install seismic restraints as required by applicable codes. Refer to Article, Submittals, in Section 23 00 50, Basic HVAC Materials and Methods, for delegated design requirements for seismic restraints.
5. Install and connect refrigerant piping as detailed in unit manufacturers' literature. Install piping to allow access to unit.
6. Install cooling coil condensate primary drain pan piping, and overflow, if provided, and run to nearest code-compliant receptacle, or as indicated on Drawings. Install secondary drain pan for units installed over permanent and suspended-tile ceilings. Install secondary drain pan piping and terminate 1/2 inch below ceiling, with escutcheon, in a readily visible location or as shown on Drawings.
7. Install air filters at each indoor unit. Install washable, permanent filters at indoor units designed to accept washable, permanent filters. Refer to Drawings schedule, and Article, Air Filters, in this Section, for filter requirements for ducted, above-ceiling units incorporating mixing boxes.
8. Duct Connections: Duct installation requirements are specified in Article, Ductwork, in this Section. Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Article, Ductwork, in this Section.

#### B. Variable Refrigerant Flow Split System Heat Pumps:

1. The system shall be installed by a factory-trained and certified contractor, in strict conformance with unit manufacturer's instructions.
2. Install indoor heat recovery controllers as detailed on Drawings. Install condensate drain pan piping and run to nearest code-compliant receptacle, or as indicated on Drawings.
  - a. Indoor Heat Recovery Controllers Identification:
    - 1) Comply with requirements for identification in Section 23 00 50, Basic HVAC Materials and Methods.
    - 2) Identify each control cable on each end, at 20' intervals, and at each terminal with a number-coded identification tag. Each cable shall have a unique tag.
    - 3) Identify each refrigerant connection with label or tag corresponding to the indoor fan coil unit served by the refrigerant piping branch. Use equipment numbers scheduled on Drawings.

3. Install ball-type refrigerant service valves in refrigerant piping at downstream connections of indoor heat recovery units.
4. Install ground or roof- mounted condensing units as detailed on Drawings. Connected condensing units shall allow space for coil cleaning and other required maintenance tasks.

### 3.03 HIGH EFFICIENCY FURNACE UNIT INSTALLATION

- A. Install vent and combustion air piping in strict compliance with manufacturer's installation guidelines. Pipe and fittings shall comply with manufacturer's instructions, flash through roof or wall as specified for piping. Refer to Drawings for special conditions.
  1. Provide concentric flue system with single roof or wall penetration. Install in accordance with manufacturer's requirements.
  - 2.
- B. Mount horizontally or vertically as indicated on Drawings. Comply with manufacturer's installation requirements specific to mounting orientation.
- C. Install cooling coil overflow drain piping and run to nearest receptacle, or as indicated on Drawings.

### 3.04 REFRIGERANT PIPING INSTALLATION

- A. General:
  1. Install refrigerant piping according to ASHRAE 15. Install and connect refrigerant piping as detailed in unit manufacturers' literature. Install piping to allow access to unit.
  2. Install piping straight and free of kinks, restrictions or traps.
  3. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
  4. Slope horizontal suction piping 1 inch/10 feet towards compressor.
  5. Install fittings for changes in direction and branch connections.
  6. Piping under raised floors shall be kept 6 inches minimum above ground; excavate as necessary.
  7. Install locking caps on refrigerant access valves located outside building, including valves located on roofs.
  8. Insulate refrigerant piping, including liquid and hot gas pipes when required by system manufacturer, and including headers, branches, and other components as detailed in unit manufacturers' literature.
- B. Factory Pre-charged and sealed line set piping:
  1. Keep the entire system clean and dry during installation.
  2. All tubing shall be evacuated and sealed at the factory. The seal must not be broken until ready for assembly.
  3. If there is any evidence of dust, moisture, or corrosion, the tubing must be cleaned out by drawing a swab soaked with methyl alcohol through the tubing as many times as necessary to thoroughly clean the tubing.
  4. Where line set piping is used, enclose in iron or steel piping and fittings or in EMT conduit.
- C. Field Assembled Refrigerant Piping:

1. Select system components with pressure rating equal to or greater than system operating pressure.
2. Where subject to mechanical injury, enclose refrigerant piping in EMT conduit.
3. Where field assembled refrigerant piping is exposed mounted at grade, on walls, and on roof, enclose in 16 gage galvanized steel enclosure.
4. When brazing, remove solenoid valve coils and sight glasses, also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

### 3.05 FAN INSTALLATION

- A. Ceiling Mounted Fans: Mount variable speed switch within fan housing. Mark final balance point on variable speed switch.
- B. Provide access doors for fans or motors mounted in ductwork.
- C. Mount all fans as detailed on Drawings and in compliance with CBC standards.
- D. Fan motors mounted in air-stream to be totally enclosed.
- E. Completely line supply, return or exhaust fan cabinets with 1 inch thick, 3/4 pound density acoustic insulation securely cemented in place.
- F. Roof fans shall be mounted level.
- G. Provide heavy-duty rubber gasket between exhaust fan mounting flange and roof curb, or as required for an airtight installation.
- H. Label fume hood fans with sign "CAUTION - HAZARDOUS EXHAUST."

### 3.06 RELIEF VENT INSTALLATION

- A. Install relief vents to provide a level mounting for backdraft damper.

### 3.07 AIR INLETS AND OUTLETS INSTALLATION

- A. Provide all air inlets and outlets with gaskets and install so that there will be no streaking of the walls or ceilings due to leakage. Duct connection to outlet on exposed duct shall be full size of outer perimeter of outlet flange.
- B. Unless otherwise indicated on Drawings, provide rectangular galvanized steel plenum on top of each diffuser and ceiling return for connection to ductwork. Line plenum with internal insulation as indicated for lined ductwork. Size plenum to allow full opening into air terminal. Plenum sheet metal gauge shall be equal to gauge for rectangular equivalent of the branch duct serving the air inlet or outlet.
- C. Ceiling-mounted air inlets, outlets, or other services installed in T-Bar type ceiling systems shall be positively attached to the ceiling suspension main runners or to cross runners with the same carrying capacity as the main runners.

1. Air inlets, outlets, or other services weighing not more than 56 pounds shall have two No. 12 gauge hangers connected from the terminal or service to the structure above. These wires may be slack.
  2. Support air inlets, outlets, or other services weighing more than 56 pounds directly from the structure above by approved hangers. Provide 4 taut 12 gauge wires each, attached to the fixture and to the structure above. The 4 taut 12 gauge wires, including their attachment to the structure above must be capable of supporting 4 times the weight of the unit.
  3. Secure air inlets and outlets to main runners of ceiling suspension system with two No. 8 sheet metal screws at opposing corners.
- D. Furnish all air inlets and outlets with a baked prime coat unless otherwise noted. Provide off-white baked enamel finish on ceiling-mounted air inlets and outlets. Paint exposed mounting screws to match the material being secured.
- E. Air inlets and outlets shall match all qualities of these specified including appearance, throw, noise level, adjustability, etc.

### 3.08 AIR TERMINAL UNIT INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Where installing piping adjacent to air terminal unit, allow space for service and maintenance.
- D. Connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange, or as detailed on Drawings.

### 3.09 FILTER HOUSING INSTALLATION

- A. Mount filters in airtight galvanized steel housings furnished by the filter manufacturer, or shop fabricated. Housings shall incorporate integral tracks to accommodate filters, and flanges for connection to duct or casing system.
1. Sealing: Incorporate positive-sealing gasket material on channels to seal top and bottom of filter cartridge frames and to prevent bypass of unfiltered air.
  2. Access Doors: Hinged, with continuous gaskets on perimeter and positive-locking latch handle devices.
- B. Air filters shall be accessible for cleaning or replacement.
- C. Identify each filter access door with 1/2 inch high minimum stenciled letters.

### 3.10 TEMPORARY FILTERS

- A. Provide temporary filters for fans that are operated during construction; after construction dirt has been removed from the building install new filters at no additional cost to the Owner. In addition to



temporary filters at filter location, provide temporary filters on all duct openings which will operate under a negative pressure.

1. Filters used for temporary operation shall be the same as permanent filters for the application. Filters used for duct openings may be 1 inch thick pleated media disposable type.

### 3.11 DAMPER INSTALLATION

- A. All dampers automatically controlled by damper motors are specified under "Temperature Control System" except those specified with items of equipment.
- B. Provide opposed blade manual air dampers at each branch duct connection and at locations indicated on the drawings and where necessary to control air flow for balancing system. Provide an opposed blade balancing damper in each zone supply duct. Provide an access panel or Ventlok flush type damper regulator on ceiling or wall for each concealed damper.
- C. Install fusible link fire dampers full size of duct at points where shown or required.
- D. Provide 18 inch x 12 inch minimum hinged access doors in ductwork and furring for easy access to each fire damper; insulated access doors in insulated ducts. Label access doors with 1/2 inch high red letters.
  1. Provide Ventlok Series 100, Durodyne, or equal access doors with hardware for convenient access to all automatic dampers and other components of the system, insulated type in insulated ducts. Provide Ventlok #202 for light duty up to 2 inch thick doors, #260 heavy-duty up to 2 inch thick doors and #310 heavy-duty for greater than 2 inch thick doors. Provide #260 hinges on all hinged and personnel access doors; include gasketing.

### 3.12 DUCTWORK INSTALLATION

- A. General:
  1. Assemble and install ductwork in accordance with recognized industry practices which will achieve air tight and noiseless (no objectionable noise) systems capable of performing each indicated service. Install each run with minimum of joints. Align ductwork accurately at connections within 1/8 inch misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers, and anchors of type which will hold ducts true to shape and to prevent buckling. Where possible, install ductwork to clear construction by 1/4 inch minimum, except at air inlets and outlets. Where ductwork will not clear construction, secure duct firmly to eliminate noise in the system.
  2. Duct Joints: Install duct sealers, pop rivets or sheet metal screws at each fitting and joint. Duct sealers shall be fire retardant. Sheet metal screws for joints shall be minimum #10 size galvanized.
  3. Where ductwork is left exposed within a room, the same shall be run true to plumb, horizontal, or intended planes. Where possible, uniform margins are to be maintained between parallel lines and/or adjacent wall, floor, or ceiling surfaces.
  4. Horizontal runs of ductwork suspended from ceilings shall provide for a maximum headroom clearance. The clearance shall not be less than 6'-6" without written approval from the Architect.

5. Provide sheet metal angle frame at all duct penetrations to wall, floor, roof, or ceiling.
6. Paint inside of ducts, visible through grille, dull black.
7. Where ductwork is installed in finished areas of buildings that do not have ceilings, paint ductwork, support hangers, and air inlets and outlets to match adjacent architectural surfaces, or as directed by Architect.
8. At the time of rough installation, or during storage on the construction site and until final startup of the heating and cooling equipment, duct and other related air distribution component openings shall be covered with tape, plastic, sheet metal, or other methods acceptable to the enforcing agency.

B. Firestopping:

1. Pack the annular space between duct openings and ducts penetrating floors and walls with UL listed fire stop, and sealed at the ends. All pipe penetrations shall be UL listed, Hilti, 3M Pro-Set, or equal.
  - a. Install fire caulking behind mechanical services installed within fire rated walls, to maintain continuous rating of wall construction.
2. Firestopping systems to be installed in strict accordance with manufacturer's instructions.
3. Alternate firestopping systems are acceptable if approved equal. However, any deviation from the above specification requires the Contractor to be responsible for determining the suitability of the proposed products and their intended use, and the Contractor shall assume all risks and liabilities whatsoever in connection therewith.

C. Flashing:

1. The work of this section shall include furnishing, layout, sizing, and coordination of penetrations required for the mechanical work.
2. Refer to Division 07 specifications and Drawings details as applicable.
3. Flashing for penetrations of roof for mechanical items such as flues and ducts shall be coordinated with the roofing manufacturer and roofing installer for the specific roofing type. The work of this section shall include furnishing, layout, sizing, and coordination of penetrations required for the mechanical work.
  - a. Furnish and install flashing and counterflashing in strict conformance with the requirements of the roofing manufacturer. Submit shop drawing details for review prior to installation.
  - b. Flues and ducts shall have 24 gauge galvanized sheet metal storm collar securely clamped to the flue above the flashing.

- D. Upper connection of support to wood structure shall be with wood screws or lag screws in shear fastened in the upper one half of the wood structural member. Fasteners shall conform to the following schedule:

|                               |                         |
|-------------------------------|-------------------------|
| For ducts with $P/2=30"$      | #10 x 1-1/2" wood screw |
| For ducts with $P/2=72"$      | 1/4" x 1-1/2" lag screw |
| For ducts with $P/2$ over 73" | 3/8" x 1-1/2" lag screw |

- E. Upper connection in tension to wood shall not be used unless absolutely necessary. Where deemed necessary the contractor shall submit calculations to show the size fastener and penetration required to support loads in tension from wood in accordance with the following schedule:

|                                    |                       |
|------------------------------------|-----------------------|
| For ducts with P/2=30"             | 260 pounds per hanger |
| For ducts with P/2=72"             | 320 pounds per hanger |
| For ducts with P/2=96"             | 460 pounds per hanger |
| For duct with P/2 larger than 120" | NOT ALLOWED           |

- F. Install concrete inserts for support of ductwork in coordination with formwork as required to avoid delays in work.
- G. Upper connection to manufactured truss construction must comply with truss manufacturers published requirements and Structural Engineers requirements.
- H. Where ducts pass through interior partitions and exterior walls, conceal space between construction opening and duct or duct plus insulation with sheet metal flanges of same gauge as duct. Overlap opening on four sides by at least 1-1/2 inches.
- I. Support ductwork in manner complying with SMACNA "HVAC Duct Construction Standards," hangers and supports sections. Where special hanging of ductwork is detailed or shown on Drawings, Drawings shall be followed. Angles shall be attached to overhead construction in a manner so as to allow a minimum of 2 inches of movement in all directions with no bending or sagging of the angle.
1. Except where modified in individual paragraphs of this Section, provide hanger support with minimum 18 gauge straps, 1 inch wide. Fold duct strap over at bottom of duct.
  2. Install duct supports to rectangular ducts with sheet metal screws. Provide one screw at top of duct and one screw into strap at bottom of duct.
- J. Installation of Flexible Ductwork:
1. Provide flexible ducts with supports at 30 inch centers with 2 inch wide, 26 gauge steel hanger collar attached to the structure with an approved duct hanger. Installation shall minimize sharp radius turns or offsets.
    - a. Supports shall be in accordance with SMACNA HVAC Duct Construction Standards (Metal and Flexible).
    - b. Flexible duct bends shall be not less than 1-1/2 duct diameter bend radius.
  2. Make connections to rigid duct and units with Panduit style draw band at inner liner material, and a second draw band over the outer vapor barrier material.
  3. Make connection to duct with spin-in fittings, with air scoop and balance damper.
- K. Installation of Fabric Duct Air Dispersion System:

1. Install fabric duct system in accordance with the requirements of the manufacturer, and per Drawings details.
    - a. Air handler and associated ductwork shall be clean and free of particulate matter at the time of fabric duct connection and pressurization of duct system.
  2. Fabric duct shall be cleaned according to manufacturers' instructions, if soiled during installation, prior to Project handover to Owner.
- L. Installation of Kitchen Exhaust Ducts (Type 1):
1. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease.
  2. Slope duct a minimum of 2 percent to drain grease back to the hood.
  3. Provide for thermal expansion of ductwork through 2000 °F temperature range.
  4. Install listed grease duct access panel assemblies at each change of direction and at maximum intervals of 12 feet in horizontal ducts, and at every floor for vertical ducts, and as indicated on Drawings. Locate access panel on top or sides of duct. Locate panel so that edge of opening is not less than 1-1/2 inch from all outside edges of the duct or welded seams. For large horizontal ducts, install 20 inch by 20 inch access panel for personnel entry at maximum intervals of 20 feet.
  5. Install listed grease duct access panel assemblies in accordance with the terms of their listings and the manufacturers' instructions. Access panels shall be labeled with the words: "Access Panel – Do Not Obstruct."
  6. Fabricate ducts with continuous welds for grease-tight construction.
  7. Grind welds to provide smooth surface free of burrs, sharp edges and weld splatter. When welding stainless steel with a No. 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to removed discoloration caused by welding.
  8. Cover grease exhaust duct with two layers of 1-1/2 inch thick field-applied grease duct enclosure. Install grease duct enclosure in accordance with manufacturer's instructions and listing requirements.
- M. Installation of Kitchen Exhaust Ducts (Type 2):
1. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease.
  2. Slope duct a minimum of 1 percent to drain back to the hood or dishwasher connection.
  3. Install duct access panel assemblies at each change of direction and at maximum intervals of 12 feet in horizontal ducts, and at every floor for vertical ducts, and as indicated on Drawings. Locate access panel on top or sides of duct. Locate panel so that edge of opening is not less than 1-1/2 inch from all outside edges of the duct. For large horizontal ducts, install 20 inch by 20 inch access panel for personnel entry at maximum intervals of 20 feet.
  4. Fabricate ducts with continuous welds for water-tight construction.
  5. Grind welds to provide smooth surface free of burrs, sharp edges and weld splatter. When welding stainless steel with a No. 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to removed discoloration caused by welding.
  6. Fabricate ducts for dishwasher exhaust with seams on top of duct, and with minimum joints.
  7. Access panels shall be labeled with the words: "Access Panel – Do Not Obstruct."
- N. Installation of Shower Exhaust Ducts:

1. Slope duct a minimum of 1 percent to drain back to the exhaust grille.

### 3.13 DUCTWORK SEALING AND LEAK TESTING

- A. All ductwork shall receive a Class A seal.
- B. Seal airtight all joints and seams, including standing seams and manufactured joints and seams, of all supply, return and exhaust ducts except those exposed in conditioned space.
- C. Leakage Classes:

| <u>Pressure Class</u> | <u>Leakage Class</u> |                         |
|-----------------------|----------------------|-------------------------|
|                       | <u>Round Duct</u>    | <u>Rectangular Duct</u> |
| 2"W.G. or less        | 8                    | 16                      |
| 4"W.G. or greater     | 2                    | 4                       |

- D. All duct systems (supply, return, outside air intake, and exhaust), except those identified on compliance forms on Drawings as requiring Acceptance Testing per the requirements of the California Energy Code, shall be tested in accordance with the requirements of SMACNA "HVAC Air Duct Leakage Test Manual." Test pressure shall be equal to the pressure class of the duct. For additional duct leak testing requirements, refer to Section 23 08 00.13, "Title 24 Commissioning of HVAC."

### 3.14 PIPING INSTALLATION

- A. General:
  1. All piping shall be concealed unless shown or otherwise directed. Allow sufficient space for ceiling panel removal.
  2. Installation of piping shall be made with appropriate fittings. Bending of piping will not be accepted.
  3. Install piping to permit application of insulation and to allow valve servicing.
  4. Where piping or conduit is left exposed within a room, the same shall be run true to plumb, horizontal, or intended planes. Where possible, uniform margins are to be maintained between parallel lines and/or adjacent wall, floor, or ceiling surfaces.
  5. Horizontal runs of pipes and conduits suspended from ceilings shall provide for a maximum headroom clearance. The clearance shall not be less than 6'-6" without written approval from the Architect.
  6. Close ends of pipe immediately after installation. Leave closure in place until removal is necessary for completion of installation.
  7. Use reducing fittings; bushings shall not be allowed. Use eccentric reducing fittings wherever necessary to provide free drainage of lines and passage of air.
  8. Verify final equipment and fixture locations for roughing-in.
  9. Where piping is installed in walls within one inch of the face of stud, provide a 16 gauge sheet metal shield plate on the face of the stud. The shield plate shall extend a minimum of 1-1/2 inches beyond the outside diameter of the pipe.

10. Each piping system shall be thoroughly flushed and proved clean before connection to equipment.
11. Install exposed polished or enameled connections with special care showing no tool marks or threads at fittings.
12. Service Markers: Mark the location of each plugged or capped pipe with a 4 inch round by 30 inch long concrete marker, set flush with finish grade. Provide 2-1/2 inch diameter engraved brass plate as part of monument marker.
13. Pipe the discharge of each relief valve, air vent, backflow preventer, and similar device to floor sink or drain.

B. Sleeves:

1. Install Adjus-to-Crete, Pipeline Seal and Insulator, or equal, pipe sleeves of sufficient size to allow for free motion of pipe, 24 gauge galvanized steel. The space between pipe and sleeves through floor slabs on ground, through outside walls above or below grade, through roof, and other locations as directed shall be caulked with oakum and mastic and made watertight. The space between pipe and sleeve and between sleeve and slab or wall shall be sealed watertight.
2. At Contractor's option, Link-Seal, Metraflex Metraseal, or equal, casing seals may be used in lieu of caulking. Wrap pipes through slabs on grade with 1 inch thick fiberglass insulation to completely isolate the pipe from the concrete.

C. Floor, Wall, and Ceiling Plates:

1. Fit all pipes with or without insulation passing through walls, floors, or ceilings, and all hanger rods penetrating finished ceilings with chrome-plated or stainless escutcheon plates.

D. Firestopping:

1. Pack the annular space between pipe sleeves and pipes penetrating floors and walls with UL listed fire stop, and sealed at the ends. All pipe penetrations shall be UL listed, Hilti, 3M Pro-Set, or equal.
  - a. Install fire caulking behind mechanical services installed within fire rated walls, to maintain continuous rating of wall construction.
2. Provide SpecSeal Systems UL fire rated sleeve/coupling penetrators for each pipe penetration or fixture opening passing through floors, walls, partitions or floor/ceiling assemblies. All Penetrators shall comply with UL Fire Resistance Directory (Latest Edition), and in accordance with CBC requirements.
3. Sleeve penetrators shall have a built in anchor ring for waterproofing and anchoring into concrete pours or use the special fit cored hole penetrator for cored holes.
4. Copper and steel piping shall have SpecSeal, or equal, plugs on both sides of the penetrator to reduce noise and to provide waterproofing.
5. Firestopping systems to be installed in strict accordance with manufacturer's instructions.
6. Alternate firestopping systems are acceptable if approved equal. However, any deviation from the above specification requires the Contractor to be responsible for determining the suitability of the proposed products and their intended use, and the Contractor shall assume all risks and liabilities whatsoever in connection therewith.

E. Flashing:

1. The work of this section shall include furnishing, layout, sizing, and coordination of penetrations required for the mechanical work.
2. Refer to Division 07 specifications and Drawings details as applicable.
3. Flashing for penetrations of metal or membrane roof for pipes shall be coordinated with the roofing manufacturer and roofing installer for the specific roofing type.
  - a. Furnish and install flashing and counterflashing in strict conformance with the requirements of the roofing manufacturer. Submit shop drawing details for review prior to installation.
  - b. Furnish and install counterflashing above each flashing required. Provide Stoneman, or equal, vandalproof top and flashing combination. Elmdor/Stoneman Model 1540.
4. Furnish and install flashing and counterflashing in strict conformance with the requirements of the roofing manufacturer. Submit shop drawing details for review prior to installation.

3.15 PUMP INSTALLATION

- A. Install pumps as shown on Drawings.
- B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories. Manufacturer recommended clearances shall be maintained.
- C. Independently support pumps and piping so that weight of piping is not supported by pumps and weight of pumps is not supported by piping.

3.16 HYDRONIC SPECIALTIES INSTALLATION

- A. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.
- B. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.
- C. Calibrated Balancing Valves: Install calibrated balancing valves per manufacturers' recommendations, including requirements for straight pipe lengths at valve inlet and outlet.
- D. Air Vent Valves:
  1. Install with shutoff valves or cocks and drain to floor sink or drain.
  2. At each high point of piping, and elsewhere where required for system air venting and drainage, provide manual air vent connection at top of pipe. Provide ball valve within 18 inches of ceiling in accessible location, and extend drain line to allow convenient access.

3.17 THERMAL AND SEISMIC EXPANSION LOOP INSTALLATION

- A. Install expansion loops where piping crosses building expansion or seismic joints, between buildings, between buildings and canopies, and as indicated on Drawings.
- B. Install expansion loops of sizes matching sizes of connected piping.

- C. Install grooved-joint expansion joints to grooved-end steel piping.
- D. Materials of construction and end fitting type shall be consistent with pipe material and type of gas or liquid conveyed by the piping system in which expansion loop is installed.

### 3.18 PIPE JOINTS AND CONNECTIONS

#### A. General:

- 1. Cutting: Cut pipe and tubing square, remove rough edges or burrs. Bevel plain ends of steel pipe.
- 2. Remove scale, slag, dirt and debris from inside and outside of pipe before assembly.
- 3. Boss or saddle type fittings or mechanically extracted tube joints will not be allowed.

#### B. Threaded Pipe: 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 thread compound to external pipe threads: Rectorseal No. 5, Permatex No. 1, or equal.
- 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

#### C. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for type of water conveyed by pipe. Join flanges with gasket and bolts according to ASME B31.9.

#### D. Copper Pipe and Tubing: All joints shall be brazed according to ASME Section IX, Welding and Brazing Qualifications, except pneumatic control piping, and hydronic piping having grooved-end fittings and couplings.

#### E. Welded Pipe:

- 1. Make up with oxyacetylene or electric arc process.
- 2. All welding shall conform to the American Standard Code for Power Piping ASME B-31.1. When requested by the Architect, furnish certification from an approved testing agency or National Certified Pipe Welding Bureau that the welders performing the work are qualified.
- 3. All line welds shall be of the single "V" butt type. Welds for flanges shall be of the fillet type.
- 4. Where the branch is two pipe sizes smaller than the main or smaller, Bonney Weldolets, Thredolets, Nibco, or equal, may be used in lieu of welding tees.

#### F. Flexible Connections:

- 1. Furnish and install Thermo Tech., Inc. F/J/R, Metraflex, or equal, flexible couplings with limiter bolts on piping connections to all equipment mounted on anti-vibration bases, except fan coil units under 2000 cfm, on each connection to each base mounted pump and where shown. Couplings shall be suitable for pressure and type of service.
- 2. Flexible connections in refrigerant lines; Flexonic, Anaconda or equal, metal hose, full size.
- 3. Anchor piping securely on the system side of each flexible connection.



### 3.19 VALVE INSTALLATION

#### A. General:

1. Valves shall be full line size unless indicated otherwise on Drawings.
2. Install horizontal valves with valve stem above horizontal, except butterfly valves.
3. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
4. Locate valves for easy access and provide separate support where necessary.
5. Install valves in position to allow full stem movement.
6. Install exposed polished or enameled connections with special care showing no tool marks or exposed threads.
7. Butterfly valves conforming to the paragraph "Butterfly Valves" may be used in lieu of gate or globe valves for locations above grade.
8. Ball valves conforming to the paragraph "Ball Valves" may be used in lieu of gate valves for locations above grade for services 2-1/2 inches and smaller.
9. Valves 2-1/2 inches and smaller (except ball valves) in nonferrous water piping systems may be solder joint type with bronze body and trim.
10. Provide gate or globe valves on inlet and outlet of each pump.

#### B. Gate Valves:

1. Furnish valves in copper lines with adapters to suit valve / line requirements.
2. Underground gate valves:
  - a. Underground valves 3 inches and smaller may be furnished with operating nuts or hand-wheels, and with Ring-Tite joint ends.
  - b. Furnish and deliver to Owner one wrench of each size required for operating underground valves.

#### C. Swing Check Valves: Install in horizontal position with hinge pin level.

#### D. Butterfly Valves: Install with stems horizontal.

#### E. Silent Check Valves: Install in horizontal or vertical position between flanges.

#### F. Valve Adjustment: Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

### 3.20 HANGER AND SUPPORT INSTALLATION

- #### A. General: Support ductwork, equipment and piping so that it is firmly held in place by approved iron hangers and supports, and special hangers. Hanger and support components shall support weight of ductwork, equipment and pipe, fluid, and pipe insulation based on spacing between supports with minimum factor of safety of five based on ultimate strength of material used. Do not exceed manufacturer's load rating. Pipe attachments or hangers, of same size as pipe or tubing on which used, or nearest available. Rigidly fasten hose faucets, fixture stops, compressed air outlets, and similar items to the building construction. The Architect shall approve hanger material before installation. Where building structural members do not match piping and ductwork support spacing,

provide “bridging” support members firmly attached to building structural members in a fashion approved by the structural engineer.

1. Materials, design, and type numbers for support of piping per Manufacturers' Standardization Society (MSS), Standard Practice (SP)-58.
    - a. Provide copper-plated or felt-lined hangers for use on uninsulated copper tubing.
  2. Materials and design for ductwork support shall be per SMACNA “HVAC Duct Construction Standards, Metal and Flexible.”
- B. Hanger components shall be provided by one manufacturer: B-Line, Grinnell, Unistrut, Badger, or equal.
- C. Riser clamps: B-line model B3373, or equal.
- D. Rubber Neoprene Pipe Isolators:
1. Pipe isolators shall comprise an internal rubber or neoprene material that isolates pipe from hanger and structure. Install at all piping located in acoustical walls. Refer to Architectural Drawings for location of acoustical walls.
  2. Isolation material shall be either a rubber or neoprene material that prevents contact between the pipe and the structure. The rubber shall have between a 45 to 55 durometer rating and a minimum thickness of 1/2 inch.
  3. Manufacturers:
    - a. Vertical runs: Acousto-Plumb or equal.
    - b. Horizontal runs: B-Line, Vibraclamp; Acousto-Plumb or equal.
- E. Pipe Hanger and Support Placement and Spacing:
1. Provide a support or hanger close to each change of direction of pipe either horizontal or vertical and as near as possible to concentrated loads.
  2. Vertical piping hanger and support spacing: Provide riser clamps for piping, above each floor, in contact with the floor. Provide support at joints, branches, and horizontal offsets. Provide additional support for vertical piping, spaced at or within the following maximum limits:

| <u>Pipe Diameter</u> | <u>Steel Threaded or Welded (Note 3)</u> | <u>Copper Brazed or Soldered (Notes 3, 4)</u> | <u>CPVC &amp; PVC (Note 2)</u> |
|----------------------|------------------------------------------|-----------------------------------------------|--------------------------------|
| 1/2 - 1"             | 12 ft.                                   | Each Floor, Not to Exceed 10 ft.              | Base and Each Floor (Note 1)   |
| 1-1/4 - 2"           | 12 ft.                                   | Each Floor, Not to Exceed 10 ft.              | Base and Each Floor (Note 1)   |
| 2-1/2 - 3"           | 12 ft.                                   | Each Floor, Not to Exceed 10 ft.              | Base and Each Floor (Note 1)   |
| Over 4"              | 12 ft.                                   | Each Floor, Not to Exceed 10 ft.              | Base and Each Floor (Note 1)   |

- a. Note 1: Provide mid-story guides.
  - b. Note 2: For PVC piping, provide for expansion every 30 feet per IAPMO installation standard. For CPVC piping, provide for expansion per IAPMO installation standard.
  - c. Note 3: Spacing of hangers and supports for piping assembled with mechanical joints shall be in accordance with standards acceptable to authorities having jurisdiction.
  - d. Note 4: Includes refrigerant piping, including vapor and hot gas pipes.
3. Horizontal piping, hanger and support spacing: Locate hangers and supports at each change of direction, within one foot of elbow, and spaced at or within following maximum limits:

| <u>Pipe Diameter</u> | <u>Steel Threaded or Welded (Note 2)</u> | <u>Copper Brazed or Soldered (Notes 2, 3)</u> | <u>CPVC &amp; PVC (Note 1)</u> |
|----------------------|------------------------------------------|-----------------------------------------------|--------------------------------|
| 1/2 - 1"             | 6 ft.                                    | 5 ft.                                         | 3 ft.                          |
| 1-1/4 - 2"           | 7 ft.                                    | 6 ft.                                         | 4 ft.                          |
| 2-1/2 - 3"           | 10 ft.                                   | 10 ft.                                        | 4 ft.                          |
| Over 4"              | 10 ft.                                   | 10 ft.                                        | 4 ft.                          |

- a. Note 1: For PVC piping, provide for expansion every 30 feet per IAPMO installation standard. For CPVC piping, provide for expansion per IAPMO installation standard.
  - b. Note 2: Spacing of hangers and supports for piping assembled with mechanical joints shall be in accordance with standards acceptable to authorities having jurisdiction.
  - c. Note 3: Includes refrigerant piping, including vapor and hot gas pipes.
4. Suspended Piping:

- a. Individually suspended piping: B-Line B3690 J-Hanger or B3100 Clevis, complete with threaded rod, or equal. All hangers on supply and return piping handling heating hot water or steam shall have a swing connector at point of support.

| <u>Pipe Size</u> | <u>Rod Size Diameter</u> |
|------------------|--------------------------|
| 2" and Smaller   | 3/8"                     |
| 2-1/2" to 3-1/2" | 1/2"                     |
| 4" to 5"         | 5/8"                     |
| 6"               | 3/4"                     |

- b. Suspend rods from concrete inserts with removable nuts where suspended from concrete decks. Power actuated inserts will not be allowed.
- c. Trapeze Suspension: B-Line, or equal, 1-5/8 inch width channel in accordance with manufacturers' published load ratings. No deflection to exceed 1/180 of a span.
- d. Trapeze Supporting Rods: Shall have a safety factor of five; securely anchor to building structure.
- e. Pipe Clamps and Straps: B-Line B2000, B2400, or equal. Where used for seismic support systems, provide B-Line B2400 series, or equal, pipe straps.
- f. Concrete Inserts: B-line B22-I continuous insert or B2500 spot insert. Do not use actuated fasteners for support of overhead piping unless approved by Architect.
- g. Steel Connectors: Beam clamps with retainers.
5. Provide support for piping through roof, arranged to anchor piping solidly in place at the roof penetration.
6. Insulated Piping:
- a. Do not interrupt insulation at pipe hangers and clamps.
- b. Use thermal hanger shield inserts or MSS protection saddles and shields.
- c. Thermal Hanger Shield Inserts:
- 1) Use thermal-hanger shield insert with clamp sized to match OD of insert.
  - 2) Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  - 3) For below ambient services, maintain continuous vapor barrier.
  - 4) For Clevis or Band Hangers: Install thermal-hanger shield inserts with insulation protection shields.
  - 5) For Trapeze or Clamped Systems: Install thermal-hanger shield inserts with heavy-duty insulation protection shields. Install additional 180-degree galvanized shield for top of support if clamping is required.
- d. MSS Protection Saddles and Shields:
- 1) MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

- 2) MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
- 3) Shield Dimensions for Pipe: Of length recommended in writing by manufacturer to prevent crushing insulation. 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.

F. Piping Support to Structure:

1. Wood Structure: Provide and install wood blocking as required to suit structure. Provide lag screws or through bolts with length to suit requirements, and with size (diameter) to match the size of hanger rods required.
  - a. Do not install Lag screws in tension without written review and acceptance by Structural Engineer.

|                      |                           |
|----------------------|---------------------------|
| Side Beam Angle Clip | B-Line B3062--MSS Type 34 |
| Side Beam Angle Clip | B-Line B3060              |
| Ceiling Flange       | B-Line B3199              |

- b. Blocking for support of piping shall be not less than 2 inch thick for piping up to 2 inch size. Provide 3 inch blocking for piping up through 5 inch size, and 4 inch blocking for larger piping. Provide support for blocking in accordance with Structural Engineers requirements.
  - c. Where lag screws are used, length of screw shall be 1/2 inch less than the wood blocking. Pre-drill starter holes for each lag screw.
2. Steel Structure: Provide and install additional steel bracing as required to suit structure. Provide through bolts with length to suit requirements of the structural components. Burning or welding on any structural member may only be done if approved by the Architect.

G. Duct Hanger and Support Spacing: Conform to Requirements of CMC and SMACNA "HVAC Duct Construction Standards, Metal and Flexible."

H. Duct Support to Structure:

1. Upper connection of support to wood structure shall be with wood screws or lag screws in shear fastened in the upper one half of the wood structural member. Fasteners shall conform to the following schedule:

|                             |                         |
|-----------------------------|-------------------------|
| For ducts with P/2=30"      | #10 x 1-1/2" wood screw |
| For ducts with P/2=72"      | 1/4"x 1-1/2" lag screw  |
| For ducts with P/2 over 73" | 3/8"x 1-1/2" lag screw  |

2. Upper connection in tension to wood shall not be used unless absolutely necessary. Where deemed necessary the contractor shall submit calculations to show the size fastener and penetration required to support loads in tension from wood in accordance with the following schedule:

|                                    |                       |
|------------------------------------|-----------------------|
| For ducts with P/2=30"             | 260 pounds per hanger |
| For ducts with P/2=72"             | 320 pounds per hanger |
| For ducts with P/2=96"             | 460 pounds per hanger |
| For duct with P/2 larger than 120" | NOT ALLOWED           |

3. Install concrete inserts for support of ductwork in coordination with formwork as required to avoid delays in work.
4. Upper connection to manufactured truss construction must comply with truss manufacturers published requirements and Structural Engineers requirements.

### 3.21 INSULATION AND FIELD-APPLIED JACKET INSTALLATION

#### A. General:

1. The term "piping" used herein includes pipe, air separators, valves, strainers and fittings.
2. Clean thoroughly, test and have approved, all piping and equipment before installing insulation and/or covering.
3. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, ductwork, and equipment.
4. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment as specified in insulation system schedules.
5. 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.
6. Install insulation with longitudinal seams at top and bottom of horizontal runs.
7. Install multiple layers of insulation with longitudinal and end seams staggered.
8. Keep insulation materials dry during application and finishing.
9. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
10. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
11. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.

12. For piping, ductwork, and equipment, with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
13. Repair all damage to existing pipe, duct and equipment insulation whether or not caused during the work of this contract, to match existing adjacent insulation for thickness and finish, but conforming to flame spread and smoke ratings specified above.
14. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - a. Install insulation continuously through hangers and around anchor attachments.
  - b. 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.
  - c. 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.
  - d. Cover inserts with jacket material matching adjacent insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

B. Piping Insulation Installation:

1. General:
  - a. Apply insulating cement to fittings, valves and strainers and trowel smooth to the thickness of adjacent covering. Cover with jacket to match piping. Extend covering on valves up to the bonnet. Leave strainer cleanout plugs accessible.
  - b. Provide removable insulation covers for items requiring periodic service or inspection.
  - c. Insulation shall be vapor tight before applying PVC jacket and fitting covers. Verify suitability with manufacturer of insulation.
  - d. Provide pre-formed PVC valve and fitting covers for indoor piping.
  - e. Provide factory-fabricated aluminum valve and fitting covers for outdoor piping.
  - f. Provide Calcium Silicate rigid insulation and sheet metal sleeve, 18 inch minimum length at each pipe hanger. Seal ends of insulation to make vapor tight with jacket.
2. Below-Ambient Services Including Chilled Water Supply and Return and Refrigerant Piping:
  - a. Insulate valves and irregular surfaces to match adjacent insulation and cover with two layers of woven glass fiber cloth saturated in Foster Sealfas 30-36, 3M, or equal, extending 3 inches over the adjoining pipe insulation. Finish with a coat of Foster Sealfas 30-36, 3M, or equal. The 3 inch wide SSL end laps furnished with the insulation shall be adhered over the end joints. Seal entire surface of insulation vapor tight, including joints and ends of PVC or aluminum fitting covers.
  - b. Variable refrigerant flow (VRF) heat pump systems: Insulation for VRF system refrigerant piping shall be installed according to VRF unit manufacturer's instructions.
3. PVC Jacket Installation:
  - a. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.

- 1) Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

4. Aluminum Jacket Installation:

- a. Where insulated piping is exposed to the weather apply aluminum jacket secured with 1/2 inch stainless-steel bands on 12 inch centers. Install jacketing with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Cover fittings with glass cloth, two coats of Foster Sealfas 30-36, and factory-fabricated aluminum fitting covers, of same material, finish, and thickness as jacket. Insulation shall be vapor tight before applying metal jacket and fitting covers.
- b. Do not install aluminum jackets on refrigerant flexible connectors to vibration isolated outdoor condensing units. Coat elastomeric insulation with insulation manufacturer's recommended ultraviolet light protective coating.

C. Duct Insulation Installation:

1. General:

- a. Insulation applied to the exterior surface of ducts located in buildings shall have a flame spread of not more than 25 and a smoke-developed rating of not more than 50 when tested as a composite installation including insulation, facing materials, tapes and adhesives as normally applied. Material exposed within ducts or plenum shall have a flame-spread rating of not more than 25 and a smoke-developed rating of not more than 50.
- b. Duct insulation applied to the exterior surface of ducts installed outside the building insulation envelope shall meet minimum R-value of R-8 at 3 inches thickness and 3/4 pound per cubic foot density.
- c. Duct insulation applied to the exterior surface of ducts installed within the building insulation envelope shall meet minimum R-value of R-4.2 at 1-1/2 inches thickness and 3/4 pound per cubic foot density.

2. Mineral Fiber Blanket Installation:

- a. Insulate all unlined concealed supply and return ducts with fiberglass duct wrap, manufactured as a blanket of glass fibers factory laminated to a reinforced foil/kraft vapor retarding facing. Provide 2 inch stapling and taping flange. Wrap insulation entirely around duct and secure with outward clinching staples on 6 inch centers. Provide mechanical fasteners at maximum 18 inch centers for all bottoms of duct which are greater than 24 inches. Lap all insulation joints 3" minimum. Insulate ducts installed tight against other work before hanging in place. Seal all seams, both longitudinal and transverse, and all staple and mechanical fastener penetrations of facing with scrim backed foil tape or recommended sealant, to provide a vapor tight installation.

3. PVC Jacket Installation:

- a. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.



- 1) Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Equipment Insulation Installation:

1. General:

- a. Insulate pumps, coil u-bends where exposed outside airstream, air separators, heating hot water and chilled water storage tanks, and other elements that are in series with the fluid flow, according to the requirements of the California Energy Code.

2. Mineral-Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

- a. Apply adhesives according to manufacturer's recommended coverage rates per unit area, and for percent coverage of tank and vessel surfaces.
- b. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
- c. Protect exposed corners with secured corner angles.
- d. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
  - 1) Do not weld anchor pins to ASME-labeled pressure vessels.
  - 2) Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
  - 3) On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
  - 4) Do not overcompress insulation during installation.
  - 5) Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
  - 6) Impale insulation over anchor pins and attach speed washers.
  - 7) Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
- e. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
- f. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
- g. Stagger joints between insulation layers at least 3 inches.

- h. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
  - i. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
  - j. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- 3. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
  - a. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
  - b. Seal longitudinal seams and end joints.
- 4. Insulation Installation on Pumps:
  - a. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch- diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism. Do not enclose or insulate pump motor.
  - b. Fabricate boxes from G90 galvanized steel, at least 0.050 inch thick.
  - c. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.
- 5. PVC Jacket Installation:
  - a. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
    - 1) Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- 6. Aluminum Jacket Installation:
  - a. Where aluminum jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### 3.22 TEMPERATURE CONTROL SYSTEM INSTALLATION

- A. Provide thermostats where indicated on drawings. All wiring shall be in conduit. Provide all relays, transformers and the like to render the control system complete and fully operable. All control conduit to be rigid steel type.

### 3.23 EQUIPMENT START-UP

- A. Initial start-up of the systems and pumps shall be under the direct supervision of the Contractor.

- B. Equipment start-up shall not be performed until the piping systems have been flushed and treated and the initial water flow balance has been completed.
- C. It shall be the responsibility of the Contractor to assemble and supervise a start-up team consisting of controls contractor, start-up technician, and test and balance contractor; all to work in concert to assure that the systems are started, balanced, and operate in accordance with the design.
- D. After start-up is complete, instruct the Owner's personnel in the operation and maintenance of the systems. Obtain from the Owner's representative a signed memo certifying that instruction has been received.
- E. For additional requirements, refer to article, Check, Test and Start Requirements, in Section 23 00 50, Basic HVAC Materials and Methods.

### 3.24 TESTING AND BALANCING

- A. For testing and balancing requirements, refer to Section 23 05 93, Testing and Balancing for HVAC.

### 3.25 CLEANING AND PROTECTION

- A. As each duct section is installed, clean interior of ductwork of dust and debris. Clean external surfaces of foreign substances that might cause corrosive deterioration of metal or where ductwork is to be painted.
- B. Strip protective paper from stainless steel ductwork surfaces, and repair finish wherever it has been damaged.
- C. Temporary Closure: At ends of ducts that are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering that will prevent entrance of dust and debris until connections are to be completed.
- D. As each internally lined duct section is installed, check internal lining for small cuts, tears, or abrasions. Repair all damage with fire retardant adhesive.

### 3.26 EQUIPMENT MOUNTING

- A. Mount and anchor equipment in strict compliance with Drawings details. Alternate anchorage methods will not be considered for roof mounted equipment.

### 3.27 INDOOR PIPING INSULATION SCHEDULE

- A. Refrigerant Suction and Hot-Gas Piping, Cooling-Only Systems:
  - 1. Suction and hot-gas piping smaller than 1-1/2 inches diameter:
    - a. Flexible Elastomeric: 1/2 inch thick.
    - b. Mineral-Fiber, Preformed Pipe: 1/2 inch thick.
  - 2. Suction piping 1-1/2 inches diameter and larger:
    - a. Flexible Elastomeric: 1 inch thick.

- b. Mineral-Fiber, Preformed Pipe: 1 inch thick.

B. Refrigerant Vapor and Liquid Piping, Heat Pump Systems:

1. Vapor piping for heat pump applications smaller than 1-1/2 inches diameter:
  - a. Flexible Elastomeric: 1-1/2 inches thick.
  - b. Mineral-Fiber, Preformed Pipe: 1-1/2 inches thick.
2. Vapor piping for heat pump applications 1-1/2 inches diameter and larger:
  - a. Flexible Elastomeric: 2 inches thick.
  - b. Mineral-Fiber, Preformed Pipe: 2 inches thick.
3. Liquid piping for heat pump applications smaller than 1 inch diameter:
  - a. Flexible Elastomeric: 1 inch thick.
  - b. Mineral-Fiber, Preformed Pipe: 1 inch thick.
4. Liquid piping for heat pump applications 1 inch diameter and larger:
  - a. Flexible Elastomeric: 1-1/2 inch thick.
  - b. Mineral-Fiber, Preformed Pipe: 1-1/2 inch thick.

C. Hydronic Piping:

1. Chilled Water Piping:
  - a. Piping smaller than 1-1/2 inches diameter:
    - 1) Mineral-Fiber, Preformed Pipe: 1/2 inch thick.
  - b. Piping 1-1/2 inches diameter and larger:
    - 1) Mineral-Fiber, Preformed Pipe: 1 inch thick.
2. Heating Hot Water Piping:
  - a. Piping smaller than 1-1/2 inches diameter:
    - 1) Mineral-Fiber, Preformed Pipe: 1-1/2 inch thick.
  - b. Piping 1-1/2 inches diameter and larger:
    - 1) Mineral-Fiber, Preformed Pipe: 2 inches thick.

3.28 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping, Cooling-Only Systems:

1. All Pipe Sizes: Insulation shall be one of the following:

- a. Flexible Elastomeric: 1 inch thick.
- b. Mineral-Fiber, Preformed Pipe: 1 inch thick.

B. Refrigerant Vapor and Liquid Piping, Heat Pump Systems:

- 1. Vapor piping for heat pump applications smaller than 1-1/2 inches diameter:
  - a. Flexible Elastomeric: 1-1/2 inches thick.
  - b. Mineral-Fiber, Preformed Pipe: 1-1/2 inches thick.
- 2. Vapor piping for heat pump applications 1-1/2 inches diameter and larger:
  - a. Flexible Elastomeric: 2 inches thick.
  - b. Mineral-Fiber, Preformed Pipe: 2 inches thick.
- 3. Liquid piping for heat pump applications smaller than 1 inch diameter:
  - a. Flexible Elastomeric: 1 inch thick.
  - b. Mineral-Fiber, Preformed Pipe: 1 inch thick.
- 4. Liquid piping for heat pump applications 1 inch diameter and larger:
  - a. Flexible Elastomeric: 1-1/2 inch thick.
  - b. Mineral-Fiber, Preformed Pipe: 1-1/2 inch thick.

C. Refrigerant Flexible Connectors:

- 1. Flexible Elastomeric: Thicknesses as specified for rigid piping.

D. Chilled Water:

- 1. All Pipe Sizes: Insulation shall be the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

E. Heating-Hot-Water Supply and Return, 200 Deg F and Below:

- 1. All Pipe Sizes: Insulation shall be the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

3.29 INDOOR FIELD-APPLIED PIPING JACKET SCHEDULE

- A. Piping, concealed: None.
- B. Piping, exposed: PVC, 20 mils thick.

3.30 OUTDOOR FIELD-APPLIED PIPING JACKET SCHEDULE

- A. All Piping: Aluminum, Stucco Embossed: Thickness as follows:

| <u>Outer Insulation Diameter<br/>(Inches)</u> | <u>Minimum Aluminum Jacket Thickness (Inch)</u> |                                          |
|-----------------------------------------------|-------------------------------------------------|------------------------------------------|
|                                               | <u>Rigid Insulation</u>                         | <u>Non-Rigid Insulation<br/>(Note 1)</u> |
| 8 and Smaller                                 | 0.024                                           | 0.024                                    |
| Larger Than 8 Thru 11                         | 0.024                                           | 0.024                                    |
| Larger Than 11 Thru 24                        | 0.024                                           | 0.024                                    |
| Larger Than 24 Thru 36                        | 0.024                                           | 0.032                                    |
| Larger Than 36                                | 0.024                                           | 0.040                                    |

- Note 1: Non-rigid Insulation is defined as having a compressive strength of less than 15 psi.

### 3.31 INDOOR DUCT INSULATION SCHEDULE

#### A. Ducts Located Within Building Thermal Envelope:

- Minimum R-Value = R-4.2.
- Supply and Return Ducts: Mineral Fiber Blanket, 1-1/2 inches thick, 0.75 lb/cu. ft.

#### B. Ducts Located Within Building Outside Thermal Envelope:

- Minimum R-Value – R-8.0.
- Supply and Return Ducts: Mineral Fiber Blanket, 3 inches thick, 0.75 lb/cu. ft.

### 3.32 OUTDOOR DUCT INSULATION SCHEDULE.

#### A. Minimum R-Value = R-8.

- #### B. Refer to article, Ductwork, for internal duct lining. Provide 2 inches thick internal duct lining where indicated on Drawings.

### 3.33 INDOOR FIELD-APPLIED DUCT JACKET SCHEDULE

#### A. Insulated ducts in concealed spaces: None.

#### B. Insulated ducts in exposed unconditioned spaces: PVC, 20 mils thick.

### 3.34 EQUIPMENT INSULATION SCHEDULE

#### A. Insulate indoor and outdoor equipment that is not factory insulated.

#### B. Chilled-water pump insulation shall be the following:

- Mineral-Fiber Board: Thickness equal to insulation thickness for connected pipes and 3-lb/cu. ft. nominal density.

#### C. Heating-hot-water pump insulation shall be the following:

1. Mineral-Fiber Board: Thickness equal to insulation thickness for connected pipes and 3-lb/cu. ft. nominal density.
- D. Chilled-water expansion/compression tank insulation shall be one of the following:
1. Flexible Elastomeric: Thickness equal to insulation thickness for connected pipes.
  2. Mineral-Fiber Board: Thickness equal to insulation thickness for connected pipes and 3-lb/cu. ft. nominal density.
  3. Mineral-Fiber Pipe and Tank: Thickness equal to insulation thickness for connected pipes.
- E. Heating-hot-water expansion/compression tank insulation shall be one of the following:
1. Mineral-Fiber Board: Thickness equal to insulation thickness for connected pipes and 3-lb/cu. ft. nominal density.
  2. Mineral-Fiber Pipe and Tank: Thickness equal to insulation thickness for connected pipes.
- F. Chilled-water air-separator insulation shall be one of the following:
1. Flexible Elastomeric: Thickness equal to insulation thickness for connected pipes.
  2. Mineral-Fiber Board: Thickness equal to insulation thickness for connected pipes and 3-lb/cu. ft. nominal density.
  3. Mineral-Fiber Pipe and Tank: Thickness equal to insulation thickness for connected pipes.
- G. Heating-hot-water air-separator insulation shall be one of the following:
1. Mineral-Fiber Board: Thickness equal to insulation thickness for connected pipes and 3-lb/cu. ft. nominal density.
  2. Mineral-Fiber Pipe and Tank: Thickness equal to insulation thickness for connected pipes.
- 3.35 INDOOR, FIELD-APPLIED EQUIPMENT JACKET SCHEDULE
- A. Equipment, Concealed: None.
  - B. Equipment, Exposed: PVC: 20 mils thick.
- 3.36 OUTDOOR, FIELD-APPLIED EQUIPMENT JACKET SCHEDULE
- A. All Equipment: Aluminum, Stucco Embossed. Thickness as follows:

| <u>Outer Insulation Diameter<br/>(Inches)</u> | <u>Minimum Aluminum Jacket Thickness (Inch)</u> |                                          |
|-----------------------------------------------|-------------------------------------------------|------------------------------------------|
|                                               | <u>Rigid Insulation</u>                         | <u>Non-Rigid Insulation<br/>(Note 1)</u> |
| 8 and Smaller                                 | 0.024                                           | 0.024                                    |
| Larger Than 8 Thru 11                         | 0.024                                           | 0.024                                    |
| Larger Than 11 Thru 24                        | 0.024                                           | 0.024                                    |
| Larger Than 24 Thru 36                        | 0.024                                           | 0.032                                    |
| Larger Than 36                                | 0.024                                           | 0.040                                    |

- Note 1: Non-rigid Insulation is defined as having a compressive strength of less than 15 psi.

END OF SECTION



## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 09/30/2022 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 01/31/2025 – Added 1.02, paragraphs C thru F. Removed York, Johnson Controls, Inc. from 2.02, paragraph S and 2.03, paragraph R. Added Daikin to 2.05, paragraph L (to match Split Heat Pumps). Revised 2.05, L, paragraph 2 to Carrier / Toshiba Corporation (to match Split Heat Pumps). Added York – Johnson Controls to 2.08, paragraph N (to match High Efficiency Furnaces). Deleted PennBarry from 2.15, paragraph L. Revised 3.20, paragraph C to reference newly added Section 23 05 29 – Mechanical Pipe Supports and Anchors. Deleted 3.20, paragraphs D thru F.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Kitchen Makeup Air System shall use 100% OSA DX cooling/electric heating systems as a Basis of Design, Evaporative Cooling Style Systems are not acceptable.
- Wall type split system shall only be use in IDF/MDF rooms, all other Split Systems shall be above ceiling cassette style units with provisions for outside air connections.

## SECTION 23 80 00

## HEATING, VENTILATING AND AIR CONDITIONING

**PART 1 - GENERAL****1.01 SUMMARY****A. Section Includes:**

1. Roof mounted air conditioning units.
2. Roof mounted heat pump units.
3. Heating and ventilating units.
4. Split system heat pump units.
5. Split system air conditioning units.
6. Variable Refrigerant Flow - Split system heat pump units.
7. High efficiency furnace units.
8. Air cooled condensing units.
9. Cooling coils.
10. Refrigerant piping and fittings.
11. Electric radiant ceiling panels.
12. Fans.
13. Kitchen exhaust hood – type 1.
14. Kitchen exhaust hood – type 2.
15. Kiln exhaust hood system.
16. Welding exhaust system.
17. Relief and intake vents.
18. Louvers.
19. Air inlets and outlets.
20. Terminal Units.
21. Filters.
22. Dampers.
23. Ductwork.
24. Hydronic Piping.
25. Hydronic pumps.
26. Hydronic Piping Specialties.
27. Expansion loops.
28. Valves.
29. Valve boxes.
30. Insulation.
31. Thermal hanger shield inserts.

**1.02 RELATED REQUIREMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 23 00 50, Basic HVAC Materials and Methods.

- C. Section 23 05 15, HVAC Equipment and Air Distribution System Cleaning.
- D. Section 23 05 29, Mechanical Pipe Supports and Anchors.
- E. Section 23 05 48, Mechanical Vibration and Seismic Control.
- F. Section 23 05 53, Mechanical Identification.
- G. Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.
- H. Section 23 09 23, Energy Management Control System.

### 1.03 ADMINISTRATIVE REQUIREMENTS

#### A. Preinstallation Meetings:

1. Variable Refrigerant Flow System Conference: Installing contractor's foreman shall attend conference at Project site with design Engineer and equipment manufacturer's representative, to comply with requirements of this Section and manufacturer's installation requirements including but not limited to, the following:
  - a. Proposed deviations from system as shown and described in Contract Documents, including location of system components and impacts to refrigerant pipe sizing.
    - 1) Provide Coordinated Layouts as required by this Section for use in discussion.
  - b. Refrigerant piping assembly practices.
  - c. General discussion, question and answer period.
  - d. Walk site with equipment manufacturer's representative to identify conditions affecting installation of system as designed.

### 1.04 ACTION SUBMITTALS

- A. For additional requirements, refer to Section 23 00 50, Basic HVAC Materials and Methods.
- B. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, dimensions, weight, corner or mounting point weights, furnished specialties and accessories; and installation and start-up instructions. Product data shall include applicable product listings and standards. Refer to Section 23 00 50, Basic HVAC Material and Methods for additional requirements.
  1. Upon approval of submittal, provide manufacturer's installation and operating instructions to the Project inspector for the following:
    - a. Fire dampers, smoke dampers, and combination smoke-fire dampers.
    - b. Type 1 kitchen exhaust field applied grease duct enclosures.
- C. VRF Systems: Submit system documentation for a fully engineered system, including shop drawings, and wiring and control diagrams, showing location of required manufactured system components, component model numbers and capacities, and size and location of all field-installed components,

including piping, required seismic and thermal expansion loops, and wiring. Identify proposed deviations from system as shown in Contract Documents.

- D. Engineering Data: Submit fan curves and sound power level data for each fan unit. Data shall be at the scheduled capacity. Data shall include the name of the rating agency or independent laboratory.

#### 1.05 INFORMATIONAL SUBMITTALS

- A. For additional requirements, refer to Section 23 00 50, Basic HVAC Materials and Methods.
- B. Roof Curb Data: For roof mounted equipment where combined weight of equipment unit and roof curb or rail exceeds 400 pounds, submit calculations from manufacturer for roof curbs proving compliance with the seismic requirements of the California Building Code, and ASCE 7-10. Manufacturer shall certify that roof curbs are suitable for use indicated on Drawings and in Specifications for the seismic design category indicated in structural Contract Documents. Calculations shall be stamped and signed by a State of California registered structural engineer.
- C. Economizer Fault Detection and Diagnostics (FDD) System Data: For all air-cooled unitary direct-expansion units equipped with an economizer, provide data for third-party supplied California Energy Commission certified FDD controller, documenting compliance with the requirements of California Building Energy Efficiency Standards. Provide evidence of certification.
- D. Record of pre-installation meeting.
- E. Training Certificates of Completion: Submit certificate from equipment manufacturer, indicating attendance and successful completion of manufacturer's training program for variable refrigerant flow systems installation and service. Training shall include manufacturer's preferred methods for assembling and insulating refrigerant piping and accessories.
- F. Coordinated Layouts: Submit coordinated layouts. For requirements refer to article, Coordinated Layouts, in this Section.

#### 1.06 CLOSEOUT SUBMITTALS

- A. For additional requirements, refer to Section 23 00 50, Basic HVAC Materials and Methods.
- B. Maintenance Data: Submit maintenance data and parts list for each piece of equipment, control, and accessory; including "trouble-shooting guide," in Operation and Maintenance Manual.
- C. Record Drawings: Submit Record Drawings of installed ductwork, duct accessories, and outlets and inlets in accordance with requirements of Division 01.

#### 1.07 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Belts: One set(s) for each belt-driven unit.
  - 2. Provide one complete set(s) of MERV-13 filters for each 4" filter bank.

## 1.08 COORDINATED LAYOUT

- A. Coordinated layouts are required to amplify, expand and coordinate the information contained in the Contract Documents.
- B. Provide minimum 1/4 inch equals one foot scaled coordinated layout drawings showing plan and pertinent section or elevation views of piping, ductwork, equipment, accessories, and electrical systems. Drawings shall be reproducible and work of each trade represented shall be fully coordinated with structure, other disciplines, and finished surfaces. Drawings shall be presented on a single size sheet. Coordinated layout drawings shall have title block, key plan, north arrow and sufficient grid lines to provide cross-reference to design Drawings.
  - 1. Provide a stamp or title block on each drawing with locations for signatures from all contractors involved, including but not limited to the General, HVAC, Plumbing, Fire Protection, and Electrical contractors. Include statement for signature that the contractor has reviewed the coordinated layout drawings in detail and has coordinated the work of his trade.
  - 2. Show on drawings the intended elevation of all ductwork in accordance with the following example:
    - a. B.O.D. = 9'-0"  
OFFSET UP 6"  
B.O.D. = 9'-6"
  - 3. Highlight, encircle or otherwise indicate deviations from the Contract Documents on the coordinated layouts. Architect will not be responsible for identifying deviations from the original Contract Documents.
- C. Since scale of contract drawings is small and all offsets and fittings are not shown, Contractor shall make allowances in bid for additional coordination time, detailing, fittings, offsets, hangers and the like to achieve a fully coordinated installation. If changes in duct size are required, equivalent area shall be maintained and the aspect ratio shall not be in excess of 2 to 1 unless approved by the engineer. Drawings shall be submitted for review prior to fabrication and installation. Drawings may be submitted in packages representing at least one quarter of the building ductwork.
- D. Check routing on all ductwork before fabricating. Report any discrepancies to Architect. No extra cost will be allowed for failure to conform to above.

## 1.09 QUALITY ASSURANCE

- A. Design Criteria:
  - 1. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture.
  - 2. Supply all equipment and accessories in accordance with requirements of applicable national, state and local codes.
  - 3. All items of a given type shall be products of the same manufacturer.
  - 4. Scheduled equipment performance is minimum capacity required.
  - 5. Scheduled electrical capacity shall be considered as maximum available.

- B. Pump types and sizes regulated by the US Department of Energy's "Energy Conservation Standards for Pumps" 10 CRF Parts 429 and 431 shall be marked with a compliant  $PEI_{CL}$  or  $PEI_{VL}$  (Pump Energy Index, constant or variable load) value, basic model number, and RPM on the nameplate. Regulated pumps shall be listed in the Hydraulic Institute (HI) Energy Rating database ([er.pumps.org](http://er.pumps.org)) and be assigned an Energy Rating as defined in the HI 40.5 program guide.
- C. Variable Refrigerant Flow Split-System Heat Pump Installer Training: Installing contractor shall have completed training in installation and service of VRF system, by equipment manufacturer.
  - 1. Installing contractor shall obtain, at his own cost, equipment manufacturer's VRF system service tool, unless service tool is normally resident on controller specified for this Project.

#### 1.10 FIELD CONDITIONS

- A. Interruption of Existing Services: Do not interrupt services to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary services according to requirements indicated:
  - 1. Notify Architect no fewer than two days in advance of proposed interruption of services.
  - 2. Do not interrupt services without Architect's written permission.

#### 1.11 WARRANTY

- A. Air Conditioning Unit, Roof-Mounted:
  - 1. Compressor shall have a five-year warranty.
  - 2. Standard heat exchanger shall have a ten-year warranty.
- B. Heat Pump Unit, Roof-Mounted: Compressor shall have a five-year warranty.
- C. Heating and Ventilating Unit: Heat exchanger shall have minimum 10-year warranty.
- D. High Efficiency Furnace Unit:
  - 1. Heat exchangers shall have a 20-year warranty.
  - 2. Entire unit shall have a 5-year warranty.
- E. Air Cooled Condensing Unit: Unit shall have 5-year limited compressor warranty.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS

- A. Insulation products, including insulation, insulation facings, jackets, adhesives, sealants and coatings shall not contain polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations in amounts greater than 0.1 percent (by mass).

#### 2.02 AIR CONDITIONING UNIT, ROOF-MOUNTED

- A. Provide factory assembled single packaged outdoor rooftop mounted, electrically controlled gas heating and electric cooling unit, rated in accordance with ARI Standards 210/240 or 340/360, and

ETL or UL listed and labeled, classified in accordance with UL 1995. Provide refrigerant charge R-410A, all internal wiring, piping, controls, and special features required prior to field startup. Design unit to conform to the following:

1. California NOx emission requirements.
  2. ASHRAE 15.
  3. ASHRAE 90.1.
  4. Insulation, adhesive, and all materials exposed to air stream shall meet NFPA 90A requirements for flame spread and smoke generation.
  5. Unit casing shall be capable of withstanding 500-hour salt spray exposure per ASTM B117 (scribed specimen).
- B. Unit shall be rated in accordance with ARI sound standards 270 or 370.
- C. Unit shall be ETL or UL tested and certified in accordance with ANSI Z21.47 Standards as a total package.
- D. Roof curb shall be designed to conform to NRCA Standards.
- E. Unit shall be designed and manufactured in accordance with ISO 9001.
- F. For unit sizes applicable to Energy Star program, units shall be Energy Star qualified.
- G. Cabinet:
1. Provide galvanized steel unit cabinet, bonderized and coated with a baked enamel finish.
  2. All airstream interior surfaces shall be insulated with a minimum 1/2 inch thick, 1.5 lb density cleanable insulation. Insulation shall be encapsulated with panel design or have sealed edges.
  3. Cabinet panels shall be hinged with integrated non-corrosive hinges. Provide hinged access panels for the filter, compressors, evaporator fan, and control box/ heat section areas. Each panel shall have multiple latches and handles. Each external hinged access panel shall be permanently attached to the rooftop unit.
  4. Return air filters shall be accessible through a dedicated hinged access panel.
  5. Fork lift slots and rigging holes shall be provided in unit base rails. Base rails shall be minimum 16 gauge.
  6. Unit shall have an integral sloped condensate drain pan, providing minimum 3/4 in.-14 NPT connections for horizontal drain configuration. Provide unit with alternate vertical thru-the-bottom drain connection when furnished as standard for units sizes scheduled on Drawings. See Drawings for drain configuration. Pan shall be removable for cleaning and maintenance. All drain pans shall conform to ASHRAE 62.1 self-draining provisions.
  7. Unit shall have standard side and alternate field or factory installed thru-the-bottom power and control wiring connection capability. Thru-the-bottom electrical connections shall use manufacturer's approved water-tight connection method.
  8. Unit shall be field convertible to, or factory furnished with, horizontal air discharge, as applicable for unit sizes as scheduled on Drawings.
- H. Fans:

1. Centrifugal supply air blower (evaporator fan) shall have sealed, permanently lubricated ball bearings, or rigid pillow block bearings, as supplied as standard equipment for unit sizes scheduled on Drawings. Units supplied with pillow block bearings shall be furnished with accessible lubricant fittings. Provide belt-driven double inlet fan wheel, centrifugal type with forward curved blades and adjustable sheaves. Multiple speed direct drive motors may be utilized when supplied as standard equipment for efficiency and electrical requirements as scheduled on the Drawings. Fan wheel shall be steel, with corrosion resistant finish, dynamically balanced.
2. Condenser fans shall be of the direct-driven propeller type, with corrosion-resistant aluminum blades. Fans shall be dynamically balanced and discharge air upwards. Induced-draft blower shall be of the direct-driven, single inlet, forward-curved, centrifugal type, made from aluminized steel with a corrosion-resistant finish and shall be dynamically balanced.
3. Induced draft fan shall be of the direct driven, single inlet, forward-curved centrifugal type. Fan wheel shall be steel, with corrosion resistant finish, dynamically balanced.

I. Motors:

1. Compressor motors shall be cooled by refrigerant gas passing through motor windings and shall have line break thermal and current overload protection.
2. Evaporator fan motor shall have permanently lubricated, sealed bearings and inherent automatic-reset thermal overload protection or manual reset calibrated circuit breakers.
3. Totally enclosed condenser-fan motor shall have permanently lubricated, sealed bearings, and inherent automatic-reset thermal overload protection.
4. Induced-draft motor shall have permanently lubricated sealed bearings and inherent automatic-reset thermal overload protection.
5. For single-phase fan motors sized larger than 1/12 hp and smaller than 1 hp, refer to Article, Electric Motors, in Section 23 00 50, Basic HVAC Materials and Methods.

J. Compressor:

1. Fully hermetic, scroll type with internal high-pressure and temperature protection.
2. Factory installed rubber shock mounted and internally spring mounted for vibration isolation.
3. Compressor Anti-Recycle Timer: Compressor shall be prevented from restarting for a minimum of five minutes after shutdown, with manufacturers installed compressor cycle delay.

K. Coils:

1. Standard evaporator and condenser coils shall have aluminum plate fins mechanically bonded to seamless internally finned copper tubes with all joints brazed.
2. Units shall have face-split type evaporator coils.
3. For units with single compressor, condenser coils shall be single slab, single pass design. For dual compressor units, condenser coils shall be single slab, 2 pass design.
4. Evaporator coils shall be leak tested at minimum 150 psig, and pressure tested at minimum 450 psig.
5. Condenser coils shall be leak tested at minimum 150 psig, and pressure tested at minimum 650 psig.

L. Heating Section:



1. Induced-draft combustion type with direct-spark ignition system and redundant main gas valve with 2-stage capability on all 3-phase units.
2. Heat Exchanger:
  - a. The standard aluminized heat exchanger shall be of the tubular-section type constructed of minimum 20-gage aluminized steel.
3. Burners shall be of the in-shot type constructed of aluminum-coated steel.
4. All gas piping shall enter the unit at a single location. Gas entry shall be through side or bottom of unit. See Drawings for gas entry location. When bottom gas entry is utilized, unit shall be furnished with field installed conversion kit, arranged so that gas shut-off valve is accessible from the roof.
5. All factory-installed orifices are for operation up to 2,000 feet of altitude. For altitudes between 2,000 feet and 7,000 feet, a factory certified kit shall be furnished for field installation.
6. Units shall be suitable for use with natural gas or propane. Provide field-installed propane conversion kit as required, see schedule on Drawings.
7. The integrated gas controller board shall include gas heat operation fault notification using an LED (light-emitting diode).
8. Unit shall be equipped with anti-cycle protection with one short cycle on unit flame rollout switch or 4 continuous short cycles on the high-temperature limit switch. Fault indication shall be made using an LED.
9. The integrated gas controller board shall contain algorithms that modify evaporator-fan operation to prevent future cycling on high-temperature limit switch.
10. The LED shall be visible without removal of control box access panel.
11. Gas burner tray shall be removable for maintenance.
12. Heating section shall be insulated with foil-faced fiberglass insulation.

M. Refrigerant Components:

1. Each refrigerant circuit shall include:
  - a. Balanced port thermostatic expansion valve (TXV) with removable power element.
  - b. Solid core refrigerant filter driers with pressure ports.
  - c. Refrigerant pressure gage ports and connections on suction, discharge, and liquid lines.

N. Filter Section:

1. Standard filter section shall accommodate 4 inch deep filters. Filters shall conform to the "Air Filters" Article in this Specification Section.
2. Filter section shall use standard size filters.

O. Controls:

1. Unit shall be complete with self-contained low voltage fuse protected control circuit. Refer to Section 25 50 00, if included, and equipment schedule, sequence of operation and control diagram on Drawings for additional requirements.
2. When third party direct digital controls with an Energy Management System will be utilized, provide electro-mechanical controls with 24V thermostat interface.

3. When stand-alone thermostat operation is utilized, provide electro-mechanical controls with 24V thermostat interface or provide microprocessor controls.
  4. When stand-alone thermostat operation is utilized for single-zone VAV units, provide microprocessor controls. Units shall have factory mounted supply fan variable frequency drives.
  5. When third party direct digital controls with an Energy Management System will be utilized for single zone VAV units, provide microprocessor controls with BACnet or LON interface. Units shall have factory mounted supply fan variable frequency drives.
  6. Electro-mechanical controls shall include the following, as a minimum:
    - a. Service run test capability.
    - b. Provide compressor minimum run time (3 minutes) and minimum off time (5 minutes).
    - c. Economizer control.
    - d. Unit shall have 35° F low ambient cooling operation.
    - e. Time delay relay.
  7. Microprocessor controls shall include the following, as a minimum:
    - a. User diagnostic interface.
    - b. Unit control with standard suction pressure transducers and condensing temperature thermistors.
    - c. Shall provide a 5° F temperature difference between cooling and heating set points to meet ASHRAE 90.1 energy standard.
    - d. Service run test capability.
    - e. Shall accept input from a CO2 sensor (indoor).
    - f. Configurable alarm light shall be provided which activates when certain types of alarms occur.
    - g. Provide compressor minimum run time (3 minutes) and minimum off time (5 minutes).
    - h. Service diagnostic mode.
    - i. Economizer control.
    - j. Unit shall have 0° F low ambient cooling operation.
    - k. Time delay relay.
- P. Safeties:
1. Unit shall incorporate a solid-state compressor lockout that provides optional reset capability at the space thermostat, should any of the following safety devices trip and shut off compressor:
    - a. Compressor lockout protection provided for either internal or external overload.
    - b. Low-pressure protection.
    - c. Freeze protection (evaporator coil).
    - d. High-pressure protection (high pressure switch or internal).
    - e. Compressor reverse rotation protection.
    - f. Loss of charge protection.
    - g. Start assist on single-phase units.
  2. Supply-air sensor shall be located in the unit and detect both heating and cooling operation.
  3. Induced draft heating section shall be provided with the following minimum protections:
    - a. High-temperature limit switch.

- b. Induced-draft motor speed sensor.
  - c. Flame rollout switch.
  - d. Flame proving controls.
  - e. Redundant gas valve.
4. Phase Protection: Provide unit-mounted "SymCom," or equal, Motor Saver three phase voltage monitor, model 201A or equal, adjustable voltage range for each unit, install per manufacturer's recommendations, mount in NEMA 3R enclosure if exposed to the weather.
- a. Units shall provide the following features:
    - 1) Low voltage fault trip and reset.
    - 2) Voltage unbalance/phasing fault trip and reset.
    - 3) High voltage fault trip and reset.
    - 4) Transient Protection (Internal).
    - 5) Automatic restart.
  - b. Provide each unit with 600V socket, "SymCom" model OT08, or equal.
- Q. Operating Characteristics:
- 1. Unit shall be capable of starting and running at 125° F ambient outdoor temperature per maximum load criteria of ARI Standards 210 or 360.
  - 2. Unit will operate in cooling down to an outdoor ambient temperature of 35° F.
  - 3. Unit shall be provided with fan time delay to prevent cold air delivery in heating mode.
- R. Electrical Requirements:
- 1. All unit power wiring shall enter unit cabinet at a single location. Both unit side and bottom power entry provisions shall be provided. Refer to Drawings schedule for thru-the-bottom power wiring requirement.
- S. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
- 1. Carrier Corporation.
  - 2. Lennox
  - 3. AAON
- T. Provide the following additional features and equipment:
- 1. Roof Curb: Formed galvanized steel with wood nailer strip capable of supporting entire unit weight. Provide 3 inch wide bottom flange.
  - 2. Provide heavy-duty 18 gauge expanded metal coil guard grille to protect all surfaces of the condensing coil. Coil guard by Micrometl, Canfab, or equal.
  - 3. Modulating Power Exhaust Economizer: Micrometl, Canfab, or equal. Integrated type capable of simultaneous economizer and compressor operation.
    - a. Provide self-contained outdoor rooftop system, mounted directly to the return air compartment of the HVAC packaged equipment. Provide differential dry bulb economizer

control system and a factory programmed, fully programmable variable frequency drive package controlled by a differential pressure transmitter, mounted directly to the return air compartment of the HVAC packaged equipment. Design the system to continuously maintain space pressure, and provide capability of introducing up to 100 percent outdoor air.

- 1) Economizer control system shall be certified as meeting the requirements for Fault Detection and Diagnostics (FDD) in the California Building Energy and Efficiency Standards.
  - b. Provide outside differential pressure tubing termination with hex style pneumatic filter-muffler, minimum filtration 40 microns, 53 SCFM maximum at 100 psi, as manufactured by McMaster-Carr, or equal.
  - c. Provide hinged cabinet access doors and include latches to provide a tool-less entry for servicing.
  - d. Provide door lock on the power exhaust cabinet to meet ETL safety requirements.
  - e. Outdoor air intake dampers shall be low leak not to exceed 3 percent at 1 inch wg pressure differential and include stainless steel side seal and neoprene edge seal. Arrange dampers to close upon loss of power.
  - f. Provide belt driven exhaust blowers, double inlet, forward-curved centrifugal type. Provide gravity backdraft damper at fan outlet.
  - g. Provide fully programmable factory programmed variable frequency drive (VFD) package for each fan, driven by 4 to 20 mA signal from a differential pressure transmitter. Pressure transmitters shall measure 0 - 0.1 in wg. Install room sensor tubing with sensor tube termination installed within the room.
    - 1) Where direct digital controls are utilized, provide Belimo, or equal, damper actuator, complete with spring return and all controls required to make the system fully operational.
    - 2) Where stand-alone controls are utilized, provide Belimo, or equal, damper actuator, complete with spring return and all controls, including logic module, required to make the system fully operational.
4. Gas Flue Extensions:
- a. Provide at all locations where gas flue outlet will be within 10 feet of an adjacent building forced air inlet, or mechanical unit air intake, and where indicated on Drawings.
5. Other features, accessories, and equipment scheduled on Drawings.
- U. Replenish for a period of one year without cost to the Owner all refrigerant and oil required to maintain the proper levels.
- V. Owner Training: Manufacturer shall provide two initial on-site 4-hour training sessions for Owners' maintenance personnel. Manufacturer shall provide one 4-hour follow-up training session to be scheduled by Owner within one year of the date of the final initial training session. Training session agenda shall be as follows:
1. First session: Equipment.

2. Second session: Controls.
3. Follow-up session: Agenda by Owner.

## 2.03 HEAT PUMP UNIT, ROOF-MOUNTED

- A. Provide factory assembled single packaged outdoor rooftop mounted, electrically controlled electric cooling and heating unit, rated in accordance with ARI Standards 210/240 or 340/360, and ETL or UL listed and labeled, classified in accordance with UL 1995. Provide refrigerant charge R-410A, all internal wiring, piping, controls, and special features required prior to field startup. Design unit to conform to the following:
  1. ASHRAE 15.
  2. ASHRAE 90.1.
  3. Insulation, adhesive, and all materials exposed to air stream shall meet NFPA 90A requirements for flame spread and smoke generation.
  4. Unit casing shall be capable of withstanding 500-hour salt spray exposure per ASTM B117 (scribed specimen).
- B. Unit shall be rated in accordance with ARI sound standards 270.
- C. Unit shall be ETL or UL tested and certified in accordance with ANSI Z21.47 Standards as a total package.
- D. Roof curb shall be designed to conform to NRCA Standards.
- E. Unit shall be manufactured in a facility registered to ISO 9001:2000.
- F. Unit shall be Energy Star qualified.
- G. Cabinet:
  1. Provide galvanized steel unit cabinet, bonderized and coated with a baked enamel finish.
  2. All airstream interior surfaces shall be insulated with a minimum 1/2 inch thick, 1 lb density cleanable insulation. Heat compartment for optional electric heater shall be insulated with minimum 1/2 inch thick, 1 lb. density foil-faced insulation.
  3. Cabinet panels shall be removable. Provide access panels for the filter, compressors, evaporator fan, and control box. Each external hinged access panel shall be insulated, with insulation encapsulated with panel or with sealed edges.
  4. Return air filters shall be accessible through a dedicated tool-less removable access panel.
  5. Fork lift slots shall be provided in unit base rail. Base rail shall be minimum 16 gauge.
  6. Unit shall have a factory-installed internally sloped condensate drain pan, providing minimum 3/4 inch-14 NPT connections for both horizontal and alternate vertical drain configuration. See Drawings for drain configuration. Pan shall be removable for cleaning and maintenance. All drain pans shall conform to ASHRAE 62.1 self-draining provisions.
  7. Unit shall have standard side and alternate field or factory installed thru-the-bottom power and control wiring connection capability.
  8. Unit shall be field or factory convertible to horizontal air discharge.
- H. Fans:

1. Centrifugal supply air blower (evaporator fan) shall have permanently lubricated bearings. Provide belt-driven double inlet fan wheel, centrifugal type with forward curved blades and adjustable sheaves. Fan wheel shall be steel, with corrosion resistant finish, dynamically balanced.
2. Evaporator-fan motors shall be continuous operation, open drip-proof, and thermally protected. Bearings shall be sealed, permanently lubricated ball-bearing type.
3. Condenser fans shall be of the direct-driven propeller type, with corrosion-resistant aluminum blades. Fans shall be dynamically balanced and discharge air upwards. Condenser-fan motors shall be totally enclosed and thermally protected.

I. Compressor:

1. Fully hermetic, scroll type with internal high-pressure and temperature protection. Furnish with crankcase heater when normally supplied as standard equipment for model size scheduled on Drawings.
2. Factory installed rubber shock mounted and internally spring mounted for vibration isolation.
3. Compressor Anti-Recycle Timer: Compressor shall be prevented from restarting for a minimum of five minutes after shutdown, with manufacturers installed compressor cycle delay.

J. Coils:

1. Standard evaporator and condenser coils shall have aluminum plate fins mechanically bonded to seamless internally finned copper tubes with all joints brazed.
2. Condenser coils shall be single slab, single pass design. Single slab, 2 pass design may be utilized when supplied as standard equipment for unit size as scheduled on the Drawings.
3. Coils shall be leak tested at minimum 150 psig and pressure tested at minimum 450 psig.

K. Refrigerant Components:

1. Each refrigerant circuit shall include:
  - a. Fixed orifice metering device.
  - b. Solid core refrigerant filter driers with pressure ports.
  - c. Refrigerant pressure gage ports and connections on suction, and discharge lines.
  - d. Suction line accumulator.
  - e. Reversing valve.

L. Filter Section:

1. Standard filter section shall accommodate 4 inch deep filters. Filters shall conform to the "Air Filters" Article in this Specification Section.
2. Filter section shall use standard size filters.

M. Controls:

1. Unit shall be complete with self-contained low voltage fuse protected control circuit. Refer to Section 25 50 00, if included, and equipment schedule, sequence of operation and control diagram on Drawings for additional requirements.

2. When third party direct digital controls with an Energy Management System will be utilized, provide electro-mechanical controls with 24V thermostat interface.
3. When stand-alone thermostat operation is utilized, provide electro-mechanical controls with 24V thermostat interface or provide microprocessor controls.
4. When stand-alone thermostat operation is utilized for single-zone VAV units, provide microprocessor controls. Units shall have factory mounted supply fan variable frequency drives.
5. When third party direct digital controls with an Energy Management System will be utilized for single zone VAV units, provide microprocessor controls with BACnet or LON interface. Units shall have factory mounted supply fan variable frequency drives.
6. Electro-mechanical controls shall include the following, as a minimum:
  - a. Provide compressor minimum off time (5 minutes).
  - b. Economizer control.
  - c. Time delay relay.
  - d. Integrated adjustable defrost cycle.
7. Microprocessor controls shall be ASHRAE 62.1 compliant and include the following, as a minimum:
  - a. User diagnostic interface.
  - b. Unit control with standard suction pressure transducers and condensing temperature thermistors.
  - c. Shall provide a 5° F temperature difference between cooling and heating set points to meet ASHRAE 90.1 Energy Standard.
  - d. Service run test capability.
  - e. Shall accept input from a CO2 sensor (indoor) and provide demand ventilation control.
  - f. Provide compressor minimum off time (5 minutes).
  - g. Service diagnostic mode.
  - h. Economizer control.
  - i. Time delay relay.
  - j. Integrated adjustable defrost cycle.

N. Safeties:

1. Unit shall incorporate a solid-state compressor lockout that provides optional reset capability at the space thermostat, should any of the following safety devices trip and shut off compressor:
  - a. Compressor lockout protection provided for either internal or external overload.
  - b. Low-pressure protection.
  - c. Freeze protection (evaporator coil).
  - d. High-pressure protection (high pressure switch or internal).
  - e. Compressor reverse rotation protection.
  - f. Loss of charge protection.
  - g. Start assist on single-phase units.
2. Supply-air sensor shall be located in the unit and detect both heating and cooling operation.
3. Phase Protection: Provide unit-mounted "SymCom," or equal, Motor Saver three phase voltage monitor, model 201A or equal, adjustable voltage range for each unit, install per manufacturer's recommendations, mount in NEMA 3R enclosure if exposed to the weather.

a. Units shall provide the following features:

- 1) Low voltage fault trip and reset.
- 2) Voltage unbalance/phasing fault trip and reset.
- 3) High voltage fault trip and reset.
- 4) Transient Protection (Internal).
- 5) Automatic restart.

b. Provide each unit with 600V socket, "SymCom" model OT08, or equal.

O. Operating Characteristics:

1. Unit shall be capable of starting and running at 115° F ambient outdoor temperature per maximum load criteria of ARI Standards 210/240 or 340/360.
2. Unit with microprocessor or electro-mechanical controls shall operate in cooling down to an outdoor ambient temperature of 25° F.
3. Unit shall be provided with fan time delay to prevent cold air delivery in heating mode.

P. Electrical Requirements:

1. All unit power wiring shall enter unit cabinet at a single location. Both unit side and bottom power entry provisions shall be provided. Refer to Drawings schedule for thru-the-bottom power wiring requirement.

Q. Motors:

1. Compressor motors shall be cooled by refrigerant gas passing through motor windings and shall have line break thermal and current overload protection.
2. Evaporator fan motor shall have permanently lubricated, sealed bearings and inherent automatic-reset thermal overload protection or manual reset calibrated circuit breakers.
3. Totally enclosed condenser-fan motor shall have permanently lubricated, sealed bearings, and inherent automatic-reset thermal overload protection.
4. For single-phase fan motors sized larger than 1/12 hp and smaller than 1 hp, refer to Article, Electric Motors, in Section 23 00 50, Basic HVAC Materials and Methods.

R. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

1. Carrier Corporation.
2. Lennox
3. AAON

S. Provide the following additional features and equipment:

1. Roof Curb: formed galvanized steel with wood nailer strip capable of supporting entire unit weight. Provide 3 inch wide bottom flange.
2. Provide heavy-duty 18 gauge expanded metal coil guard grille to protect all surfaces of the condensing coil. Coil guard to be Micrometl, Canfab, or equal.



3. Modulating Power Exhaust Economizer: Micrometl, Canfab, or equal. Integrated type capable of simultaneous economizer and compressor operation.
  - a. Provide self-contained outdoor rooftop system, mounted directly to the return air compartment of the HVAC packaged equipment. Provide differential dry bulb economizer control system and a factory programmed, fully programmable variable frequency drive package controlled by a differential pressure transmitter, mounted directly to the return air compartment of the HVAC packaged equipment. Design the system to continuously maintain space pressure, and provide capability of introducing up to 100 percent outdoor air.
    - 1) Economizer control system shall be certified as meeting the requirements for Fault Detection and Diagnostics (FDD) in the California Building Energy and Efficiency Standards.
  - b. Provide outside differential pressure tubing termination with hex style pneumatic filter-muffler, minimum filtration 40 microns, 53 SCFM maximum at 100 psi, as manufactured by McMaster-Carr, or equal.
  - c. Provide hinged cabinet access doors and include latches to provide a tool-less entry for servicing.
  - d. Provide door lock on the power exhaust cabinet to meet ETL safety requirements.
  - e. Outdoor air intake dampers shall be low leak not to exceed 3 percent at 1 inch wg pressure differential and include stainless steel side seal and neoprene edge seal. Arrange dampers to close upon loss of power.
  - f. Provide belt driven exhaust blowers, double inlet, forward-curved centrifugal type. Provide gravity backdraft damper at fan outlet.
  - g. Provide fully programmable factory programmed variable frequency drive (VFD) package for each fan, driven by 4 to 20 mA signal from a differential pressure transmitter. Pressure transmitters shall measure 0 - 0.1 in wg. Install room sensor tubing with sensor tube termination installed within the room.
    - 1) Where direct digital controls are utilized, provide Belimo, or equal, damper actuator, complete with spring return and all controls required to make the system fully operational.
    - 2) Where stand-alone controls are utilized, provide Belimo, or equal, damper actuator, complete with spring return and all controls, including logic module, required to make the system fully operational.
- T. Replenish for a period of one year without cost to the Owner all refrigerant and oil required to maintain the proper levels.
- U. Owner Training: Manufacturer shall provide two initial on-site 4-hour training sessions for Owners' maintenance personnel. Manufacturer shall provide one 4-hour follow-up training session to be scheduled by Owner within one year of the date of the final initial training session. Training session agenda shall be as follows:
  1. First session: Equipment.
  2. Second session: Controls.
  3. Follow-up session: Agenda by Owner.

## 2.04 SPLIT SYSTEM HEAT PUMPS

- A. General: Furnish and install split system air-to-air heat pump system, with R410A refrigerant, and complete with automatic controls. Equipment shall be shipped factory assembled, wired, tested, and ready for field connections.
- B. Quality Assurance:
  - 1. Unit shall be ETL or UL listed and labeled.
  - 2. Unit shall be manufactured in a facility registered to ISO 9001:2000.
  - 3. Unit shall be rated in accordance with ARI standard 210.
- C. Delivery, Storage and Handling: Follow manufacturer's recommendations.
- D. Heating/Cooling System: The total certified heating/cooling capacity shall not be less than scheduled. The compressor power input shall not exceed that of the unit specified.
- E. Indoor Section: Wall mounted, ceiling surface mounted, or ceiling recessed mounted, as indicated on Drawings.
  - 1. Cabinet:
    - a. Wall mounted: Molded white high strength plastic.
      - 1) Provide wall mounted unit with factory mounting plate.
    - b. Ceiling surface mounted: Molded white high strength plastic with provision for outside air duct connection.
    - c. Ceiling recessed mounted: galvanized steel with provision for outside air duct connection.
  - 2. Fans: Double inlet, forward curved, statically and dynamically balanced.
  - 3. Fan Motor: Direct drive, permanently lubricated, with two or 4 speed operation for unit size scheduled on Drawings.
    - a. For single-phase fan motors sized larger than 1/12 hp and smaller than 1 hp, refer to Article, Electric Motors, in Section 23 00 50, Basic HVAC Materials and Methods.
  - 4. Air Outlet: With motorized horizontal and vertical vanes.
    - a. Wall and ceiling surface mounted units: Horizontal vane shall close air outlet upon unit shut-down.
  - 5. Evaporator Coil: Aluminum fins mechanically bonded to copper tubes. Coils shall be pressure leak tested.
  - 6. Insulation: Interior surfaces exposed to the airstream shall be fully insulated.
- F. Outdoor Section:
  - 1. Casing: Galvanized steel plate, powder coated with acrylic or polyester.
  - 2. Condenser Fan Grille: ABS plastic.

3. Fan and fan motor: Direct drive, totally enclosed, propeller type, permanently lubricated, horizontal discharge.
  4. Compressor: Variable speed rotary type, with crankcase heater and accumulator. Compressor shall be capable of operating at 0 degrees F. Compressor mounted on vibration isolator pads.
  5. Coil: Aluminum fins mechanically bonded to copper tubes. Coils shall be pressure leak tested. Provide coil with integral metal guard.
- G. Controls: Hard wired, microprocessor based, wall mounted controller with LCD display shall provide the following functions, as a minimum:
1. 7-day programmable timer.
  2. Test and check functions.
  3. Diagnostic functions.
  4. Vane position control.
  5. Fan speed adjustment.
  6. Temperature adjustment.
  7. Automatic restart.
  8. Mode selection, including heat/auto/cool/dry/fan.
    - a. Provide lockable enclosure for wall mounted controller.
- H. Safeties: Shall include the following, as a minimum:
1. Five minute compressor anti-recycle timer.
  2. High pressure protection.
  3. Current and temperature sensing motor overload protection.
- I. Filters: Provide manufacturers washable filters for indoor unit. Provide sufficient filters for four complete changes for each unit.
- J. Service Access: All components, wiring, and inspection areas shall be completely accessible through removable panels.
- K. Refrigerant Piping:
1. Provide factory pre-charged and sealed line set piping, length to suit the location of equipment. Tubing sizes shall be in accordance with manufacturers written instructions.
  2. Provide refrigeration piping in accordance with Article, Refrigerant Piping, in this Section.
- L. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
1. Mitsubishi Electric Corporation
  2. Carrier / Toshiba Corporation.
  3. Daikin
- M. Owner Training: Manufacturer shall provide one on-site 2-hour training session for Owners' maintenance personnel.

**2.05 SPLIT SYSTEM AC UNIT**

- A. General: Furnish and install split system air conditioner, with R410A refrigerant, and complete with automatic controls. Equipment shall be shipped factory assembled, wired, tested, and ready for field connections.
- B. Quality Assurance:
  - 1. Unit shall be ETL or UL listed and labeled.
  - 2. Unit shall be manufactured in a facility registered to ISO 9001:2000.
  - 3. Unit shall be rated in accordance with ARI standard 210.
- C. Delivery, Storage and Handling: Follow manufacturer's recommendations.
- D. Cooling System: The total certified cooling capacity shall not be less than scheduled. The compressor power input shall not exceed that of the unit specified.
- E. Indoor Section: Wall mounted, ceiling surface mounted, or ceiling recessed mounted, as indicated on Drawings.
  - 1. Cabinet:
    - a. Wall mounted: Molded white high strength plastic.
      - 1) Provide wall mounted unit with factory mounting plate.
    - b. Ceiling surface mounted: Molded white high strength plastic with provision for outside air duct connection.
    - c. Ceiling recessed mounted: galvanized steel with provision for outside air duct connection.
  - 2. Fans: Double inlet, forward curved, statically and dynamically balanced.
  - 3. Fan Motor: Direct drive, permanently lubricated, with two or 4 speed operation for unit size scheduled on Drawings.
    - a. For single-phase fan motors sized larger than 1/12 hp and smaller than 1 hp, refer to Article, Electric Motors, in Section 23 00 50, Basic HVAC Materials and Methods.
  - 4. Air Outlet: With motorized horizontal and vertical vanes.
    - a. Wall and ceiling surface mounted units: Horizontal vane shall close air outlet upon unit shut-down.
  - 5. Evaporator Coil: Aluminum fins mechanically bonded to copper tubes. Coils shall be pressure leak tested.
  - 6. Insulation: Interior surfaces exposed to the airstream shall be fully insulated.
- F. Outdoor Section:
  - 1. Casing: Galvanized steel plate, powder coated with acrylic or polyester.
  - 2. Condenser Fan Grille: ABS plastic.

3. Fan and fan motor: Direct drive, totally enclosed, propeller type, permanently lubricated, horizontal discharge.
  4. Compressor: Variable speed rotary type, with crankcase heater and accumulator. Compressor shall be capable of operating at 0 degrees F. Compressor mounted on vibration isolator pads.
  5. Coil: Aluminum fins mechanically bonded to copper tubes. Coils shall be pressure leak tested. Provide coil with integral metal guard.
- G. Controls: Hard wired, microprocessor based, wall mounted controller with LCD display shall provide the following functions, as a minimum:
1. 7-day programmable timer.
  2. Test and check functions.
  3. Diagnostic functions.
  4. Vane position control.
  5. Fan speed adjustment.
  6. Temperature adjustment.
  7. Automatic restart.
  8. Mode selection, including cool/dry/fan.
- a. Provide lockable enclosure for wall mounted controller.
- H. Safeties: Shall include the following, as a minimum:
1. Five minute compressor anti-recycle timer.
  2. High pressure protection.
  3. Current and temperature sensing motor overload protection.
- I. Filters: Provide 1 inch thick fiberglass throwaway filters with cardboard holding frames for indoor unit. Provide sufficient filters for four complete changes for each unit.
- J. Service Access: All components, wiring, and inspection areas shall be completely accessible through removable panels.
- K. Refrigerant Piping:
1. Provide factory pre-charged and sealed line set piping, length to suit the location of equipment. Tubing sizes shall be in accordance with manufacturers written instructions.
  2. Provide refrigeration piping in accordance with Article, Refrigerant Piping, in this Section.
- L. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
1. Mitsubishi Electric Corporation.
  2. Carrier / Toshiba Corporation.
  3. Daikin.
- M. Owner Training: Manufacturer shall provide one on-site 2-hour training session for Owners' maintenance personnel.

**2.06 VARIABLE REFRIGERANT FLOW - SPLIT SYSTEM HEAT PUMPS – HEAT RECOVERY TYPE**

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

1. Mitsubishi w/diamond panel integration (Basis of Design) w/BACnet integration to Johnson Controls via Diamond Panel Integration.
2. Daikin w/BACnet integration to Johnson Controls
3. Hitachi w/BACnet integration to Johnson Controls

B. Indoor Units

1. General:

- a. Galvanized steel casing.
- b. Ducted, ceiling-recessed, or in-room units per Drawings schedule. Available styles shall include:

1) Concealed (ducted) units:

- a) Horizontal/Vertical air handling unit for closet or above-ceiling installation.
- b) Ceiling concealed.
- c) Ceiling concealed, with high-static option.

2) Recessed Units:

- a) Ceiling-recessed units: One-, two-, and four-way throw configurations.
- b) Floor-standing, recessed.

3) In-room units:

- a) Ceiling-suspended.
- b) Wall-mounted.
- c) Floor-standing.

- c. Factory assembled and tested with factory wiring, piping, expansion valve, control circuit board, and fan motor. Units shall have, as a minimum, the following functions:

- 1) Self-diagnostic function.
- 2) Auto restart function.
- 3) Auto changeover function.
- 4) Emergency operation function.
- 5) 3-minute time delay shall provide minimum 3 minute run time for cooling and heating.

- d. Indoor unit and refrigerant pipes shall be charged with dehydrated air prior to shipment from the factory.

- e. The indoor units shall be equipped with a return air thermistor.

2. Unit Cabinet:

- a. The cabinet shall be insulated with foamed polystyrene and polyethylene insulation.

3. Fan:

- a. The fan shall be direct-drive type, statically and dynamically balanced impeller with multiple high and low fan speeds. Auto fan setting shall automatically adjust fan speed.
- b. The fan motor shall be thermally protected.
- c. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings.
- d. For single-phase fan motors sized larger than 1/12 hp and smaller than 1 hp, refer to Article, Electric Motors, in Section 23 00 50, Basic HVAC Materials and Methods.
- e. Ceiling recessed and wall-mounted units shall have motorized louvers to direct airflow in up and down directions, and manually adjusted vanes for side-to-side adjustment of airflow direction.
- f. Ceiling suspended units shall have motorized guide vanes to vary airflow direction.
- g. All units shall be provided with a condensate drain pan below the coil. Drain pans shall have primary and overflow drains.
- h. Ceiling recessed units shall have an integral condensate pump. Refer to Drawings schedule for additional condensate pump requirements.

4. Coil:

- a. Coils shall be aluminum fins bonded to internally grooved copper tubes. Fins shall have corrosion-resistant coating.
- b. The coils shall be pressure tested at the factory.
- c. Unit shall be provided with ball-type refrigerant service valves at each refrigerant piping connection.
- d. A condensate pan and drain connections shall be provided under the coil. Provide overflow cutoff switch to disable unit during overflow condition.

5. Filters:

- a. Provide indoor units manufactured to accept washable filter media with two sets for each unit.
- b. Refer to Drawings schedule, and article, Filters, in this Section for filter requirements for ducted, above-ceiling units incorporating mixing boxes.

6. Controls:

- a. Units shall have controls provided by the manufacturer to perform input functions necessary to operate the system.
- b. Operating modes shall include Auto Changeover (heat recovery systems only), Heating, Cooling, Dry, and Fan Only.
- c. Units shall be compatible with a BMS system via optional LonWorks or BACnet gateways.
- d. Units incorporating mixing boxes for economizer operation shall be furnished with economizer control system certified as meeting the requirements for Fault Detection and Diagnostics (FDD) in the California Building Energy and Efficiency Standards.

C. Outdoor Condensing Units:

1. General:

- a. Condensing unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves (when required by manufacturer), 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and refrigerant accumulator and regulator.
- b. The following safety devices shall be included as part of the condensing unit; high pressure sensor and switch, low pressure sensor, control circuit fuses, over- and under-current protection, phase failure and phase reversal protection, fusible plug or pressure relief valve, and crankcase heater..
- c. All refrigerant lines shall be individually insulated between the condensing units and indoor units. .
- d. The system will automatically restart operation after a power failure without loss of settings.
- e. The condensing units shall be modular in design and allow for side-by-side installation with minimum spacing. Provide kit for field piping between connected condensing units. Refer to Drawings schedules and diagrams for connected units.
- f. To ensure the liquid refrigerant does not flash when supplying to indoor units, the circuit shall be provided with a sub-cooling feature.
- g. Oil recovery cycle shall be automatic occurring 2 hours after start of operation, and thereafter every 8 hours of operation. Each system shall maintain continuous heating during oil return operation. Reverse cycle (cooling mode) oil return during heating operation shall not be permitted due to the potential reduction in space temperature.
- h. The condensing unit shall be capable of heating operation at 0°F dry bulb ambient temperature without additional low ambient controls or an auxiliary heat source.
  - 1) Provide condensing unit with low ambient kit when scheduled on Drawings. Low ambient kit components shall be furnished with NEMA 4x rated control box for outdoor installation.

2. Unit Cabinet:

- a. The condensing unit cabinet shall be weatherproof and corrosion resistant. The unit shall be constructed from rust-proofed galvanized steel panels coated with a baked enamel or powder coat finish.

3. Fan:

- a. The condensing unit shall consist of one or more direct-drive, vertical discharge propeller fans with blades constructed of thermoplastic polymer material.
- b. The condensing unit fan motor shall be variable-speed digitally commutating (DC) type. Fan motor dipswitch shall allow increase of external static pressure setting.
- c. The fan motor shall have inherent protection and permanently lubricated bearings and be mounted on vibration isolators.
- d. The fan motor shall be provided with a fan guard to prevent contact with moving parts.

4. Condenser Coil:



- a. Coils shall be aluminum fins bonded to internally grooved copper tubes. Fins shall have corrosion-resistant coating.
  - b. The coils shall be pressure tested at the factory.
  - c. Unit shall be provided with ball-type refrigerant service valves at each refrigerant piping connection.
  - d. Condensing unit cabinet shall be provided with metal coil guard.
5. Compressor:
- a. The scroll compressors shall be variable speed pulse-width inverter (PVM inverter) controlled type, hermetically sealed, which shall vary the compressor speed to follow fluctuations in total cooling and heating load, determined by the suction gas pressure as measured in the condensing unit.
    - 1) The inverter driven compressor motor in each condensing unit shall be the reluctance DC (digitally commutating) type.
  - b. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.
  - c. Oil separators shall be provided as part of the compressor module together with an intelligent oil management system.
  - d. The compressor shall be isolated to avoid the transmission of vibration.
  - e. In the event of compressor failure the remaining compressors shall continue to operate and provide heating or cooling as required at a proportionally reduced capacity.
  - f. Multiple compressor operation sequencing: When multiple condenser modules are combined, operation hours of each compressor shall be balanced by means of a duty cycling function, enabling sequential starting of each module at each start/stop cycle, completion of oil return, and completion of defrost, or every 8 hours.
  - g. Refrigerant shall be R410a.
- D. Indoor Heat Recovery Controllers: Two- or three-pipe refrigerant control units to match outdoor condensing unit configuration. Heat recovery units shall be installed between outdoor condensing units and indoor zone-conditioning units. Indoor heat recovery unit shall operate to remove heat from zones requiring cooling, and distribute that heat to zones requiring heating. Refer to Drawings for unit locations. Refer to Drawings schedules and details for unit configuration and electrical requirements.
- E. Refrigerant Piping:
- F. All refrigerant lines shall be individually insulated between the condensing units and indoor units.
- 1. For interconnecting piping between outdoor and indoor equipment, refer to Article, Refrigeration Pipe and Fittings, in this Section.
- G. System Controls:
- 1. General: The controls network shall be capable of supporting remote controllers, schedule timers, system controllers, centralized controllers, an integrated web based interface, graphical

- user workstation, and system integration to a Building Management Systems via BACnet® and/or LonWorks®.
2. For additional information, Refer to Section 23 09 23, Direct Digital Control System for HVAC.
  3. Programmable Local Remote Controller: The programmable local remote controller shall be capable of controlling a minimum of 16 indoor units serving a single zone, and of operation with or without a central controller. Controller shall have the following minimum functions:
    - a. On/Off.
    - b. Operating mode (cool, heat, auto, dry, and fan, depending on selected system type).
    - c. Temperature setting.
    - d. Fan speed setting.
    - e. Air swing settings.
    - f. Room temperature and humidity display.
    - g. Occupancy sensor capable.
    - h. Schedule operations.
    - i. Allow/Prohibit local remote control functions.
    - j. Unit level error code display.
    - k. Test run.
    - l. Set temperature range limit.
    - m. Override of scheduled functions for indoor unit groups.
    - n. Lock out of On/Off, Mode, Set Temp., Hold-button, and Air Direction.
  4. Centralized Controller: The controller shall support system configuration, daily/weekly scheduling, monitoring of operation status, error email notification, online maintenance tool and malfunction monitoring. The controller shall have basic operation controls which can be applied to an individual indoor unit, a group of indoor units, or all indoor units. (cool, heat, auto, dry, and fan)The central controller shall be able to enable or disable operation of local remote controllers via a PC. Controller shall have the following minimum functions:
    - a. On/Off.
    - b. Operating mode (cool, heat, auto, dry, and fan, depending on selected system type).
    - c. Temperature setting.
    - d. Fan speed setting.
    - e. Air swing settings.
    - f. Room temperature display.
    - g. Schedule operations.
    - h. Morning warm-up/cool-down.
    - i. Night setback setting.
    - j. Allow/Prohibit local remote control functions.
    - k. Unit level error code display.
    - l. External input/output.
    - m. PC data back-up.
  5. BACnet® and/or LonWorks® Gateway: Gateway to allow connection to Energy Management Systems shall allow changes to the following, as a minimum:
    - a. On/Off.
    - b. Temperature setting.

- c. Alarm.
    - d. Operating mode.
    - e. Fan speed setting.
    - f. Allow/Prohibit local remote control functions.
    - g. High/Low limit setback temperature (heat recovery systems only).
    - h. Air direction/swing settings.
  - 6. Web browser: The controls network shall allow multiple individual users to monitor and control user defined zones via a network PC web browser.
  - H. Owner Training: Manufacturer shall provide one on-site 8-hour training session for Owners' maintenance personnel. 8-hour training shall include instruction in use of equipment manufacturer's service tool.
- 2.07 HIGH EFFICIENCY FURNACE UNIT (only allowed on modernization replacement project).
- A. Provide high efficiency multiple-speed condensing furnace/blower unit for upflow, downflow or horizontal application as indicated on the Drawings. Design unit to conform to the following:
    - 1. California Air Quality Management District emission requirements.
    - 2. ANSI Z 21.47/CSA 2.3 design standard for gas-fired central furnaces.
    - 3. When installed in Classrooms use "TeamAir" Enclosures with fully lined panels, Closure Panels to match roof angles, and Sound Attenuators.
  - B. Furnace unit shall have the following certifications:
    - 1. Third party certification by CSA International to current ANSI Z 21.47/CSA 2.3 design standard for gas-fired central furnaces.
    - 2. CSA Blue Star® and Blue Flame® labeled.
    - 3. Efficiency testing per current DOE test procedure as listed in the Federal Register.
    - 4. Federal Trade Commission Energy Guide efficiency labeled.
    - 5. GAMA Consumers' Directory of Certified Efficiency Ratings listed.
  - C. Unit shall be manufactured in a facility registered to ISO 9001:2000.
  - D. Cabinet:
    - 1. Pre-painted galvanized steel, minimum .030 inches thickness.
    - 2. Acoustically insulated blower section.
    - 3. Removable bottom closure panel for bottom return air configuration.
  - E. Fans and Motors:
    - 1. Centrifugal supply air blower shall be constructed of galvanized steel, statically and dynamically balanced.
    - 2. Blower motor shall be direct drive variable speed ECM type, with sealed permanently lubricated ball bearings.
    - 3. Inducer motor shall be direct drive variable speed ECM type, with sealed permanently lubricated ball bearings.

F. Heating Section:

1. Primary heat exchanger shall be 20 gauge corrosion resistant aluminized steel of fold-and-crimp sectional design, with Monoport inshot burners and redundant gas valve.
2. Secondary heat exchanger shall be polypropylene laminated steel of fold-and-crimp design.
3. Heat exchanger section shall be insulated with foil-faced insulation.
4. Line voltage ignitor.
5. Sealed combustion system.

G. Filters:

1. Standard filter section shall accommodate 4 inch deep filters, MERV 13 filters. Filters shall conform to the "Air Filters" Article in this Specification Section.
2. When Drawings indicate contractor-fabricated plenum containing filters, plenum shall accommodate 4 inch deep filters. Filters shall conform to the "Air Filters" Article in this Specification Section.
3. Filter section shall use standard size filters.

H. Controls:

1. Fused microprocessor based control board with diagnostic LED and self-test capability.
2. Unit blower shall operate at continuous speed only, adjust to achieve the airflow scheduled on the Drawings. Other blower speed settings shall be locked out.

I. Safeties:

1. Provide pressure switch for proving flow of flue products and manual reset over-temperature switch.
2. Provide with blower access panel safety interlock switch.

J. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

1. Carrier Corporation.
2. York – Johnson Controls
3. Lennox

K. Provide with mixed air plenum with filter rack and return and outside air dampers, arranged as indicated on Drawings.

1. Where economizer operation is indicated on Drawings, provide differential dry-bulb economizer control system, certified as meeting the requirements for Fault Detection and Diagnostics (FDD) in the California Building Energy and Efficiency Standards.

L. Provide condensate pump, arranged as indicated on Drawings, for removal of condensate from furnace units.

M. Owner Training: Manufacturer shall provide one on-site 1-hour training session for Owners' maintenance personnel.

**2.08 AIR COOLED CONDENSING UNIT**

- A. Provide outdoor-mounted, factory assembled, single piece, air-cooled, split-system air conditioner unit suitable for ground or rooftop installation, rated in accordance with ARI Standard 210, and UL or ETL listed and labeled. Provide refrigerant charge R-410A, all internal wiring, piping, controls, compressor, and special features required prior to field start-up. Design unit to conform to the following:
  - 1. ANSI/ASHRAE latest edition.
  - 2. NEC latest edition.
  - 3. Unit cabinet to be capable of withstanding Federal Test Method Standard No. 141 (Method 6061) 500-hr salt spray test.
  - 4. Unit shall be constructed in accordance with UL standards.
- B. Unit shall be certified for capacity and efficiency, and listed in the latest ARI directory.
- C. Unit shall be manufactured in a facility registered to ISO 9001:2000.
- D. Unit shall be Energy Star Qualified.
- E. Provide unit with 5 year limited parts warranty.
- F. Cabinet:
  - 1. Unit cabinet constructed of galvanized steel, bonderized, and coated with powder coat paint.
- G. Fans:
  - 1. Direct-drive propeller type condenser fan, discharging air vertically.
  - 2. Totally enclosed condenser fan motors, 1-phase type with Class B insulation and permanently lubricated bearings, and corrosion resistant shafts.
  - 3. Condenser fan openings equipped with PVC-coated steel wire safety guards.
  - 4. Statically and dynamically balanced fan blades.
- H. Compressor:
  - 1. Hermetically sealed compressor mounted on rubber vibration isolators.
  - 2. Compressor with sound insulator.
- I. Refrigeration Components:
  - 1. Refrigerant circuit to include liquid and vapor line shut-off valves with sweat connections.
  - 2. System charge of R-410A refrigerant and compressor oil.
  - 3. Unit to be equipped with factory-supplied high-pressure switch, low pressure switch, and filter drier.
  - 4. Provide unit with manufacturer's refrigerant line set.
  - 5. Provide refrigeration piping in accordance with Article, Refrigerant Piping, in this Section.
- J. Condenser Coil:

1. Air-cooled condenser coil constructed of aluminum fins mechanically bonded to copper tubes.
2. Coils shall be leak and pressure tested.

K. Electrical Requirements:

1. Unit shall have single point power connection.
2. Provide unit with 24V control circuit.

L. Operating Characteristics:

1. Unit shall be capable of starting and running a 115 degrees F ambient outdoor temperature per maximum load criteria of ARI Standard 210.
2. Compressor with standard controls shall be capable of operation down to 55 degrees F ambient outdoor temperature.

M. Provide the following additional components and features:

1. Provide evaporator freeze thermostat, winter start control, compressor start assist capacitor and relay, low ambient controller, and ball bearing fan motor.
2. Provide expanded metal coil guard for all sides of the air-cooled condensing unit. Coil guard shall be as manufactured by MicroMetl, Can-Fab, or equal.

N. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

1. Carrier Corporation.
2. York – Johnson Controls
3. Lennox

O. Owner Training: Manufacturer shall provide one on-site 1-hour training sessions for Owners' maintenance personnel.

## 2.09 COOLING COIL

A. Provide direct expansion encased cooling coil.

1. Install encased coil to operate properly in vertical or horizontal position as required. Construct coil with aluminum plate fins mechanically bonded in non-ferrous tubing with all joints brazed ultrasonically. Coil shall have factory-installed refrigerant metering device, refrigerant line fittings which permit mechanical connections, and condensate pan with primary and auxiliary drain connections.
2. Construct casings of galvaneal steel, bonderize, insulate, and finish with baked enamel.

## 2.10 REFRIGERATION PIPE AND FITTINGS

- A. Refrigeration gas and liquid piping shall be type ACR hard drawn copper tubing, cleaned and capped in accordance with ASTM B280, with wrought copper fittings. All joints shall be brazed with Sil-fos under nitrogen purge. Relief valve discharge piping shall be full size of relief discharge port.

1. Manufactured, pre-charged and pre-insulated refrigerant line-set refrigerant piping may be utilized at Contractor's discretion.
  - a. VRF Systems: Use of manufactured, pre-charged and pre-insulated refrigerant line-set refrigerant piping between outdoor condensing units and indoor heat recovery controllers, or distribution headers and tees is not allowed. When system manufacturer's installation instructions allow use of refrigerant line-set piping between indoor heat recovery controllers, or distribution headers and tees, and air terminal devices, follow instructions for allowable pipe size range and support to avoid forming traps in the piping.
- B. Variable Refrigerant Flow Heat Pump Systems Fittings:
  1. For systems manufacturers requiring engineered, pre-assembled headers and branch fittings, Contractor shall obtain such fittings from system manufacturer. Fittings shall be suitable for system type and configuration.
  2. For systems manufacturers not requiring engineered, pre-assembled headers and branch fittings, Contractor shall furnish fittings complying with manufacturer's requirements.
- C. Refrigeration Piping Specialties: Furnish and install Superior, Sporlan, Alco, Henry, or equal, stop valves, solenoid valves, adjustable thermal expansion valves, sight glass, flexible connection, charging valve, and drier with valve bypass in the liquid lines and Superior DFN shell and cartridge suction line filter sized 2-1/2 times tonnage.
  1. Install only those refrigeration piping specialties recommended by manufacturer of specific installed equipment.

#### 2.11 REFRIGERANT ACCESS VALVE LOCKING CAPS

- A. Each refrigerant circuit access valve located outside buildings, including valves located on roofs, shall be provided with a locking cap. Caps shall be of metal construction, with threaded brass inserts. Caps shall be color-coded according to ASHRAE standards for R22 and R410A refrigerant gasses, universal color for other refrigerant gasses. Caps shall be removable only with cap manufacturer's handheld tool.
  1. Provide minimum of two (2) cap removal tools for every ten (10) air conditioning units or other systems containing refrigerant installed under this Project.

#### 2.12 ELECTRIC RADIANT CEILING PANELS

- A. Provide radiant ceiling panels in locations as indicated and with capacities, style, and accessories as scheduled. The panels shall be UL or ETL listed.
- B. Construct panels using 24 gauge galvanized steel back overlapping and riveted to a 22 gauge galvanized steel front. Provide carbon (graphite) element and provide surface of multi-faceted crystalline type which will demonstrate a watt density of 1.00 watt per square foot at a distance of six feet down from the center of the panel, with a rated input of 95 watts per square foot with an average surface temperature of not more than 200 degrees F.
- C. Panels shall come with a five year warranty.

- D. Provide an extruded aluminum support frame, with 0.070 inch thick support brackets. Install brackets, frame and panels in accordance with manufacturers printed instructions.
- E. Provide a heavy-duty double line break thermostat, modified with blank front panel and 50 degrees F to 90 degrees F range.
- F. Provide locking cover for each thermostat.
- G. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
  - 1. Aztec Radiant Heating.

## 2.13 FANS

- A. All fans shall be Air Moving and Control Association Inc. (AMCA) labeled.
- B. Provide self-aligning, enclosed ball bearings, accessible for lubrication unless specified otherwise.
- C. Provide variable speed switch for all direct drive fans.
- D. Roof Mounted:
  - 1. Direct or V-belt Drive: Provide one-piece heavy-duty ventilator housings, one piece heavy gauge spun aluminum construction, with weatherproof assembly and integral weather shield. Mount ventilators on curbs furnished by the fan manufacturer. Install with fan assembly level.
  - 2. Fan wheels shall be centrifugal design, statically and dynamically balanced. Tip speed, rpm and motor horsepower shall not exceed listing in manufacturer's catalog for unit specified.
  - 3. Fans shall have integral factory formed base and one piece spinning without welding. Housings shall be provided with wiring channel and are to be of the direct discharge design. Motor and fan assembly shall be on vibration isolating mounts. Fans shall have capacity, speeds and motor sizes as shown.
  - 4. Provide the following accessories:
    - a. Gravity backdraft dampers.
    - b. Aluminum bird screen with a minimum of 85 percent free area.
    - c. Adjustable motor pulley.
    - d. Laboratory fume hood exhaust fans shall be Keysite coated.
    - e. Provide grease collection tray for kitchen exhaust fans.
    - f. Provide ventilated roof curb for kitchen exhaust fans where exhaust duct is mounted within rated shaft.
    - g. Provide hinge kit for kitchen hood exhaust fans.
- E. In-Line Propeller Fans:
  - 1. Heavy-duty propeller type with belt or direct drive as specified. Blades shall be individually mounted to wheel.
  - 2. Provide sloped roof or flat roof type roof cap, or wall cap to suit the location indicated on the Drawings.



## F. In-Line Centrifugal Fans:

1. Centrifugal fan with airfoil blades, aluminum or steel housing, externally mounted belt-drive motor, external lube tubes, integral support brackets.
2. Provide sloped roof or flat roof type roof cap, or wall cap to suit the location indicated on the Drawings.

## G. Ceiling Mounted Fans:

1. Acoustic lined cabinet, built-in back draft damper, vibration isolated fan and motor, variable speed switch.
2. Provide sloped roof or flat roof type roof cap, or wall cap to suit the location indicated on the Drawings.

## H. Fan Drives:

1. Drive Design: The design horsepower rating of each drive shall be at least 1.5 times, single belt drives 2 times, the nameplate rating of the motor with proper allowances for sheave diameters, speed ratio, arcs of contact and belt length.
2. Provide variable speed drives, Dayco, Browning, Woods, or equal. Allow for replacement of fan and motor drives and belts as required to suit the balance requirements of the project.
3. Select variable speed drives to allow an increase or decrease of minimum of ten percent of design fan speed.

## I. Motors:

1. Motors of 25 HP and less shall have adjustable pitch sheaves; sheaves on motors above 25 HP may be non-adjustable. Change, at no extra cost to Owner, the non-adjustable sheaves to obtain desired air quantities.
2. For single-phase fan motors sized larger than 1/12 hp and smaller than 1 hp, refer to Article, Electric Motors, in Section 23 00 50, Basic HVAC Materials and Methods.

## J. Sheaves: Sheaves shall be cast or fabricated, bored to size or bushed with fully split tapered bushings to fit properly on the shafts. All sheaves shall be secured with keys and set screws.

## K. Belts:

1. All belts shall be furnished in matched sets.
2. Belts shall be within 1 degree 30 minutes of true alignment in all cases.

## L. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

1. Greenheck Fan Corporation.
2. Loren Cook Company.

## M. Fly Fan (Air Curtain)

1. Manufacturer's standard, high velocity, non-recirculating type. Units for kitchens or food storage shall comply with NSF 37.

2. Casing: Sheet metal or polycarbonate plastic. Provide internal or external vibration isolation to effectively prevent transmission of vibration and noise from units to building structure. Units shall completely house all parts and have manufacturer's standard finish coating.
  3. Fans: Ruggedly constructed, statically and dynamically balanced. Noise level shall not exceed 77 dBA measured at 5 feet distance.
  4. Air Discharge Outlet Nozzle: Cover full width of door opening. Fan discharge ducts, plenum, flow control vanes and nozzles shall provide a uniform distribution of air over entire length of door. Provide adjustable volume and directional control.
  5. Heating Coil: Provide electric heating coil. Maximum discharge air temperature shall be 120 degrees F.
  6. Controls: Provide on-off door operated switch. The "on-off" switch circuit shall close to start fan motors when door starts to open and open when the door reaches closed position. A local disconnect switch for each fan motor shall be provided and shall be mounted to be accessible without use of ladder.
  7. Motors: Provide heavy-duty totally enclosed fan motor, sealed ball bearings, resilient mounting, automatic thermal overload switch, UL listed. Provide weather protection for motor and electrical equipment.
  8. Available Manufacturers: Subject to compliance with requirements, manufacturers offering air doors / fly fans which may be incorporated in the work include the following, or equal:
    - a. Mars Air Products; Mars Air Door Division.
    - b. Berner International.
    - c. Fantech.
- N. Owner Training: Manufacturer shall provide one on-site 1-hour training session for Owners' maintenance personnel.

#### 2.14 KITCHEN EXHAUST HOOD – TYPE 1

- A. Furnish packaged pre-manufactured ventilator, constructed of stainless steel, complete with baffles and lights. Unit shall be equal to that specified in equipment schedule.
- B. Each ventilator shall be a high velocity type grease extractor.
  1. Centrifugal grease extraction efficiency of 90 percent to be accomplished without the use of filters, cartridges, or constant running water. (Verify with hood selected)
- C. Compensating ventilators shall not be of the short-circuiting type. Furnish integral front face discharge for up to 80 percent make-up air of the exhausted air.
- D. Construction: The ventilator shall be of all stainless steel construction not less than 18 gauge, Type 304, number 4 finish. The assembly at joints and seams shall be liquid tight and all exposed external welds shall be ground and polished to match the original finish of the metal. All unexposed surfaces shall be constructed of minimum 18 gauge galvanized steel, including but not limited to duct, plenums, framing and brackets. Provide stainless steel closure panels as required for a complete finish, satisfactory to the Architect.
- E. Filters: Grease Filters shall be manufactured in accordance with UL 1046.

- F. Approvals: Ventilators to be listed or recognized by ICBO (refer to Research Report 2064), NSF, UL and in accordance with all recommendations of NFPA's Standard #96.
- G. Fire Suppression System:
  - 1. Fire suppression system shall be listed and labeled as conforming to NFPA 17A and UL 300, current edition.
  - 2. Furnish wet chemical system to protect the hood, exhaust duct and cooking appliances against fire. The system shall be installed by an authorized distributor in accordance with NFPA 96, NFPA 17A, UL listings, and the requirements of authorities having jurisdiction.
  - 3. The system shall be manually operable at the release. The system shall contain a fusible link series detector system for automatic actuation of the system. Actuation of the system shall provide automatic mechanical gas valve line shutoff. Provide manual operation, with local actuation at the tank enclosure.
  - 4. System shall consist of suppressant, pressurizing cartridge, Schedule 40 piping and nozzles. Provide system with fresh cartridge. Provide stainless steel enclosure for cartridge, regulated release mechanism, regulator and all other material required for operation of the system.
  - 5. System shall be Ansul R102, Kidde, or equal. Provide multiple system if required.
  - 6. Upon completion of the installation of the fire suppression system a test of the system shall be conducted in the presence of the enforcing agency.
- H. Owner Training: Manufacturer shall provide one on-site 1-hour training session for Owners' maintenance personnel.

#### 2.15 KITCHEN EXHAUST HOOD – TYPE 2

- A. General:
  - 1. Furnish ventilator hood of size and qualities as indicated on plans, the ventilator shall be of all stainless steel construction not less than 18 gauge, Type 304, Number 4 finish.
  - 2. Furnish condensate hoods with full perimeter welded condensate collecting gutter with 1/2 inch NPT stainless steel drain fitting.
- B. Approvals: Ventilators to be listed or recognized by ICBO (Research Report 2064), NSF, UL, and in accordance with all recommendations of NFPA-96.
- C. Owner Training: Manufacturer shall provide one on-site 1-hour training session for Owners' maintenance personnel.

#### 2.16 KILN EXHAUST HOOD SYSTEM

- A. Furnish Vent-A-Kiln, or equal, overhead, adjustable fume exhaust system at each kiln, with size as indicated on drawings, and as recommended by manufacturer. Unit shall be furnished with two speed motor and blower, spun aluminum hood, overhead counterweight pulley system, venting kit with flexible hose, and all clamps and mounting plates required for complete system operation.
- B. Provide three year warranty on all parts of the system.

**2.17 WELDING EXHAUST SYSTEM**

- A. Furnish Plymovent, Car-Mon, Nederman, or equal welding exhaust system with weld proof flexible tubing and receptors. Exhaust fan and exhaust apparatus to be by same manufacturer. Ductwork shall be United McGill Corp Sheet Metal Division, Air Systems, Inc., or equal.
- B. Owner Training: Manufacturer shall provide one on-site 4-hour training session for Owners' maintenance personnel.

**2.18 RELIEF AND INTAKE VENTS**

- A. Galvanized steel housing with 1/2 inch mesh screen, counterbalanced backdraft damper and matching prefabricated curb. Omit backdraft damper on intake vents. Provide pitched roof curb for relief vents, and install with backdraft damper level.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
  - 1. Greenheck Fan Corporation.
  - 2. Lauren Cook Company.
  - 3. PennBarry.
  - 4. American Coolair Corporation.

**2.19 LOUVERS**

- A. Louvers shall be minimum 16 gauge steel with Bonderite and Epon gray primer and 1/2 inch square mesh, 16 gauge galvanized steel screen on the inside. Louvers shall be Airolite #609, Arrow United Industries, or equal, with 4 inch louver depth.

**2.20 AIR INLETS AND OUTLETS**

- A. Except as otherwise indicated, provide manufacturer's standard inlets and outlets where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.
- B. Ceiling, wall or floor Compatibility: Provide inlets and outlets with border styles that are compatible with adjacent ceiling, wall or floor systems, and that are specifically manufactured to fit into ceiling, wall or floor module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems that will contain each type of air outlet and inlet.
- C. Refer to Schedule on Mechanical Drawings for details of inlets and outlets to be used.

**2.21 AIR TERMINAL UNITS**

- A. Shutoff, Single-Duct Air Terminal Units:
  - 1. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
  - 2. Casing: 0.034-inch-thick galvanized steel, single wall.

- a. Casing liner: Fibrous-glass duct liner, complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
  - 1) Minimum Thickness: 1/2 inch
  - 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) 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.
  - 4) Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
    - a) Adhesive VOC Content: 80 g/L or less.
    - b) Adhesive shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
    - c)
3. Inlets and Outlets: Air inlet shall be round or rectangular stub connection or S-slip and drive connections for duct attachment. Air outlet shall be S-slip and drive connections, size matching inlet size.
4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
6. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
  - a. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at 3-inch wg 6-inch wg inlet static pressure.
7. Hydronic Heating Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.
8. Controls:
  - a. Air terminal units shall be furnished with damper and multipoint velocity sensor. Damper actuator, pressure-independent, variable-air-volume (VAV) or constant-air-volume (CAV) controller with electronic airflow transducer, and room sensor are specified in Section 23 09 23 "Direct Digital Control (DDC) System for HVAC.
  - b. Control devices shall be compatible with temperature controls system
    - 1) Electronic Damper Actuator: 24 V, powered open, spring return.
    - 2) Terminal Unit Controller: Pressure-independent, variable-air-volume (VAV) or constant-air-volume (CAV) controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:
      - a) Occupied and unoccupied operating mode.
      - b) Remote reset of airflow or temperature set points.
      - c) Adjusting and monitoring with portable terminal.

- d) Communication with temperature-control system.
- 3) Room Sensor: Wall mounted, with the following features:
  - a) Digital display of sensed temperature.
  - b) Local temperature setpoint adjustment. Capable of manual override through control system operator.
  - c) Local override to turn HVAC on. Capable of manual override through control system operator.
  - d) Access for connection of portable operator terminal.
- 9. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Price Limited.
  - b. Titus.
  - c. Johnson Controls, Inc.

## 2.22 AIR FILTERS

- A. Provide MERV 13 disposable pleated media type. Refer to specific equipment Articles for filter depth and for exceptions to this specification. Filters shall conform to the following:
  - 1. Standards:
    - a. ASHRAE Standard 52.2-2007.
    - b. Underwriters Laboratories: U.L. 900, Class 2.
  - 2. Construction:
    - a. Media: Synthetic or cotton-synthetic blend with radial pleats.
    - b. Media Frame: High wet-strength beverage board.
    - c. Media Support: Welded wire or expanded metal grid bonded to air leaving side of the media.
  - 3. Performance: 4" deep filter shall have a maximum initial air resistance of 0.31 inches w.g.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
  - 1. Camfil Farr, Inc., model 30/30.
  - 2. Flanders Corporation, model 40 LPD.
- C. Temporary (Construction Period) Filters:
  - 1. Install new temporary filters in all units that have filter systems installed. Temporary filters shall match the permanent filters that are specified for the units. Replace filters as needed, in accordance with manufacturer's directions, in order to provide protection for the unit prior to occupancy by the Owner.

2. If air handling units are operated during construction of the project, install temporary filters directly over each return air inlet. Filters shall match the permanent filters that are specified for the units. Select size of filter to completely cover the frame of the return air inlet, and tape filters firmly in place to eliminate any construction debris from entering the duct system or unit. Remove the temporary filters upon completion of the work, and repair all damaged paintwork.

D. Spare Filters:

1. Furnish two new, complete sets of filter cartridges for each filter bank on completion and acceptance of the work. Install one set of filters in units (prior to final air balance). Provide units designed to accommodate washable, permanent filters with one washable, permanent filter.

## 2.23 DAMPERS

A. Backdraft Dampers: Ruskin CBD2, counterbalanced, Nailer Industries, or equal.

B. Manual Air and Balance Dampers: Provide dampers of single blade type or multi-blade type constructed in accordance with SMACNA, "HVAC Duct Construction Standards," except as noted herein.

1. Rectangular Ductwork:

- a. Single damper blades may be used in ducts up to 10 inches in height. Dampers shall be 16 gauge minimum. Provide self-locking regulators, equal to Ventlok 641. Provide end bearings equal to Ventlok 607 at each damper. Provide continuous solid 3/8 inch square shafts.
- b. Multiple blade dampers shall be equal to Ruskin CD35 Standard Control Damper. Maximum width for multiple damper blades for use in rectangular duct shall not exceed 6 inches.
- c. Where duct velocity may be expected to exceed 1500 fpm, provide Ruskin CD-50, or equal, low leakage dampers with airfoil blades.

2. Round Ductwork:

- a. Single damper blades may be used in ducts up to 12 inches in diameter. Provide multiple blade opposed blade dampers, with connected linkage, for ductwork larger than 12 inches in diameter.
- b. Damper blades for round ductwork shall be 20 gauge steel for ducts up to 12 inches diameter and 16 gauge steel for dampers larger than 12 inches diameter. Provide self-locking regulators, equal to Ventlok 641, Durodyne, or equal for operation of dampers. Provide end bearings equal to Ventlok 607 and provide continuous solid 3/8 inch square shafts.

3. Where ductwork is externally insulated, provide self-locking regulators equal to Ventlok 644, Durodyne, or equal for rectangular ductwork, and Ventlok 637, Durodyne, or equal for round ducts.

C. Fire Dampers and Combination Fire/Smoke Dampers:

1. Fire dampers and combination fire/smoke dampers shall be listed and approved by the California State Fire Marshal. Installation shall conform to the manufacturer's UL approved installation instructions.

- a. Fire dampers shall be UL 555 classified and labeled as dynamic fire dampers approved for wall and floor installation. They shall ship from the manufacturer as an assembly with a minimum 20-gauge factory installed sleeve. Sleeve length shall suit the requirements of the wall construction. Each dynamic fire damper/sleeve assembly shall ship complete with factory "roll formed" one-piece angles with pre-punched holes for easy installation. Dynamic fire dampers for vertical installation must consist of a single section on sizes up to 33" x 36" and a single section on sizes up to 24" x 24" for horizontal installation. 1-1/2 hour dynamic fire dampers shall be Ruskin DIBD20, Pottorff, or equal. 3 hour dynamic fire dampers shall be Ruskin DIBD230, Pottorff, or equal.
- b. Fire dampers for high pressure/velocity systems where velocities exceed 2000 fpm and/or 4" w.g. pressure fire damper shall be Ruskin FD60, Pottorff, or equal.
- c. Fire dampers for ceiling installation shall be UL 555C classified and labeled as ceiling dampers. They shall be provided with a thermal insulating blanket to fit the inlet or outlet condition if required by the application. Ceiling dampers shall be Ruskin CFD 2, 3, 4 or 5. Ceiling dampers for ceilings constructed of wood shall have UL tested in design L501 and shall be Ruskin CFD7, Pottorff, or equal.
- d. Combination fire/smoke dampers. Dampers shall be UL classified and labeled as Leakage Class I Smoke Dampers in accordance with the latest version of UL 555S. Dampers shall be warranted to be free from defects in material and workmanship for a period of 5 years after date of shipment. Damper/actuator assembly shall be tested to full open and full close at minimum 2000 fpm 250° F heated air and 4" w.g. with airflow in both directions. (Specified select: 250° / 350°, 2000 fpm/3000 fpm). Each damper shall be equipped with "controlled closure" quick detect heat actuated release device to prevent duct and HVAC component damage resulting from instantaneous damper closure. Release device shall be EFL type and shall allow reset from outside the sleeve after moderate temperature exposure. (Replacement type fusible links not acceptable.)
- e. Two position combination fire smoke dampers shall be equipped with one or more factory installed, direct coupled, 120 volt, single phase, electric actuator for energize open – fail close operation. Dampers with multiple actuators shall be factory wired with single point connection at the EFL heat release device for connection to power. Damper actuator shall include minimum one-year energized hold open (no cycles) and spring return (fail) close reliability. Damper/actuator shall include minimum 20,000 full open-full close cycle performances.
- f. Modulating combination fire smoke dampers shall be equipped with one or more factory installed contact for modulating signal connection. Damper/actuator shall include minimum 100,000 full open-full close cycle performances with spring return (fail) close on loss of power.
- g. Round combination fire smoke dampers up to 24" diameter shall be true round type with minimum 20 gauge galvanized steel designed for lowest pressure drop and noise performance. Bearings shall be stainless steel sleeve turning in an extruded hole in the frame. Blade seals shall be silicone edge designed to withstand 450° F and galvanized steel mechanically locked in to the blade edge (adhesive type seals are not acceptable). Each damper shall be equipped with a factory-installed sleeve of 17 inches minimum length and factory "roll formed" one-piece angles with pre-punched holes. Dampers shall be Ruskin FSDR25, Pottorff, or equal.
- h. Round (larger than 24" diameter) or rectangular combination fire smoke dampers shall include roll-formed structural hat channel frame, reinforced at the corners, formed from a



single piece of minimum 16 gauge equivalent thickness formed from single piece galvanized steel. Bearings shall be stainless steel turning in an extruded hole in the frame. Blade edge seals shall be silicone rubber designed to withstand 450° F and galvanized steel mechanically locked in to the blade edge (adhesive type seals are not acceptable). Each damper shall be equipped with a factory-installed sleeve of 17" minimum length and factory "roll formed" one-piece angles with pre-punched holes for easy installation. Dampers shall be Ruskin FSD60, Pottorff, or equal.

- i. 3-hour rated combination fire smoke dampers shall be Ruskin model FSD60-3, Pottorff, or equal.
- j. All FSD60 type dampers shall be AMCA licensed and shall bear the AMCA Seal for Air Performance. AMCA certified testing shall verify pressure drop does not exceed .03" w.g. at a face velocity of 1,000 fpm on a 24" x 24" damper.
- k. Wall type fire/smoke damper:
  - 1) Combination fire/smoke dampers for use in the wall of exit corridors shall be classified and labeled as Leakage Class II Smoke Dampers in accordance with the latest version of UL 555S. Dampers shall meet the requirements for combination fire/smoke dampers in paragraph 3 above except AMCA certified testing shall verify pressure drop does not exceed .07" w.g. at a face velocity of 1,000 fpm on a 24" x 24" damper and blades shall be single skin galvanized steel 10 gauge minimum with 3 longitudinal grooves for reinforcement. Dampers shall be Ruskin FSD36, Pottorff, or equal.
  - 2) Front access combination fire/smoke dampers shall meet all the requirements for combination fire/smoke dampers in paragraph 3 above except pressure drop requirement. In addition the dampers shall be constructed so that actuators and all accessories are accessible from the grille side. Actuators and accessories shall be housed within an integral cabinet on the side of the damper frame and shall not be installed in the air stream in front of the damper. The damper sleeve shall be minimum 14" and flanged to accept a steel framed grille. The sleeve shall be covered with fire resistant material. Dampers shall be Ruskin FSD60FA, Pottorff, or equal.
- l. Ceiling type fire/smoke damper for tunnel type corridor construction: Combination fire/smoke dampers for use in the corridor ceiling of tunnel type corridor construction shall be UL classified and labeled as Corridor Damper. Dampers shall meet the requirements of paragraph 4a above except pressure drop testing does not require AMCA certification. Dampers shall be Ruskin FSD36C, Pottorff, or equal.
- m. Fusible links shall have temperature rating approximately 50° F above normal maximum operating temperature of the heat producing appliance.
  - 1) If project requires re-openable fire/smoke dampers, provide Ruskin 165 ° F / 350° F TS150, NCA or equal. The TS150 firestat replaces the EFL and allows the damper to be re-opened from remote location up to 350 ° F. TS150 shall include full open and full closed damper position contacts for interface with remote position indication panel.
  - 2) Each fire/smoke damper shall be equipped with "controlled closure" quick detect heat actuated release device to prevent duct and HVAC component damage. Release device shall allow easy reset after moderate temperature rise outside the sleeve. Heat release device shall be the Ruskin EFL, NCA or equal.
  - 3) Unless the system is using a validation control system, each fire/smoke damper shall be equipped with a control panel including blade position indicator lights and a key

operated switch. The panel cover shall be oversized for flush mount into the wall or ceiling and shall have a brushed look. Control panel shall be Ruskin MCP2, Pottorff, or equal.

2. All actuators used for smoke dampers or combination fire/smoke dampers shall have a cycle time requirement of not more than every twelve months and shall be rated for continuous "On" duty and shall be provided with internal spring return. Actuators shall be equipped with pilot light, remote key test switch, end switch and circuitry to activate pilot light on remote key (test) switch located in corridor ceiling adjacent to damper. Electric motors shall be Invensys MA-250, MA-253, Honeywell H2000, or equal.
- D. Where required to suit the size of damper required, provide manufacturers standard UL Classified mullions, arranged to support multiple dampers. Assembly shall be of minimum 16 gauge galvanized steel, complete with all accessory caps and framing members required for installation.

## 2.24 DUCTWORK

- A. Construct and install sheet metal ductwork in accordance with the California Mechanical Code for 2 inches static pressure for supply air, and 2 inches minimum for return and exhaust air unless otherwise noted on Drawings.
  1. Where not in conflict with the California Mechanical Code, construct and install all sheet metal ductwork in accordance with SMACNA HVAC Duct Construction Standards (Metal and Flexible). Where applicable for HVAC work, construct and install sheet metal work in accordance with SMACNA Architectural Sheet Metal Manual.
  2. Provide variations in duct size, and additional duct fittings as required to clear obstructions and maintain clearances as approved by the Architect at no extra cost to the Owner.
  3. Gauges, joints and bracing shall be in accordance with the California Mechanical Code.
  4. Provide beading or cross breaking for all ductwork inside building. Provide cross breaking for ductwork exposed to weather.
  5. At the contractor's option, ductwork may be fabricated using the Ductmate, Nexus, Quickduct, Transverse Duct Connection (TDC), Pyramid-Loc duct connection systems, or equal. Fabricate in strict conformance with manufacturer's written installation instructions and in accordance with California Mechanical Code.
    - a. Seal flanged ends with pressure sensitive high density, closed cell neoprene or polyethylene tape gasket, Thermo 440, or equal.
    - b. Provide metal clips for duct connections, except at breakaway connections for fire dampers and fire smoke dampers. Provide corner clips at each corner of duct, through bolted, at all locations except at breakaway connections for fire dampers and fire smoke dampers. Where used on locations exposed to weather, provide continuous metal clip at top and sides of duct, with 1 inch overhang for top side.
- B. Design and installation standards:
  1. SMACNA Compliance: Comply with applicable portions of Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) for all work in this section.

2. NFPA Compliance: Comply with ANSI/NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," and ANSI/NFPA 90B, "Standard for the Installation of Warm Air Heating and Air Conditioning Systems."
  3. California Mechanical Code.
- C. Duct sizes indicated are external sizes.
- D. Galvanized Sheet Steel: Lock-forming quality, ASTM A924 and ASTM A653, Coating Designation G 90. Provide mill phosphatized finish for exposed surfaces of ducts exposed to view.
1. Provide mill certification for galvanized material at request of the Project Inspector.
- E. Duct Sealants:
1. Sealant shall have a VOC content of 250 g/L or less.
  2. Sealant shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
  3. Provide one part, non-sag, synthetic latex sealant, formulated with a minimum of 68 percent solids. Sealant shall comply with ASTM E84, Surface Burning Characteristics.
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
      - 1) Design Polymerics, model DP1010.
      - 2) Polymer Adhesive Sealant Systems Inc, model Airseal #11.
      - 3) McGill Airseal, LLC.
- F. Duct Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, straps, trim, and angles for support of ductwork.
- G. Rectangular Duct Fabrication:
1. Shop fabricate ductwork of gauges and reinforcement complying with the more stringent of the following standards, except as noted herein.
    - a. SMACNA HVAC Duct Construction Standards
    - b. California Mechanical Code
  2. Fabricate ducts for 2 inch pressure class with minimum duct gauges and reinforcement as follows, except as otherwise noted:

| <u>Table A</u>        |                      |                                    |
|-----------------------|----------------------|------------------------------------|
| <u>Duct Dimension</u> | <u>Minimum Gauge</u> | <u>Joint Reinforcement Per CMC</u> |
| Through 12"           | 26                   | Not Required                       |
| 13" through 18"       | 24                   | Not Required                       |
| 19" through 30"       | 24                   | C/4                                |
| 31" through 42"       | 22                   | E/4                                |
| 43" through 54"       | 22                   | F/2                                |
| 55" through 60"       | 20                   | G/4                                |
| 61" through 84"       | 20                   | I/2                                |
| 85" through 96"       | 20                   | J/2                                |
| Over 96"              | 18                   | K/2                                |

3. Fabricate duct fittings to match adjoining ducts and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to 1.5 times associated duct width. Fabricate to include single thickness turning vane in elbows where space does not permit the above radius or where square elbows are shown. Limit angular tapers to 30 degrees for contracting tapers and 20 degrees for expanding tapers. Turning vanes shall be E-Z Rail II, Durodyne, or equal.
4. Fabricate round supply connections at rectangular, plenum type fittings using spin-in type fittings, complete with extractor and volume control damper. Refer to Paragraph "DAMPERS" for damper requirements.
5. Provide drive slip or equivalent flat seams for ducts exposed in the conditioned space or where necessary due to space limitations. On ducts with flat seams, provide standard reinforcing on inside of duct. Duct connection to outlet on exposed duct shall be full size of outer perimeter of outlet flange.
6. Ducts exposed in the conditioned space shall be free of dents and blemishes and be mounted tight against adjacent surface with flat hangers. Remove all fabrication labels from ductwork.
7. Provide 20 gauge minimum for ductwork exposed within occupied spaces.

H. Rectangular Internally Insulated Duct Fabrication:

1. Provide internal duct lining where indicated on the Drawings, with a minimum of 10'-0" length in each direction from the fan, fan casing, or unit casing. Line all transfer ducts.

- a. Where ductwork is exposed to weather or outside the building insulation envelope, provide 2 inch thick, 1-1/2 pound density internal lining with matte facing, with an R-Value of 8.0 minimum.
- b. Where ductwork is within the building insulation envelope, lining shall be 1" thick, 1-1/2 pound density, with R-value of 4.2 minimum.
- c. Ducts exposed in the conditioned space shall be free of dents and blemishes and be mounted tight against adjacent surface with flat hangers. Remove all fabrication labels from ductwork.
- d. Where installed exposed in the conditioned space, duct shall be minimum 20 gauge with 1 inch insulation layer (minimum R-value – R-4.2).
- e. Cement duct liner in place with nonflammable, non-hardening duct adhesive. Seal all raw edges of insulation inside ductwork with adhesive, including longitudinal liner edges.
- f. Provide metal nosing at all locations where liner is preceded by unlined metal.
- g. Provide sheet metal weld pins and washers or clinch pins and washers on all ductwork on 12 inch intervals with the first row within 3 inches of the leading edge of each piece of insulation and within 4 inches of corners. No use of adhesive mounted pins will be considered.
  - 1) Install clinched pin fasteners with properly adjusted automatic fastening equipment. Manual installation will not be considered.
  - 2) Install weld pins with properly adjusted automatic fastening equipment. Installation shall not damage the galvanized coating on the outside of the duct.
- h. All ductwork, adhesives, lining, sealant, flex duct and the like shall have a flame spread of 25 or less and developed smoke rating of 50 or less when tested in accordance with one of the following test methods: NFPA 255, ASTM E84, or UL 723.
- i. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

| <u>Manufacturer:</u>    | <u>Product:</u> |
|-------------------------|-----------------|
| Johns Manville          | Linacoustic RC  |
| CertainTeed Corporation | ToughGard       |
| Fosters Adhesive        | 85-62           |
| Swifts Adhesive         | 7336            |

I. Round and Oval Ductwork Fabrication:

1. Round and oval duct and fittings shall be spiral lockseam or longitudinal seam as indicated in table below. Provide couplings to join each length of duct.

- a. At contractors' option, round or oval ductwork may be utilized in place of rectangular ductwork shown on Drawings, provided available space allows installation of round or oval ductwork without compromising space required for installation of products and systems of other trades.
- 1) Round or oval ductwork utilized in place of rectangular ductwork shown on Drawings shall be sized to have a static pressure loss equivalent to rectangular duct shown on Drawings.
  - 2) Unlined round or oval duct shall not be utilized in place of rectangular internally lined ductwork shown on Drawings.
2. Fabricate duct fittings to match adjoining ducts and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to 1.5 times associated duct width. Provide two-piece, die-stamped, 45-degree to 90-degree elbows for sizes up to 12 inches; five-piece, 90-degree elbows for sizes 12 inches and above; conical tees; and conical laterals. All reducers shall be placed after a tap has been made on the duct main. Reducers shall be long-taper style.
3. Round Ductwork: Construct of galvanized sheet steel complying with ANSI/ASTM A 653 by the following methods and in minimum gauges listed.

| <u>Diameter</u> | <u>Minimum Gauge</u> | <u>Method of Manufacture</u> |
|-----------------|----------------------|------------------------------|
| Up to 14"       | 26                   | Spiral Lockseam              |
| 15" to 23"      | 24                   | Spiral Lockseam              |
| 24" to 36"      | 22                   | Spiral Lockseam              |
| 37" to 50"      | 20                   | Spiral Lockseam              |
| 51" to 60"      | 18                   | Spiral Lockseam              |
| Over 60"        | 14                   | Longitudinal Seam            |

4. Provide locked seams for spiral duct; fusion welded butt seam for longitudinal seam duct.
5. Fittings and Couplings: Construct of minimum gauges listed. Provide continuous welds along seams at exposed ducts. Provide spot weld bonded seams at concealed ducts.

| <u>Diameter</u> | <u>Minimum Gauge</u> |
|-----------------|----------------------|
| 3" to 36"       | 20                   |
| 38" to 50"      | 18                   |
| Over 50"        | 16                   |

6. Ducts exposed in the conditioned space shall be free of dents and blemishes and be mounted tight against adjacent surface with flat hangers. Remove all fabrication labels from ductwork.
  7. Provide 20 gauge minimum for ductwork exposed within occupied spaces.
- J. Round Internally Insulated Duct and Fittings: Where ductwork is exposed to weather or outside the building insulation envelope, construct with outer pressure shell, 2 inch thick (Minimum R-value = R-8) insulation layer, and perforated inner liner. Where ductwork is within the building insulation envelope, construct with outer pressure shell, 1 inch thick (minimum R-value = R4.2) insulation layer, and perforated inner liner. Construct shell and liner of galvanized sheet steel complying with ANSI/ASTM A 653, of spiral lockseam construction (use longitudinal seam for over 59 inches), in minimum gauges listed in table below. Where installed exposed in the conditioned space: duct and fitting outer pressure shell shall be minimum 20 gauge with 1 inch insulation layer (minimum R-value = R-4.2), and perforated inner liner.

| <u>Nominal Duct Diameter</u> | <u>Outer Shell</u> | <u>Inner Liner</u> |
|------------------------------|--------------------|--------------------|
| 3" TO 12"                    | 26 gauge           | 24 gauge           |
| 13" TO 24"                   | 24 gauge           | 24 gauge           |
| 25" to 34"                   | 22 gauge           | 24 gauge           |
| 35" to 48"                   | 20 gauge           | 24 gauge           |
| 49" to 58"                   | 18 gauge           | 24 gauge           |
| Over 59"                     | 16 gauge           | 20 gauge           |

1. Fittings and Couplings: Construct of minimum gauges listed. Provide continuous weld along seams of outer shell at exposed ducts. Provide spot weld bonded seams at concealed ducts.

| <u>Nominal Duct Diameter</u> | <u>Outer Shell</u> | <u>Inner Liner</u> |
|------------------------------|--------------------|--------------------|
| 3" to 34"                    | 20 gauge           | 24 gauge           |
| 36" to 48"                   | 18 gauge           | 24 gauge           |
| Over 48"                     | 16 gauge           | 24 gauge           |

2. Inner Liner: Perforate with 3/32 inch holes for 22 percent open area. Provide metal spacers welded in position to maintain spacing and concentricity.
3. Ducts exposed in the conditioned space shall be free of dents and blemishes and be mounted tight against adjacent surface with flat hangers. Remove all fabrication labels from ductwork.
4. Where installed exposed in the conditioned space, duct shall be minimum 20 gauge with 1 inch insulation layer (minimum R-value – R-4.2).

5. All ductwork, adhesives, lining, sealant, flex duct and the like shall have a flame spread of 25 or less and developed smoke rating of 50 or less when tested in accordance with one of the following test methods: NFPA 255, ASTM E84, or UL 723.
  6. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. Sheet Metal Div., McGill AirFlow, LLC., Acousti-k27
    - b. Semco Duct and Acoustical Products, Inc.
    - c. Air Systems Manufacturing, Inc. - Las Vegas
- K. Duct Access Doors:
1. Duct Access: Provide hinged access door in rectangular ducts for access to fire dampers, control equipment, etc. Access door size shall be duct diameter wide by duct diameter high for all ducts under 24 inches. Ducts over 24 inches in diameter shall have 24-inch by 18-inch access doors. Minimum size access doors shall be 6 inches by 6 inches.
  2. Provide hinged style access doors for round ductwork, NCA Manufacturing, Inc., Model AD-RD-87, Pottorff Series 60, or equal. Access doors shall be 16 gauge galvanized steel with continuous piano hinge. Locks shall be plated steel strike and catch. Provide 1" x 3/8" Polyethylene "Perma Stik" gasket all around door.
- L. Flexible Air Ducts:
1. Provide exterior reinforced laminated vapor barrier, fiberglass insulation, encapsulated spring steel wire Helix, and impervious, smooth, non-perforated interior vinyl liner. Individual lengths of flexible ducts shall contain factory fabricated steel connection collars.
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
      - 1) C.A. Schroeder, Inc., Cal Flex model 2PMJ.
      - 2) ThermaFlex model M KC.
  2. Factory made air ducts shall be approved for the use intended and shall conform to the requirements of UL 181 and NFPA 90A. Each portion of a factory-made air duct system shall be identified by the manufacturer with a label or other suitable identification indicating compliance with UL 181, Class 1. Ducts shall be UL listed Class 1, maximum 25/50 smoke and flame spread and shall be installed in accordance with the terms of their listing and the requirements of SMACNA HVAC Duct Construction Standards (Metal and Flexible). Factory-made air ducts shall have the following minimum R-values: R-6.0 for ductwork installed within the building insulation envelope, R-8.0 for ductwork installed outside the building insulation envelope.
  3. Flexible ductwork shall be maximum of 5 feet long, and shall be extended to the fullest possible length, in order to minimize pressure drop in the duct.
  4. Flexible ducts shall be selected for minimum of 6 inch positive static pressure and minimum of 1 inch negative static pressure.
- M. Fabric Duct Air Dispersion System:



1. Duct: Fabric duct shall be constructed of inherently fire resistant polyester fabric complying with flame spread and smoke development index requirements of NFPA 90A when evaluated in accordance with UL 723 or other standard acceptable to authorities having jurisdiction. Treated or laminated fabric is not acceptable. Fabric shall be classified according to ICC AC167 and UL 2518. Fabric weight shall be minimum 6.75 oz./sq. yd. as tested per ASTM D3776. Duct shall be designed for inlet static pressure range of 0.25-3.0 in. wg. Fabric shall withstand without damage temperature range of 0-180 degrees F. Fabric air permeability shall be 0.5 CFM per sq. ft. when tested according to the requirements of ASTM D737.
  - a. Linear vent shall consist of round, open orifices in duct fabric, sized and spaced per Drawings, or as recommended by the manufacturer.
  - b. Duct color shall be selected by Architect from among manufacturers' available colors.
2. Duct Shape Retention System: Provide duct with shape retention system consisting of removable, round, 360 degree hoops, placed inside duct and spaced at 5 ft. o.c., or as recommended by fabric duct system manufacturer.
3. Duct Connections: Provide fabric duct system with hardware for duct inlet connection to metal duct. Inlet connection shall include zipper for removal or maintenance of duct. Duct sections and end caps shall be provided with zippers for connection, removal, and maintenance, number and location as normally provided by the manufacturer for the size and arrangement of duct as shown on Drawings.
4. Provide system with airflow, pressure control, and balancing devices as shown on Drawings and Drawing schedules.
5. Mounting: Provide fabric duct system with hardware for galvanized cable suspension system detailed on Drawings. Provide hanger attachment points on fabric duct, with locations compatible with duct suspension system detailed on Drawings.
6. Warranty: Provide with manufacturers' minimum 10 year warranty.
7. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
  - a. DurkeeSox.
  - b. DuctSox.

N. Kitchen Exhaust Ducts (Type 1):

1. Fabricate kitchen exhaust ducts and supports used for removal of smoke and grease-laden air from cooking equipment of 16 gauge minimum black steel where concealed and of 18 gauge minimum Type 304 stainless steel where exposed. At Contractor's option, 18 gauge minimum Type 304 stainless steel may be used where concealed. Finish exposed stainless steel with Number 4 finish. All ductwork shall be of welded construction in accordance with Section 510 of California Mechanical Code. For duct construction, comply with SMACNA "HVAC Duct Construction Standards" and ANSI/NFPA 96 "Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations."
2. Kitchen Exhaust Duct Access Panels:
  - a. Provide listed duct access panel assembly of the same material and gauge used for the duct. Duct access panels shall conform to the following:

- 1) Fasteners: Black steel or stainless steel to match material used for the duct. Panel fasteners shall not penetrate duct wall.
      - 2) Gasket: Comply with NFPA 96, grease-tight, high temperature ceramic fiber, rated for minimum 1500 °F.
      - 3) Minimum Pressure rating: 10 inches wg., positive or negative.
    - b. Available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      - 1) Ductmate Industries, Inc.
      - 2) 3M.
      - 3) Flame Gard, Inc.
  3. Field-Applied Grease Duct Enclosure:
    - a. Thermal Ceramics Firemaster FastWrap XL, or equal, field-applied grease duct enclosure listed in accordance with ASTM E 2336.
- O. Kitchen Exhaust Ducts (Type 2):
1. Cooking Equipment Exhaust Ducts:
    - a. Fabricate kitchen exhaust ducts and supports used for removal of vapor, heat and odors from cooking equipment of 16 gauge minimum black steel where concealed and of 18 gauge minimum Type 304 stainless steel where exposed. At Contractor's option, 18 gauge minimum Type 304 stainless steel may be used where concealed. Finish exposed stainless steel with Number 4 finish. All ductwork shall be of welded construction in accordance with Section 510 of California Mechanical Code. For duct construction, comply with SMACNA "HVAC Duct Construction Standards" and ANSI/NFPA 96 "Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations."
  2. Dishwasher Exhaust Ducts:
    - a. Fabricate dishwasher exhaust ducts and supports used for steam removal from dishwasher of 18 gauge minimum 304 stainless steel. All ductwork shall be of welded construction in accordance with Section 510 of California Mechanical Code. For duct construction, comply with California Mechanical Code, SMACNA "HVAC Duct Construction Standards," and ANSI/NFPA 96 "Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations."
  3. Duct Access Panels:
    - a. Provide duct access panel assembly of the same material and gauge used for the duct. Duct access panels shall conform to the following:
      - 1) Fasteners: Black steel or stainless steel to match material used for the duct. Panel fasteners shall not penetrate duct wall.
      - 2) Gasket: Comply with NFPA 96, grease-tight, high temperature ceramic fiber, rated for minimum 1500 °F.

- P. Type 1 Clothes Dryer Exhaust Ducts: Provide aluminum duct and fittings in wall and ceiling as indicated on Drawings.
- Q. Type 2 Clothes Dryer Exhaust Ducts:
1. Fabricate ducts and supports of 18 gauge minimum, Type 304, stainless steel. All duct seams and joints shall be welded. Finish exposed stainless steel with Number 4 finish.
- R. Shower exhaust ducts: Provide ducts and supports from stainless steel for a length of 20 feet from exhaust grille or register.
- S. Fume Hood Exhaust Ducts:
1. Round Ductwork:
    - a. Provide 18 gauge 304 stainless steel duct with spiral lockseam and welded joints. Fittings shall be 304 stainless steel, solid welded.
  2. Rectangular Duct:
    - a. Provide 18 gauge 304 stainless steel duct with Pittsburgh lockseam and welded joints. Fittings shall be 304 stainless steel, solid welded.
  3. Duct Finish: Where exposed to view, Number 4 finish.
  4. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. McGill Airflow, Inc.
    - b. SEMCO LLC.
- T. Flexible Connectors:
1. Materials: Flame-retardant or noncombustible fabrics. Coatings and adhesives shall comply with UL 181, Class 1, with flame spread index of 25 or less, and smoke-developed index of 50 or less.
  2. Metal-Edged Connectors: Factory fabricated with a fabric strip 3 inches wide attached to two strips of 3-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.
  3. Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
    - a. Minimum Weight: 26 oz./sq. yd.
    - b. Tensile Strength: Minimum 475 lbf/inch in the warp and minimum 375 lbf/inch in the filling.
    - c. Service Temperature: Minus 50 to plus 200 deg F.
  4. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. Ductmate Industries, Inc., model Proflex.
    - b. Ventfabrics, Inc., model Ventlon.

## 2.25 HYDRONIC PIPING

- A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Provide materials and products complying with California Mechanical Code. Where more than one type of material or product is indicated, selection from materials or products specified is Contractor's option.
- B. Chilled Water, Heating Hot Water, and Condenser Water Piping:
  - 1. Copper Tube and Fittings Aboveground:
    - a. Copper Tube and Fittings Aboveground: ASTM B88, Type L, drawn-temper, 150 psig minimum working pressure at 200 deg. F. Provide wrought-copper fittings and unions, ASTM B16.22, with full solder cup. Capped outlets shall be Schedule 40 screwed brass.
  - 2. Steel Pipe and Fittings Aboveground:
    - a. 2 inches and smaller: ASTM A 53/A 53M, Schedule 40 black steel with plain ends, 150 psig minimum working pressure at 200 deg. F. Provide malleable-iron threaded fittings, ASTM B16.3, Class 150, and unions, ASTM B16.39, Class 150, and cast-iron flanges and flange fittings, and threaded joints.
    - b. 2-1/2 inches and larger: ASTM A 53/A 53M, Schedule 40 black steel with plain ends, 150 psig minimum working pressure at 200 deg. F. Provide wrought-steel fittings, ASTM A 234/A 234M, and wrought-cast or forged-steel flanges and flange fittings, ASME B16.5, material group 1.1, with butt welding end connections and raised face.
  - 3. Underground Hydronic Piping:
    - a. Refer to Section 23 21 13.13, Underground Hydronic Piping.

## 2.26 HYDRONIC PUMPS

- A. Close-Coupled, End Suction Centrifugal Pumps
  - 1. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, cast iron, bronze-fitted, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally.
  - 2. Pump Construction:
    - a. Casing: Radially split, cast iron, drain plug at bottom and air vent at top of volute, threaded gage tappings at inlet and outlet, and flanged connections.
    - b. Impeller: ASTM B 584, cast bronze or cast brass; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
    - c. Pump Shaft: Steel, with copper-alloy shaft sleeve.
    - d. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.
    - e. Pump Bearings: Permanently lubricated or grease lubricated ball bearings as normally furnished for pump size scheduled on Drawings.

3. Motor: Single speed and rigidly mounted to pump casing with integral pump support.
    - a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
      - 1) Enclosure: Open, dripproof
      - 2) Enclosure Materials: Rolled steel.
      - 3) Motor Bearings: Permanently lubricated or grease-lubricated ball bearings as normally furnished for pump size scheduled on Drawings.
      - 4) Efficiency: Premium efficient.
  4. 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. ITT Corporation; Bell & Gossett.
    - b. Armstrong Pumps Inc.
    - c. PACO Pumps.
    - d. TACO Incorporated.
- B. Separately Coupled, Base-Mounted, End-Suction Centrifugal Pumps
1. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, cast iron, bronze-fitted, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal.
  2. Pump Construction:
    - a. Casing: Radially split, cast iron, drain plug at bottom and air vent at top of volute, threaded gage tappings at inlet and outlet, and flanged connections.
    - b. Impeller: ASTM B 584, cast bronze or cast brass; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
    - c. Pump Shaft: Steel, with copper-alloy shaft sleeve.
    - d. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.
    - e. Pump Bearings: Permanently lubricated or grease lubricated ball bearings as normally furnished for pump size scheduled on Drawings.
  3. Shaft Coupling: Replaceable molded-rubber insert and interlocking spider capable of absorbing vibration. Provide EPDM coupling sleeve for variable-speed applications.
  4. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.
  5. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.
  6. Motor: Single speed and secured to mounting frame, with adjustable alignment.
    - a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- 1) Enclosure: Open, dripproof.
  - 2) Enclosure Materials: Rolled steel.
  - 3) Motor Bearings: Permanently lubricated or grease-lubricated ball bearings as normally furnished for pump size scheduled on Drawings.
  - 4) Efficiency: Premium efficient.
7. 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. ITT Corporation; Bell & Gossett.
  - b. Armstrong Pumps Inc.
  - c. PACO Pumps.
  - d. TACO Incorporated.

C. Close-Coupled, In-Line Centrifugal Pumps

1. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, cast-iron, bronze fitted in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically.
2. Pump Construction:
  - a. Casing: Radially split, cast iron, drain plug at bottom and air vent at top of volute, threaded gage tapings at inlet and outlet, and flanged connections.
  - b. Impeller: ASTM B 584, cast bronze or cast brass; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
  - c. Pump Shaft: Steel, with copper-alloy shaft sleeve.
  - d. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.
  - e. Pump Bearings: Permanently lubricated or grease lubricated ball bearings as normally furnished for pump size scheduled on Drawings.
3. Motor: Single speed and rigidly mounted to pump casing.
  - a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
    - 1) Enclosure: Open, dripproof.
    - 2) Enclosure Materials: Rolled steel.
    - 3) Motor Bearings: Permanently lubricated or grease-lubricated ball bearings as normally furnished for pump size scheduled on Drawings.
    - 4) Efficiency: Premium efficient.
4. 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. ITT Corporation; Bell & Gossett.
  - b. Armstrong Pumps Inc.
  - c. PACO Pumps.

d. TACO Incorporated.

D. Separately Coupled, Horizontally Mounted Centrifugal In-Line Pumps

1. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, cast-iron, bronze fitted in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally.
2. Pump Construction:
  - a. Casing: Radially split, cast iron, drain plug at bottom and air vent at top of volute, threaded gage tappings at inlet and outlet, and flanged connections.
  - b. Impeller: ASTM B 584, cast bronze or cast brass; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
  - c. Pump Shaft: Steel, with copper-alloy shaft sleeve.
  - d. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket.
  - e. Pump Bearings: Permanently lubricated ball bearings.
3. Shaft Coupling: Replaceable molded-rubber insert with interlocking spider.
4. Motor: Single speed and resiliently mounted to pump casing.
  - a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
    - 1) Enclosure: Open, dripproof.
    - 2) Enclosure Materials: Rolled steel.
    - 3) Motor Bearings: Permanently lubricated or grease-lubricated ball bearings as normally furnished for pump size scheduled on Drawings.
    - 4) Efficiency: Premium efficient.
5. 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. ITT Corporation; Bell & Gossett.
  - b. Armstrong Pumps Inc.
  - c. PACO Pumps.
  - d. TACO Incorporated.

2.27 HYDRONIC PIPING SPECIALTIES

A. Bladder-Type Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
  - a. AMTROL, Inc.
  - b. Armstrong Pumps, Inc.
  - c. Bell & Gossett; a Xylem brand.

- d. TACO Comfort Solutions, Inc.
  2. Tank: Welded steel, rated for 125-psig (860-kPa) working pressure and 375 deg F (191 deg C) maximum operating temperature. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
  3. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
  4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.
- B. Tangential-Type Air Separators:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. AMTROL, Inc.
    - b. Armstrong Pumps, Inc.
    - c. Bell & Gossett; a Xylem brand.
    - d. TACO Comfort Solutions, Inc.
  2. Tank: Welded steel; ASME constructed and labeled for 125-psig (860-kPa) minimum working pressure and 375 deg F (191 deg C) maximum operating temperature.
  3. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
  4. Tangential Inlet and Outlet Connections: Threaded for NPS 2 (DN 50) and smaller; flanged connections for NPS 2-1/2 (DN 65) and larger.
  5. Blowdown Connection: Threaded.
  6. Size: Match system flow capacity.
- C. Calibrated Balance Valves (Symbol CBV): Provide globe style valves for precision regulation and control rated 175 psi for sizes 2-1/2 inches through 12 inches and rated 240 psi for bronze sizes 2 inches and smaller. Each valve shall have two metering/test ports with internal check valves and protective caps. All valves shall be equipped with visual position readout and concealed memory stops for repeatable regulation and control.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. Bell & Gossett Circuit Setter Plus.
    - b. Armstrong CBV.
    - c. Flow Design Inc. Accusetter.
    - d. Tour & Andersson.
    - e. Circuit Sensor with butterfly valve above 3 inches.
    - f. Illinois Series 5000 through 2 inches.
- D. Pressure Independent Flow Limiting Balancing Valves:
1. Ball Valve Type:
    - a. Body: Dezincification resistant brass.



- b. Cartridge: Removable, interchangeable, differential pressure regulating. Removable orifice plate to restrict maximum flow. Stainless steel spring. EPDM diaphragm.
- c. Ball: Plated brass or stainless steel.
- d. End Connections: Threaded or socket.
- e. Temperature/Pressure Gage Test Ports: Integral seals for portable testing instruments.
- f. Handle Style: Lever.
- g. Blowdown port with field-installed drain valve with hose-end connection.
- h. Provide valves with field-installed test port and operating handle extensions for insulated services.
- i. CWP Rating: Minimum 400 psig.
- j. Maximum Operating Temperature: 210 deg F.

2. Wafer Valve Type:

- a. Body: Ductile Iron.
- b. Cartridge: Single or multiple cartridges, removable, interchangeable, differential pressure regulating. Removable orifice plate to restrict maximum flow. Stainless steel spring. EPDM diaphragm.
- c. End Connections: Flanged.
- d. Temperature/Pressure Gage Test Ports: Integral seals for portable testing instruments. Provide valves with field-installed test port extensions for insulated services.
- e. CWP Rating: Minimum 250 psig.
- f. Maximum Operating Temperature: 230 deg F.

3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

a. Ball Valve Type:

- 1) Bell & Gossett; a Xylem Brand, model Circuit Sentry.
- 2) Griswold Controls, model Isolator "R".
- 3) Caleffi North America, Inc, model Flocal.

b. Wafer Valve Type:

- 1) Bell & Gossett; a Xylem Brand, model Circuit Sentry Wafer Valve.
- 2) Griswold Controls, model Wafer AHU.

E. Air Vent Valves:

- 1. Provide Armstrong #1AV, Hoffman Model 78, Metraflex Model MV-15A, or equal, where automatic type air vent is shown.

2.28 THERMAL AND SEISMIC EXPANSION LOOPS

- A. Manufactured assembly consisting of inlet and outlet elbow fittings, two sections of flexible metal hose and braid, and 180-degree return bend. Return bend section shall have support lug and plugged FPT drain. Flexible hose shall consist of corrugated metal inner hose and braided metal outer sheath. Assemblies shall be constructed from materials compatible with the fluid or gas being

conveyed and shall be suitable for the system operating pressure and temperature. Provide assembly selected for 4 inches of movement.

- B. Basis-of-Design Product: Subject to compliance with requirements, provide Metraflex Inc., Metraloop series, or comparable product by one of the following, or equal:

1. Flexicraft Industries.

## 2.29 PIPE JOINING MATERIALS

- A. Refer to Division 22 and 23 piping sections for special joining materials not listed below.

- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated
  - a. Full-Face Type: For flat-face, Class 125, cast iron and cast bronze flanges.
  - b. Narrow-Face Type: For raised-face, Class 250, cast iron and steel flanges.
2. AWWA C111, rubber, flat face, 1/8-inch (3.2mm) thick, unless otherwise indicated; and full-face or ring type, unless other indicated.
3. Flange Bolts and Nuts: AWWA C111, carbon steel, unless otherwise indicated.

- C. Brazing Filler Metals:

1. General Duty: AWS A5.8, BCup-5 Series, copper-phosphorus unless otherwise indicated. Sil-Fos 15, or equal.
2. Refrigerant Piping:
  - a. Joining copper to copper: AWS A5.8, BCup-5 Series, copper-phosphorus unless otherwise indicated. Sil-Fos 15, or equal.
  - b. Joining copper to bronze or steel: AWS A5.8, Bag-1, silver alloy unless otherwise indicated.

- D. Welding Filler Metals: Comply with ASME B31.1 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

## 2.30 VALVES

- A. Gate Valves:

1. 2-1/2 inches and smaller: Class150, bronze body, union bonnet, rising stem, solid wedge, threaded or solder ends, conforming to MSS SP-80. Hammond IB641, IB648, Nibco T-134, S-134, Milwaukee 1151, 1169, or equal.
2. 3 inches and larger: Class 125, iron body, bronze mounted, bolted bonnet, non-rising stem, solid wedge, flanged ends, conforming to MSS SP-70. Hammond IR-1138, Nibco F619, Milwaukee F2882A, Stockham G-612, or equal.

3. Underground valves 2 inches thru 12 inches: 250 psi, iron body, Non-rising stem, bolted bonnet, resilient wedge valves, conforming to AWWA C509, equipped with operating nuts, Mueller Series 2360, Nibco F-619-RW-SON, or equal.
  - a. Underground valves 3 inches and smaller may be furnished with operating nuts or hand-wheels, and with Ring-Tite joint ends.
  - b. Furnish and deliver to Owner one wrench of each size required for operating underground valves.
- B. Ball Valves:
  1. 2 inches and smaller: 600 psi CWP, 150 psi SWP, cast bronze body, full port, two piece, threaded ends, and reinforced PTFE seal, conforming to MSS SP-110. Nibco T585-70, Milwaukee BA-400, Stockham T-285, or equal.
  2. 2-1/2 inches and larger: Class 150, carbon steel body, full port, two piece, stainless steel vented ball, flanged ends, and reinforced PTFE seal, conforming to MSS SP-72. Nibco F-515-CS-F-66-FS, Milwaukee F20-CS-15-F-02-GO-VB, or equal.
- C. Swing Check Valves: Class 125 or 150, bronze body, suitable for regrinding, threaded ends, conforming to MSS SP-80. Stockham B-321, Milwaukee 509, or equal.
- D. Butterfly Valves:
  1. General: Tight closing, full lug type, with resilient seat suitable for minimum working pressure of 200 psig, conforming to MSS SP-67. Bi-direction dead end service with downstream flange removed.
  2. Provide valves with the following:
    - a. Seats: Suitable for 40 degrees F for cold water service and 250 degrees F for hot water service. Seats shall cover inside surface of body and extend over body ends.
    - b. Bodies: Ductile iron or cast iron.
    - c. Discs: Bronze or stainless steel.
    - d. Stems or Shafts: Stainless steel.
    - e. Control Handles: Suitable for locking in any position or with 10 degree or 15 degree notched throttling plates to hold valve in selected position. Provide extended necks to compensate for insulation thickness. Provide gear operator for valves 5 inches and larger.
  3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - a. 2 through 12 inches: Milwaukee Valve, CL series, Nibco, Inc., model LD2000-3, or equal.
- E. Silent Check Valves (for use on pump discharge):
  1. General: Provide spring loaded check valves at pump discharge of all pumps.
    - a. 2 inches and smaller: 250 psi CWP, bronze body, Nibco Model T-480, Milwaukee 548-T, or equal.

- b. 2-1/2 inches and larger: Class 250, cast iron body, wafer style, suitable for regrinding. Nibco Model F960, Milwaukee 1400, Mueller 103MAP, or equal.

## 2.31 VALVE BOXES

### A. General:

1. Where several valves or other equipment are grouped together, provide larger boxes of rectangular "vault" type adequately sized for condition and similar in construction to those specified above.
  2. Provide valve box extensions as required to set bottom of valve box tight up to top of piping in which valve is installed.
  3. Provide a tee handle wrench for each size, Alhambra Foundry Co. #A-3008, or equal.
- B. Valve Boxes in Traffic Areas: Provide Christy No. G5 traffic valve box, Brooks, or approved equal, 10-3/8 inches inside diameter with extensions to suit conditions, with cast iron locking cover. Provide Owner with set of special wrenches or tools as required for operation of valves.
- C. Valve Boxes in Non-Traffic Areas: Provide Christy No. F22, Brooks, or approved equal, 8 inches inside diameter by 30 inches long, with cast iron locking cover. Provide Owner with set of special wrenches or tools as required for operation of valves. Cut bottom of plastic body for operation of valves.
- D. Valve Box (Rectangular Vault Type): Precast concrete or cast iron with cast iron locking type covers lettered to suit service – Brooks No. 3-TL, Christy No. B3, Fraser No. 3, Alhambra A-3004 or A-3005, Alhambra E-2202, or E-2702, or approved equal, with extension to suit conditions.

## 2.32 INSULATION MATERIALS

### A. General:

1. Insulation products, including insulation, insulation facings, jackets, adhesives, sealants and coatings shall not contain polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations in amounts greater than 0.1 percent (by mass).
2. Products shall not contain asbestos, lead, mercury, or mercury compounds.
3. 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.
4. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
5. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
6. Test insulation, jackets and lap-seal adhesives as a composite product and confirm flame spread of not more than 25 and a smoke developed rating of not more than 50 when tested in accordance with UL723 or ASTM E84.
7. Adhesives and sealants shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.

### B. Insulation Materials:

1. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
  - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - 1) Aeroflex USA, Inc.
    - 2) Armacell LLC.
    - 3) K-Flex USA.
2. Mineral-Fiber, Preformed Pipe Insulation:
  - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - 1) Johns Manville; a Berkshire Hathaway company.
    - 2) Knauf Insulation.
    - 3) Manson Insulation Inc.
    - 4) Owens Corning.
  - b. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL.
3. 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. Provide 2-inch wide stapling and taping flange.
  - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - 1) CertainTeed Corporation.
    - 2) Johns Manville.
    - 3) Knauf Insulation.
    - 4) Owens Corning.
4. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket.
  - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - 1) CertainTeed Corporation.
    - 2) Johns Manville.
    - 3) Knauf Insulation.
    - 4) Owens Corning.
5. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5

lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less.

- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

- 1) CertainTeed Corporation.
- 2) Johns Manville; a Berkshire Hathaway company.
- 3) Knauf Insulation.
- 4) Owens Corning.

C. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

- a. Design Polymerics.
- b. Foster Brand; H. B. Fuller Construction Products.
- c. Knauf Insulation.

2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

- a. Design Polymerics.
- b. Childers Brand; H. B. Fuller Construction Products.
- c. Foster Brand; H. B. Fuller Construction Products.

2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

- a. Design Polymerics.
- b. Childers Brand; H. B. Fuller Construction Products.
- c. Foster Brand; H. B. Fuller Construction Products.
- d. Knauf Insulation.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

F. Field Applied Jackets:

1. PVC Jacket and Factory Fabricated Fitting Covers: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming.
  - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - 1) Johns Manville, model Zeston, with Zeston 2000 fitting covers.
    - 2) Proto Corporation, model LoSmoke.
2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
  - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
    - 1) Childers Brand; H. B. Fuller Construction Products.
    - 2) ITW Insulation Systems; Illinois Tool Works, Inc.
    - 3) RPR Products, Inc.
  - b. Finish and thickness are indicated in field-applied jacket schedules.
  - c. Moisture Barrier for Outdoor Applications: 2.5-mil- thick polysurlyn.
  - d. Factory-Fabricated Fitting Covers:
    - 1) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    - 2) Tee covers.
    - 3) Flange and union covers.
    - 4) End caps.
    - 5) Beveled collars.
    - 6) Valve covers.
    - 7) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.33 THERMAL HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
  1. Buckaroos, Inc.
  2. Carpenter & Paterson, Inc.
  3. Clement Support Services.
  4. Rilco Manufacturing Co., Inc.
- B. Flame-spread index of 25 or less and smoke-developed index of 50 or less as tested by ASTM E 84.
- C. Insulation-Insert Material for Cold or Hot Piping, from Minus 40 to Plus 275 Deg F: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength or ASTM C 1126, Type III rigid phenolic foam and vapor barrier.
  1. Phenolic:

- a. NPS 10 and Smaller: 3.75-lb/cu. Ft. minimum compressive strength.
- b. NPS 12 to NPS 30: 5.0-lb/cu. ft. minimum compressive strength.
- D. Insulation-Insert Material for Piping Above 275 Deg F: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig or ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength.
- E. Insulation Protection Shields: Galvanized metal, G90 coating designation, complying with ASTM A 653/A 653M, 180-degree saddle.
- F. Heavy Duty Insulation Protection Shields: Galvanized metal, 12-gage, G90 coating designation, complying with ASTM A 653/A 653M, 180-degree saddle. Structural steel plate welded to bottom of galvanized shield for sizes NPS 6 and larger.
- G. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- H. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- I. Insert Length: Extend minimum 1-1/2 inches beyond sheet metal shield.

## 2.34 TEMPERATURE CONTROL SYSTEM

- A. Refer to Section 23 09 23, Direct Digital Control System for HVAC.

## PART 3 - EXECUTION

### 3.01 ROOF MOUNTED EQUIPMENT INSTALLATION

- A. Mount and anchor equipment in strict compliance with Drawings details. Alternate anchorage methods will not be considered for roof mounted equipment.
- B. Examine rough-in for roof mounted equipment to verify actual locations of piping and duct connections prior to final equipment installation.
- C. Verify that piping to be installed adjacent to roof mounted equipment allows service and maintenance.
- D. Verify that gas piping will be installed with sufficient clearance for burner removal and service.
- E. Install gas flue extensions. Attach gas flue extensions to unit according to unit manufacturers' installation instructions. Terminate gas flue extensions with lowest discharge opening at height compliant with requirements of California Mechanical Code, based on final unit location.
- F. Install ducts to termination at top of roof curb and install heavy duty rubber gaskets on supply and return openings and on full perimeter of curb, or as required for an airtight installation, prior to setting unit on curb.
- G. Cover roof inside each roof mounted air conditioning unit, heat pump unit, and heating and ventilating unit roof curb with 2 inch thick, 3 pound density fiberglass insulation board.



- H. Connect supply and return air ducts to horizontal discharge roof mounted equipment with flexible duct connectors. Provide G 90 galvanized steel weather hood over flexible connections exposed to the weather. Weather hood minimum gauge shall be per PART 2 article, Ductwork, Table A.
- I. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.

### 3.02 SPLIT SYSTEM AC, HEAT PUMP, AND VRF SYSTEMS INSTALLATION

#### A. General:

1. Install units level and plumb.
2. Install evaporator-fan components as detailed on Drawings.
3. Install ground or roof- mounted condensing units as detailed on Drawings.
4. Install seismic restraints as required by applicable codes. Refer to Article, Submittals, in Section 23 00 50, Basic HVAC Materials and Methods, for delegated design requirements for seismic restraints.
5. Install and connect refrigerant piping as detailed in unit manufacturers' literature. Install piping to allow access to unit.
6. Install cooling coil condensate primary drain pan piping, and overflow, if provided, and run to nearest code-compliant receptacle, or as indicated on Drawings. Install secondary drain pan for units installed over permanent and suspended-tile ceilings. Install secondary drain pan piping and terminate 1/2 inch below ceiling, with escutcheon, in a readily visible location or as shown on Drawings.
7. Install air filters at each indoor unit. Install washable, permanent filters at indoor units designed to accept washable, permanent filters. Refer to Drawings schedule, and Article, Air Filters, in this Section, for filter requirements for ducted, above-ceiling units incorporating mixing boxes.
8. Duct Connections: Duct installation requirements are specified in Article, Ductwork, in this Section. Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Article, Ductwork, in this Section.

#### B. Variable Refrigerant Flow Split System Heat Pumps:

1. The system shall be installed by a factory-trained and certified contractor, in strict conformance with unit manufacturer's instructions.
2. Install indoor heat recovery controllers as detailed on Drawings. Install condensate drain pan piping and run to nearest code-compliant receptacle, or as indicated on Drawings.
  - a. Indoor Heat Recovery Controllers Identification:
    - 1) Comply with requirements for identification in Section 23 00 50, Basic HVAC Materials and Methods.
    - 2) Identify each control cable on each end, at 20' intervals, and at each terminal with a number-coded identification tag. Each cable shall have a unique tag.
    - 3) Identify each refrigerant connection with label or tag corresponding to the indoor fan coil unit served by the refrigerant piping branch. Use equipment numbers scheduled on Drawings.

3. Install ball-type refrigerant service valves in refrigerant piping at downstream connections of indoor heat recovery units.
4. Install ground or roof- mounted condensing units as detailed on Drawings. Connected condensing units shall allow space for coil cleaning and other required maintenance tasks.

### 3.03 HIGH EFFICIENCY FURNACE UNIT INSTALLATION

- A. Install vent and combustion air piping in strict compliance with manufacturer's installation guidelines. Pipe and fittings shall comply with manufacturer's instructions, flash through roof or wall as specified for piping. Refer to Drawings for special conditions.
  1. Provide concentric flue system with single roof or wall penetration. Install in accordance with manufacturer's requirements.
  - 2.
- B. Mount horizontally or vertically as indicated on Drawings. Comply with manufacturer's installation requirements specific to mounting orientation.
- C. Install cooling coil overflow drain piping and run to nearest receptacle, or as indicated on Drawings.

### 3.04 REFRIGERANT PIPING INSTALLATION

- A. General:
  1. Install refrigerant piping according to ASHRAE 15. Install and connect refrigerant piping as detailed in unit manufacturers' literature. Install piping to allow access to unit.
  2. Install piping straight and free of kinks, restrictions or traps.
  3. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
  4. Slope horizontal suction piping 1 inch/10 feet towards compressor.
  5. Install fittings for changes in direction and branch connections.
  6. Piping under raised floors shall be kept 6 inches minimum above ground; excavate as necessary.
  7. Install locking caps on refrigerant access valves located outside building, including valves located on roofs.
  8. Insulate refrigerant piping, including liquid and hot gas pipes when required by system manufacturer, and including headers, branches, and other components as detailed in unit manufacturers' literature.
- B. Factory Pre-charged and sealed line set piping:
  1. Keep the entire system clean and dry during installation.
  2. All tubing shall be evacuated and sealed at the factory. The seal must not be broken until ready for assembly.
  3. If there is any evidence of dust, moisture, or corrosion, the tubing must be cleaned out by drawing a swab soaked with methyl alcohol through the tubing as many times as necessary to thoroughly clean the tubing.
  4. Where line set piping is used, enclose in iron or steel piping and fittings or in EMT conduit.
- C. Field Assembled Refrigerant Piping:

1. Select system components with pressure rating equal to or greater than system operating pressure.
2. Where subject to mechanical injury, enclose refrigerant piping in EMT conduit.
3. Where field assembled refrigerant piping is exposed mounted at grade, on walls, and on roof, enclose in 16 gage galvanized steel enclosure.
4. When brazing, remove solenoid valve coils and sight glasses, also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

### 3.05 FAN INSTALLATION

- A. Ceiling Mounted Fans: Mount variable speed switch within fan housing. Mark final balance point on variable speed switch.
- B. Provide access doors for fans or motors mounted in ductwork.
- C. Mount all fans as detailed on Drawings and in compliance with CBC standards.
- D. Fan motors mounted in air-stream to be totally enclosed.
- E. Completely line supply, return or exhaust fan cabinets with 1 inch thick, 3/4 pound density acoustic insulation securely cemented in place.
- F. Roof fans shall be mounted level.
- G. Provide heavy-duty rubber gasket between exhaust fan mounting flange and roof curb, or as required for an airtight installation.
- H. Label fume hood fans with sign "CAUTION - HAZARDOUS EXHAUST."

### 3.06 RELIEF VENT INSTALLATION

- A. Install relief vents to provide a level mounting for backdraft damper.

### 3.07 AIR INLETS AND OUTLETS INSTALLATION

- A. Provide all air inlets and outlets with gaskets and install so that there will be no streaking of the walls or ceilings due to leakage. Duct connection to outlet on exposed duct shall be full size of outer perimeter of outlet flange.
- B. Unless otherwise indicated on Drawings, provide rectangular galvanized steel plenum on top of each diffuser and ceiling return for connection to ductwork. Line plenum with internal insulation as indicated for lined ductwork. Size plenum to allow full opening into air terminal. Plenum sheet metal gauge shall be equal to gauge for rectangular equivalent of the branch duct serving the air inlet or outlet.
- C. Ceiling-mounted air inlets, outlets, or other services installed in T-Bar type ceiling systems shall be positively attached to the ceiling suspension main runners or to cross runners with the same carrying capacity as the main runners.

1. Air inlets, outlets, or other services weighing not more than 56 pounds shall have two No. 12 gauge hangers connected from the terminal or service to the structure above. These wires may be slack.
  2. Support air inlets, outlets, or other services weighing more than 56 pounds directly from the structure above by approved hangers. Provide 4 taut 12 gauge wires each, attached to the fixture and to the structure above. The 4 taut 12 gauge wires, including their attachment to the structure above must be capable of supporting 4 times the weight of the unit.
  3. Secure air inlets and outlets to main runners of ceiling suspension system with two No. 8 sheet metal screws at opposing corners.
- D. Furnish all air inlets and outlets with a baked prime coat unless otherwise noted. Provide off-white baked enamel finish on ceiling-mounted air inlets and outlets. Paint exposed mounting screws to match the material being secured.
- E. Air inlets and outlets shall match all qualities of these specified including appearance, throw, noise level, adjustability, etc.

### 3.08 AIR TERMINAL UNIT INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Where installing piping adjacent to air terminal unit, allow space for service and maintenance.
- D. Connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange, or as detailed on Drawings.

### 3.09 FILTER HOUSING INSTALLATION

- A. Mount filters in airtight galvanized steel housings furnished by the filter manufacturer, or shop fabricated. Housings shall incorporate integral tracks to accommodate filters, and flanges for connection to duct or casing system.
1. Sealing: Incorporate positive-sealing gasket material on channels to seal top and bottom of filter cartridge frames and to prevent bypass of unfiltered air.
  2. Access Doors: Hinged, with continuous gaskets on perimeter and positive-locking latch handle devices.
- B. Air filters shall be accessible for cleaning or replacement.
- C. Identify each filter access door with 1/2 inch high minimum stenciled letters.

### 3.10 TEMPORARY FILTERS

- A. Provide temporary filters for fans that are operated during construction; after construction dirt has been removed from the building install new filters at no additional cost to the Owner. In addition to

temporary filters at filter location, provide temporary filters on all duct openings which will operate under a negative pressure.

1. Filters used for temporary operation shall be the same as permanent filters for the application. Filters used for duct openings may be 1 inch thick pleated media disposable type.

### 3.11 DAMPER INSTALLATION

- A. All dampers automatically controlled by damper motors are specified under "Temperature Control System" except those specified with items of equipment.
- B. Provide opposed blade manual air dampers at each branch duct connection and at locations indicated on the drawings and where necessary to control air flow for balancing system. Provide an opposed blade balancing damper in each zone supply duct. Provide an access panel or Ventlok flush type damper regulator on ceiling or wall for each concealed damper.
- C. Install fusible link fire dampers full size of duct at points where shown or required.
- D. Provide 18 inch x 12 inch minimum hinged access doors in ductwork and furring for easy access to each fire damper; insulated access doors in insulated ducts. Label access doors with 1/2 inch high red letters.
  1. Provide Ventlok Series 100, Durodyne, or equal access doors with hardware for convenient access to all automatic dampers and other components of the system, insulated type in insulated ducts. Provide Ventlok #202 for light duty up to 2 inch thick doors, #260 heavy-duty up to 2 inch thick doors and #310 heavy-duty for greater than 2 inch thick doors. Provide #260 hinges on all hinged and personnel access doors; include gasketing.

### 3.12 DUCTWORK INSTALLATION

- A. General:
  1. Assemble and install ductwork in accordance with recognized industry practices which will achieve air tight and noiseless (no objectionable noise) systems capable of performing each indicated service. Install each run with minimum of joints. Align ductwork accurately at connections within 1/8 inch misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers, and anchors of type which will hold ducts true to shape and to prevent buckling. Where possible, install ductwork to clear construction by 1/4 inch minimum, except at air inlets and outlets. Where ductwork will not clear construction, secure duct firmly to eliminate noise in the system.
  2. Duct Joints: Install duct sealers, pop rivets or sheet metal screws at each fitting and joint. Duct sealers shall be fire retardant. Sheet metal screws for joints shall be minimum #10 size galvanized.
  3. Where ductwork is left exposed within a room, the same shall be run true to plumb, horizontal, or intended planes. Where possible, uniform margins are to be maintained between parallel lines and/or adjacent wall, floor, or ceiling surfaces.
  4. Horizontal runs of ductwork suspended from ceilings shall provide for a maximum headroom clearance. The clearance shall not be less than 6'-6" without written approval from the Architect.

5. Provide sheet metal angle frame at all duct penetrations to wall, floor, roof, or ceiling.
6. Paint inside of ducts, visible through grille, dull black.
7. Where ductwork is installed in finished areas of buildings that do not have ceilings, paint ductwork, support hangers, and air inlets and outlets to match adjacent architectural surfaces, or as directed by Architect.
8. At the time of rough installation, or during storage on the construction site and until final startup of the heating and cooling equipment, duct and other related air distribution component openings shall be covered with tape, plastic, sheet metal, or other methods acceptable to the enforcing agency.

B. Firestopping:

1. Pack the annular space between duct openings and ducts penetrating floors and walls with UL listed fire stop, and sealed at the ends. All pipe penetrations shall be UL listed, Hilti, 3M Pro-Set, or equal.
  - a. Install fire caulking behind mechanical services installed within fire rated walls, to maintain continuous rating of wall construction.
2. Firestopping systems to be installed in strict accordance with manufacturer's instructions.
3. Alternate firestopping systems are acceptable if approved equal. However, any deviation from the above specification requires the Contractor to be responsible for determining the suitability of the proposed products and their intended use, and the Contractor shall assume all risks and liabilities whatsoever in connection therewith.

C. Flashing:

1. The work of this section shall include furnishing, layout, sizing, and coordination of penetrations required for the mechanical work.
2. Refer to Division 07 specifications and Drawings details as applicable.
3. Flashing for penetrations of roof for mechanical items such as flues and ducts shall be coordinated with the roofing manufacturer and roofing installer for the specific roofing type. The work of this section shall include furnishing, layout, sizing, and coordination of penetrations required for the mechanical work.
  - a. Furnish and install flashing and counterflashing in strict conformance with the requirements of the roofing manufacturer. Submit shop drawing details for review prior to installation.
  - b. Flues and ducts shall have 24 gauge galvanized sheet metal storm collar securely clamped to the flue above the flashing.

- D. Upper connection of support to wood structure shall be with wood screws or lag screws in shear fastened in the upper one half of the wood structural member. Fasteners shall conform to the following schedule:

|                               |                         |
|-------------------------------|-------------------------|
| For ducts with $P/2=30"$      | #10 x 1-1/2" wood screw |
| For ducts with $P/2=72"$      | 1/4" x 1-1/2" lag screw |
| For ducts with $P/2$ over 73" | 3/8" x 1-1/2" lag screw |

- E. Upper connection in tension to wood shall not be used unless absolutely necessary. Where deemed necessary the contractor shall submit calculations to show the size fastener and penetration required to support loads in tension from wood in accordance with the following schedule:

|                                    |                       |
|------------------------------------|-----------------------|
| For ducts with P/2=30"             | 260 pounds per hanger |
| For ducts with P/2=72"             | 320 pounds per hanger |
| For ducts with P/2=96"             | 460 pounds per hanger |
| For duct with P/2 larger than 120" | NOT ALLOWED           |

- F. Install concrete inserts for support of ductwork in coordination with formwork as required to avoid delays in work.
- G. Upper connection to manufactured truss construction must comply with truss manufacturers published requirements and Structural Engineers requirements.
- H. Where ducts pass through interior partitions and exterior walls, conceal space between construction opening and duct or duct plus insulation with sheet metal flanges of same gauge as duct. Overlap opening on four sides by at least 1-1/2 inches.
- I. Support ductwork in manner complying with SMACNA "HVAC Duct Construction Standards," hangers and supports sections. Where special hanging of ductwork is detailed or shown on Drawings, Drawings shall be followed. Angles shall be attached to overhead construction in a manner so as to allow a minimum of 2 inches of movement in all directions with no bending or sagging of the angle.
1. Except where modified in individual paragraphs of this Section, provide hanger support with minimum 18 gauge straps, 1 inch wide. Fold duct strap over at bottom of duct.
  2. Install duct supports to rectangular ducts with sheet metal screws. Provide one screw at top of duct and one screw into strap at bottom of duct.
- J. Installation of Flexible Ductwork:
1. Provide flexible ducts with supports at 30 inch centers with 2 inch wide, 26 gauge steel hanger collar attached to the structure with an approved duct hanger. Installation shall minimize sharp radius turns or offsets.
    - a. Supports shall be in accordance with SMACNA HVAC Duct Construction Standards (Metal and Flexible).
    - b. Flexible duct bends shall be not less than 1-1/2 duct diameter bend radius.
  2. Make connections to rigid duct and units with Panduit style draw band at inner liner material, and a second draw band over the outer vapor barrier material.
  3. Make connection to duct with spin-in fittings, with air scoop and balance damper.
- K. Installation of Fabric Duct Air Dispersion System:

1. Install fabric duct system in accordance with the requirements of the manufacturer, and per Drawings details.
    - a. Air handler and associated ductwork shall be clean and free of particulate matter at the time of fabric duct connection and pressurization of duct system.
  2. Fabric duct shall be cleaned according to manufacturers' instructions, if soiled during installation, prior to Project handover to Owner.
- L. Installation of Kitchen Exhaust Ducts (Type 1):
1. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease.
  2. Slope duct a minimum of 2 percent to drain grease back to the hood.
  3. Provide for thermal expansion of ductwork through 2000 °F temperature range.
  4. Install listed grease duct access panel assemblies at each change of direction and at maximum intervals of 12 feet in horizontal ducts, and at every floor for vertical ducts, and as indicated on Drawings. Locate access panel on top or sides of duct. Locate panel so that edge of opening is not less than 1-1/2 inch from all outside edges of the duct or welded seams. For large horizontal ducts, install 20 inch by 20 inch access panel for personnel entry at maximum intervals of 20 feet.
  5. Install listed grease duct access panel assemblies in accordance with the terms of their listings and the manufacturers' instructions. Access panels shall be labeled with the words: "Access Panel – Do Not Obstruct."
  6. Fabricate ducts with continuous welds for grease-tight construction.
  7. Grind welds to provide smooth surface free of burrs, sharp edges and weld splatter. When welding stainless steel with a No. 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to removed discoloration caused by welding.
  8. Cover grease exhaust duct with two layers of 1-1/2 inch thick field-applied grease duct enclosure. Install grease duct enclosure in accordance with manufacturer's instructions and listing requirements.
- M. Installation of Kitchen Exhaust Ducts (Type 2):
1. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease.
  2. Slope duct a minimum of 1 percent to drain back to the hood or dishwasher connection.
  3. Install duct access panel assemblies at each change of direction and at maximum intervals of 12 feet in horizontal ducts, and at every floor for vertical ducts, and as indicated on Drawings. Locate access panel on top or sides of duct. Locate panel so that edge of opening is not less than 1-1/2 inch from all outside edges of the duct. For large horizontal ducts, install 20 inch by 20 inch access panel for personnel entry at maximum intervals of 20 feet.
  4. Fabricate ducts with continuous welds for water-tight construction.
  5. Grind welds to provide smooth surface free of burrs, sharp edges and weld splatter. When welding stainless steel with a No. 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to removed discoloration caused by welding.
  6. Fabricate ducts for dishwasher exhaust with seams on top of duct, and with minimum joints.
  7. Access panels shall be labeled with the words: "Access Panel – Do Not Obstruct."
- N. Installation of Shower Exhaust Ducts:



1. Slope duct a minimum of 1 percent to drain back to the exhaust grille.

### 3.13 DUCTWORK SEALING AND LEAK TESTING

- A. All ductwork shall receive a Class A seal.
- B. Seal airtight all joints and seams, including standing seams and manufactured joints and seams, of all supply, return and exhaust ducts except those exposed in conditioned space.
- C. Leakage Classes:

| <u>Pressure Class</u> | <u>Leakage Class</u> |                         |
|-----------------------|----------------------|-------------------------|
|                       | <u>Round Duct</u>    | <u>Rectangular Duct</u> |
| 2"W.G. or less        | 8                    | 16                      |
| 4"W.G. or greater     | 2                    | 4                       |

- D. All duct systems (supply, return, outside air intake, and exhaust), except those identified on compliance forms on Drawings as requiring Acceptance Testing per the requirements of the California Energy Code, shall be tested in accordance with the requirements of SMACNA "HVAC Air Duct Leakage Test Manual." Test pressure shall be equal to the pressure class of the duct. For additional duct leak testing requirements, refer to Section 23 08 00.13, "Title 24 Commissioning of HVAC."

### 3.14 PIPING INSTALLATION

- A. General:
  1. All piping shall be concealed unless shown or otherwise directed. Allow sufficient space for ceiling panel removal.
  2. Installation of piping shall be made with appropriate fittings. Bending of piping will not be accepted.
  3. Install piping to permit application of insulation and to allow valve servicing.
  4. Where piping or conduit is left exposed within a room, the same shall be run true to plumb, horizontal, or intended planes. Where possible, uniform margins are to be maintained between parallel lines and/or adjacent wall, floor, or ceiling surfaces.
  5. Horizontal runs of pipes and conduits suspended from ceilings shall provide for a maximum headroom clearance. The clearance shall not be less than 6'-6" without written approval from the Architect.
  6. Close ends of pipe immediately after installation. Leave closure in place until removal is necessary for completion of installation.
  7. Use reducing fittings; bushings shall not be allowed. Use eccentric reducing fittings wherever necessary to provide free drainage of lines and passage of air.
  8. Verify final equipment and fixture locations for roughing-in.
  9. Where piping is installed in walls within one inch of the face of stud, provide a 16 gauge sheet metal shield plate on the face of the stud. The shield plate shall extend a minimum of 1-1/2 inches beyond the outside diameter of the pipe.

10. Each piping system shall be thoroughly flushed and proved clean before connection to equipment.
11. Install exposed polished or enameled connections with special care showing no tool marks or threads at fittings.
12. Service Markers: Mark the location of each plugged or capped pipe with a 4 inch round by 30 inch long concrete marker, set flush with finish grade. Provide 2-1/2 inch diameter engraved brass plate as part of monument marker.
13. Pipe the discharge of each relief valve, air vent, backflow preventer, and similar device to floor sink or drain.

B. Sleeves:

1. Install Adjus-to-Crete, Pipeline Seal and Insulator, or equal, pipe sleeves of sufficient size to allow for free motion of pipe, 24 gauge galvanized steel. The space between pipe and sleeves through floor slabs on ground, through outside walls above or below grade, through roof, and other locations as directed shall be caulked with oakum and mastic and made watertight. The space between pipe and sleeve and between sleeve and slab or wall shall be sealed watertight.
2. At Contractor's option, Link-Seal, Metraflex Metraseal, or equal, casing seals may be used in lieu of caulking. Wrap pipes through slabs on grade with 1 inch thick fiberglass insulation to completely isolate the pipe from the concrete.

C. Floor, Wall, and Ceiling Plates:

1. Fit all pipes with or without insulation passing through walls, floors, or ceilings, and all hanger rods penetrating finished ceilings with chrome-plated or stainless escutcheon plates.

D. Firestopping:

1. Pack the annular space between pipe sleeves and pipes penetrating floors and walls with UL listed fire stop, and sealed at the ends. All pipe penetrations shall be UL listed, Hilti, 3M Pro-Set, or equal.
  - a. Install fire caulking behind mechanical services installed within fire rated walls, to maintain continuous rating of wall construction.
2. Provide SpecSeal Systems UL fire rated sleeve/coupling penetrators for each pipe penetration or fixture opening passing through floors, walls, partitions or floor/ceiling assemblies. All Penetrators shall comply with UL Fire Resistance Directory (Latest Edition), and in accordance with CBC requirements.
3. Sleeve penetrators shall have a built in anchor ring for waterproofing and anchoring into concrete pours or use the special fit cored hole penetrator for cored holes.
4. Copper and steel piping shall have SpecSeal, or equal, plugs on both sides of the penetrator to reduce noise and to provide waterproofing.
5. Firestopping systems to be installed in strict accordance with manufacturer's instructions.
6. Alternate firestopping systems are acceptable if approved equal. However, any deviation from the above specification requires the Contractor to be responsible for determining the suitability of the proposed products and their intended use, and the Contractor shall assume all risks and liabilities whatsoever in connection therewith.

E. Flashing:

1. The work of this section shall include furnishing, layout, sizing, and coordination of penetrations required for the mechanical work.
2. Refer to Division 07 specifications and Drawings details as applicable.
3. Flashing for penetrations of metal or membrane roof for pipes shall be coordinated with the roofing manufacturer and roofing installer for the specific roofing type.
  - a. Furnish and install flashing and counterflashing in strict conformance with the requirements of the roofing manufacturer. Submit shop drawing details for review prior to installation.
  - b. Furnish and install counterflashing above each flashing required. Provide Stoneman, or equal, vandalproof top and flashing combination. Elmdor/Stoneman Model 1540.
4. Furnish and install flashing and counterflashing in strict conformance with the requirements of the roofing manufacturer. Submit shop drawing details for review prior to installation.

3.15 PUMP INSTALLATION

- A. Install pumps as shown on Drawings.
- B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories. Manufacturer recommended clearances shall be maintained.
- C. Independently support pumps and piping so that weight of piping is not supported by pumps and weight of pumps is not supported by piping.

3.16 HYDRONIC SPECIALTIES INSTALLATION

- A. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.
- B. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.
- C. Calibrated Balancing Valves: Install calibrated balancing valves per manufacturers' recommendations, including requirements for straight pipe lengths at valve inlet and outlet.
- D. Air Vent Valves:
  1. Install with shutoff valves or cocks and drain to floor sink or drain.
  2. At each high point of piping, and elsewhere where required for system air venting and drainage, provide manual air vent connection at top of pipe. Provide ball valve within 18 inches of ceiling in accessible location, and extend drain line to allow convenient access.

3.17 THERMAL AND SEISMIC EXPANSION LOOP INSTALLATION

- A. Install expansion loops where piping crosses building expansion or seismic joints, between buildings, between buildings and canopies, and as indicated on Drawings.
- B. Install expansion loops of sizes matching sizes of connected piping.

- C. Install grooved-joint expansion joints to grooved-end steel piping.
- D. Materials of construction and end fitting type shall be consistent with pipe material and type of gas or liquid conveyed by the piping system in which expansion loop is installed.

### 3.18 PIPE JOINTS AND CONNECTIONS

#### A. General:

- 1. Cutting: Cut pipe and tubing square, remove rough edges or burrs. Bevel plain ends of steel pipe.
- 2. Remove scale, slag, dirt and debris from inside and outside of pipe before assembly.
- 3. Boss or saddle type fittings or mechanically extracted tube joints will not be allowed.

#### B. Threaded Pipe: 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 thread compound to external pipe threads: Rectorseal No. 5, Permatex No. 1, or equal.
- 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

#### C. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for type of water conveyed by pipe. Join flanges with gasket and bolts according to ASME B31.9.

#### D. Copper Pipe and Tubing: All joints shall be brazed according to ASME Section IX, Welding and Brazing Qualifications, except pneumatic control piping, and hydronic piping having grooved-end fittings and couplings.

#### E. Welded Pipe:

- 1. Make up with oxyacetylene or electric arc process.
- 2. All welding shall conform to the American Standard Code for Power Piping ASME B-31.1. When requested by the Architect, furnish certification from an approved testing agency or National Certified Pipe Welding Bureau that the welders performing the work are qualified.
- 3. All line welds shall be of the single "V" butt type. Welds for flanges shall be of the fillet type.
- 4. Where the branch is two pipe sizes smaller than the main or smaller, Bonney Weldolets, Thredolets, Nibco, or equal, may be used in lieu of welding tees.

#### F. Flexible Connections:

- 1. Furnish and install Thermo Tech., Inc. F/J/R, Metraflex, or equal, flexible couplings with limiter bolts on piping connections to all equipment mounted on anti-vibration bases, except fan coil units under 2000 cfm, on each connection to each base mounted pump and where shown. Couplings shall be suitable for pressure and type of service.
- 2. Flexible connections in refrigerant lines; Flexonic, Anaconda or equal, metal hose, full size.
- 3. Anchor piping securely on the system side of each flexible connection.

### 3.19 VALVE INSTALLATION

#### A. General:

1. Valves shall be full line size unless indicated otherwise on Drawings.
2. Install horizontal valves with valve stem above horizontal, except butterfly valves.
3. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
4. Locate valves for easy access and provide separate support where necessary.
5. Install valves in position to allow full stem movement.
6. Install exposed polished or enameled connections with special care showing no tool marks or exposed threads.
7. Butterfly valves conforming to the paragraph "Butterfly Valves" may be used in lieu of gate or globe valves for locations above grade.
8. Ball valves conforming to the paragraph "Ball Valves" may be used in lieu of gate valves for locations above grade for services 2-1/2 inches and smaller.
9. Valves 2-1/2 inches and smaller (except ball valves) in nonferrous water piping systems may be solder joint type with bronze body and trim.
10. Provide gate or globe valves on inlet and outlet of each pump.

#### B. Gate Valves:

1. Furnish valves in copper lines with adapters to suit valve / line requirements.
2. Underground gate valves:
  - a. Underground valves 3 inches and smaller may be furnished with operating nuts or hand-wheels, and with Ring-Tite joint ends.
  - b. Furnish and deliver to Owner one wrench of each size required for operating underground valves.

#### C. Swing Check Valves: Install in horizontal position with hinge pin level.

#### D. Butterfly Valves: Install with stems horizontal.

#### E. Silent Check Valves: Install in horizontal or vertical position between flanges.

#### F. Valve Adjustment: Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

### 3.20 HANGER AND SUPPORT INSTALLATION

- A. General: Support ductwork, equipment and piping so that it is firmly held in place by approved iron hangers and supports, and special hangers. Hanger and support components shall support weight of ductwork, equipment and pipe, fluid, and pipe insulation based on spacing between supports with minimum factor of safety of five based on ultimate strength of material used. Do not exceed manufacturer's load rating. Pipe attachments or hangers, of same size as pipe or tubing on which used, or nearest available. Rigidly fasten hose faucets, fixture stops, compressed air outlets, and similar items to the building construction. The Architect shall approve hanger material before installation. Where building structural members do not match piping and ductwork support spacing,

provide "bridging" support members firmly attached to building structural members in a fashion approved by the structural engineer.

1. Materials, design, and type numbers for support of piping per Manufacturers' Standardization Society (MSS), Standard Practice (SP)-58.
  - a. Provide copper-plated or felt-lined hangers for use on uninsulated copper tubing.
2. Materials and design for ductwork support shall be per SMACNA "HVAC Duct Construction Standards, Metal and Flexible."
- B. Hanger components shall be provided by one manufacturer: B-Line, Grinnell, Unistrut, Badger, or equal.
- C. For mechanical piping hanger and support requirements, refer to Section 23 05 29 – Mechanical Pipe Supports and Anchors.
- D. Duct Hanger and Support Spacing: Conform to Requirements of CMC and SMACNA "HVAC Duct Construction Standards, Metal and Flexible."
- E. Duct Support to Structure:
  1. Upper connection of support to wood structure shall be with wood screws or lag screws in shear fastened in the upper one half of the wood structural member. Fasteners shall conform to the following schedule:

|                             |                         |
|-----------------------------|-------------------------|
| For ducts with P/2=30"      | #10 x 1-1/2" wood screw |
| For ducts with P/2=72"      | 1/4"x 1-1/2" lag screw  |
| For ducts with P/2 over 73" | 3/8"x 1-1/2" lag screw  |

2. Upper connection in tension to wood shall not be used unless absolutely necessary. Where deemed necessary the contractor shall submit calculations to show the size fastener and penetration required to support loads in tension from wood in accordance with the following schedule:

|                                    |                       |
|------------------------------------|-----------------------|
| For ducts with P/2=30"             | 260 pounds per hanger |
| For ducts with P/2=72"             | 320 pounds per hanger |
| For ducts with P/2=96"             | 460 pounds per hanger |
| For duct with P/2 larger than 120" | NOT ALLOWED           |

3. Install concrete inserts for support of ductwork in coordination with formwork as required to avoid delays in work.
4. Upper connection to manufactured truss construction must comply with truss manufacturers published requirements and Structural Engineers requirements.

### 3.21 INSULATION AND FIELD-APPLIED JACKET INSTALLATION

#### A. General:

1. The term "piping" used herein includes pipe, air separators, valves, strainers and fittings.
2. Clean thoroughly, test and have approved, all piping and equipment before installing insulation and/or covering.
3. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, ductwork, and equipment.
4. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment as specified in insulation system schedules.
5. 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.
6. Install insulation with longitudinal seams at top and bottom of horizontal runs.
7. Install multiple layers of insulation with longitudinal and end seams staggered.
8. Keep insulation materials dry during application and finishing.
9. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
10. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
11. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
12. For piping, ductwork, and equipment, with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
13. Repair all damage to existing pipe, duct and equipment insulation whether or not caused during the work of this contract, to match existing adjacent insulation for thickness and finish, but conforming to flame spread and smoke ratings specified above.
14. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - a. Install insulation continuously through hangers and around anchor attachments.
  - b. 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.
  - c. 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.
  - d. Cover inserts with jacket material matching adjacent insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

#### B. Piping Insulation Installation:

##### 1. General:

- a. Apply insulating cement to fittings, valves and strainers and trowel smooth to the thickness of adjacent covering. Cover with jacket to match piping. Extend covering on valves up to the bonnet. Leave strainer cleanout plugs accessible.
- b. Provide removable insulation covers for items requiring periodic service or inspection.
- c. Insulation shall be vapor tight before applying PVC jacket and fitting covers. Verify suitability with manufacturer of insulation.
- d. Provide pre-formed PVC valve and fitting covers for indoor piping.
- e. Provide factory-fabricated aluminum valve and fitting covers for outdoor piping.
- f. Provide Calcium Silicate rigid insulation and sheet metal sleeve, 18 inch minimum length at each pipe hanger. Seal ends of insulation to make vapor tight with jacket.

2. Below-Ambient Services Including Chilled Water Supply and Return and Refrigerant Piping:

- a. Insulate valves and irregular surfaces to match adjacent insulation and cover with two layers of woven glass fiber cloth saturated in Foster Sealfas 30-36, 3M, or equal, extending 3 inches over the adjoining pipe insulation. Finish with a coat of Foster Sealfas 30-36, 3M, or equal. The 3 inch wide SSL end laps furnished with the insulation shall be adhered over the end joints. Seal entire surface of insulation vapor tight, including joints and ends of PVC or aluminum fitting covers.
- b. Variable refrigerant flow (VRF) heat pump systems: Insulation for VRF system refrigerant piping shall be installed according to VRF unit manufacturer's instructions.

3. PVC Jacket Installation:

- a. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.
  - 1) Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

4. Aluminum Jacket Installation:

- a. Where insulated piping is exposed to the weather apply aluminum jacket secured with 1/2 inch stainless-steel bands on 12 inch centers. Install jacketing with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Cover fittings with glass cloth, two coats of Foster Sealfas 30-36, and factory-fabricated aluminum fitting covers, of same material, finish, and thickness as jacket. Insulation shall be vapor tight before applying metal jacket and fitting covers.
- b. Do not install aluminum jackets on refrigerant flexible connectors to vibration isolated outdoor condensing units. Coat elastomeric insulation with insulation manufacturer's recommended ultraviolet light protective coating.

C. Duct Insulation Installation:

1. General:

- a. Insulation applied to the exterior surface of ducts located in buildings shall have a flame spread of not more than 25 and a smoke-developed rating of not more than 50 when tested



as a composite installation including insulation, facing materials, tapes and adhesives as normally applied. Material exposed within ducts or plenum shall have a flame-spread rating of not more than 25 and a smoke-developed rating of not more than 50.

- b. Duct insulation applied to the exterior surface of ducts installed outside the building insulation envelope shall meet minimum R-value of R-8 at 3 inches thickness and 3/4 pound per cubic foot density.
- c. Duct insulation applied to the exterior surface of ducts installed within the building insulation envelope shall meet minimum R-value of R-4.2 at 1-1/2 inches thickness and 3/4 pound per cubic foot density.

2. Mineral Fiber Blanket Installation:

- a. Insulate all unlined concealed supply and return ducts with fiberglass duct wrap, manufactured as a blanket of glass fibers factory laminated to a reinforced foil/kraft vapor retarding facing. Provide 2 inch stapling and taping flange. Wrap insulation entirely around duct and secure with outward clinching staples on 6 inch centers. Provide mechanical fasteners at maximum 18 inch centers for all bottoms of duct which are greater than 24 inches. Lap all insulation joints 3" minimum. Insulate ducts installed tight against other work before hanging in place. Seal all seams, both longitudinal and transverse, and all staple and mechanical fastener penetrations of facing with scrim backed foil tape or recommended sealant, to provide a vapor tight installation.

3. PVC Jacket Installation:

- a. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.
  - 1) Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Equipment Insulation Installation:

1. General:

- a. Insulate pumps, coil u-bends where exposed outside airstream, air separators, heating hot water and chilled water storage tanks, and other elements that are in series with the fluid flow, according to the requirements of the California Energy Code.

2. Mineral-Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

- a. Apply adhesives according to manufacturer's recommended coverage rates per unit area, and for percent coverage of tank and vessel surfaces.
- b. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
- c. Protect exposed corners with secured corner angles.
- d. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

- 1) Do not weld anchor pins to ASME-labeled pressure vessels.
  - 2) Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
  - 3) On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
  - 4) Do not overcompress insulation during installation.
  - 5) Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
  - 6) Impale insulation over anchor pins and attach speed washers.
  - 7) Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
- e. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
  - f. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
  - g. Stagger joints between insulation layers at least 3 inches.
  - h. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
  - i. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
  - j. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
3. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
    - a. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
    - b. Seal longitudinal seams and end joints.
4. Insulation Installation on Pumps:
    - a. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch- diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism. Do not enclose or insulate pump motor.
    - b. Fabricate boxes from G90 galvanized steel, at least 0.050 inch thick.

- c. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

5. PVC Jacket Installation:

- a. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
  - 1) Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

6. Aluminum Jacket Installation:

- a. Where aluminum jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.22 TEMPERATURE CONTROL SYSTEM INSTALLATION

- A. Provide thermostats where indicated on drawings. All wiring shall be in conduit. Provide all relays, transformers and the like to render the control system complete and fully operable. All control conduit to be rigid steel type.

3.23 EQUIPMENT START-UP

- A. Initial start-up of the systems and pumps shall be under the direct supervision of the Contractor.
- B. Equipment start-up shall not be performed until the piping systems have been flushed and treated and the initial water flow balance has been completed.
- C. It shall be the responsibility of the Contractor to assemble and supervise a start-up team consisting of controls contractor, start-up technician, and test and balance contractor; all to work in concert to assure that the systems are started, balanced, and operate in accordance with the design.
- D. After start-up is complete, instruct the Owner's personnel in the operation and maintenance of the systems. Obtain from the Owner's representative a signed memo certifying that instruction has been received.
- E. For additional requirements, refer to article, Check, Test and Start Requirements, in Section 23 00 50, Basic HVAC Materials and Methods.

3.24 TESTING AND BALANCING

- A. For testing and balancing requirements, refer to Section 23 05 93, Testing and Balancing for HVAC.

### 3.25 CLEANING AND PROTECTION

- A. As each duct section is installed, clean interior of ductwork of dust and debris. Clean external surfaces of foreign substances that might cause corrosive deterioration of metal or where ductwork is to be painted.
- B. Strip protective paper from stainless steel ductwork surfaces, and repair finish wherever it has been damaged.
- C. Temporary Closure: At ends of ducts that are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering that will prevent entrance of dust and debris until connections are to be completed.
- D. As each internally lined duct section is installed, check internal lining for small cuts, tears, or abrasions. Repair all damage with fire retardant adhesive.

### 3.26 EQUIPMENT MOUNTING

- A. Mount and anchor equipment in strict compliance with Drawings details. Alternate anchorage methods will not be considered for roof mounted equipment.

### 3.27 INDOOR PIPING INSULATION SCHEDULE

- A. Refrigerant Suction and Hot-Gas Piping, Cooling-Only Systems:
  - 1. Suction and hot-gas piping smaller than 1-1/2 inches diameter:
    - a. Flexible Elastomeric: 1/2 inch thick.
    - b. Mineral-Fiber, Preformed Pipe: 1/2 inch thick.
  - 2. Suction piping 1-1/2 inches diameter and larger:
    - a. Flexible Elastomeric: 1 inch thick.
    - b. Mineral-Fiber, Preformed Pipe: 1 inch thick.
- B. Refrigerant Vapor and Liquid Piping, Heat Pump Systems:
  - 1. Vapor piping for heat pump applications smaller than 1-1/2 inches diameter:
    - a. Flexible Elastomeric: 1-1/2 inches thick.
    - b. Mineral-Fiber, Preformed Pipe: 1-1/2 inches thick.
  - 2. Vapor piping for heat pump applications 1-1/2 inches diameter and larger:
    - a. Flexible Elastomeric: 2 inches thick.
    - b. Mineral-Fiber, Preformed Pipe: 2 inches thick.
  - 3. Liquid piping for heat pump applications smaller than 1 inch diameter:
    - a. Flexible Elastomeric: 1 inch thick.
    - b. Mineral-Fiber, Preformed Pipe: 1 inch thick.

4. Liquid piping for heat pump applications 1 inch diameter and larger:
    - a. Flexible Elastomeric: 1-1/2 inch thick.
    - b. Mineral-Fiber, Preformed Pipe: 1-1/2 inch thick.
  - C. Hydronic Piping:
    1. Chilled Water Piping:
      - a. Piping smaller than 1-1/2 inches diameter:
        - 1) Mineral-Fiber, Preformed Pipe: 1/2 inch thick.
      - b. Piping 1-1/2 inches diameter and larger:
        - 1) Mineral-Fiber, Preformed Pipe: 1 inch thick.
    2. Heating Hot Water Piping:
      - a. Piping smaller than 1-1/2 inches diameter:
        - 1) Mineral-Fiber, Preformed Pipe: 1-1/2 inch thick.
      - b. Piping 1-1/2 inches diameter and larger:
        - 1) Mineral-Fiber, Preformed Pipe: 2 inches thick.
- 3.28 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE
- A. Refrigerant Suction and Hot-Gas Piping, Cooling-Only Systems:
    1. All Pipe Sizes: Insulation shall be one of the following:
      - a. Flexible Elastomeric: 1 inch thick.
      - b. Mineral-Fiber, Preformed Pipe: 1 inch thick.
  - B. Refrigerant Vapor and Liquid Piping, Heat Pump Systems:
    1. Vapor piping for heat pump applications smaller than 1-1/2 inches diameter:
      - a. Flexible Elastomeric: 1-1/2 inches thick.
      - b. Mineral-Fiber, Preformed Pipe: 1-1/2 inches thick.
    2. Vapor piping for heat pump applications 1-1/2 inches diameter and larger:
      - a. Flexible Elastomeric: 2 inches thick.
      - b. Mineral-Fiber, Preformed Pipe: 2 inches thick.
    3. Liquid piping for heat pump applications smaller than 1 inch diameter:
      - a. Flexible Elastomeric: 1 inch thick.

- b. Mineral-Fiber, Preformed Pipe: 1 inch thick.
- 4. Liquid piping for heat pump applications 1 inch diameter and larger:
  - a. Flexible Elastomeric: 1-1/2 inch thick.
  - b. Mineral-Fiber, Preformed Pipe: 1-1/2 inch thick.
- C. Refrigerant Flexible Connectors:
  - 1. Flexible Elastomeric: Thicknesses as specified for rigid piping.
- D. Chilled Water:
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
- E. Heating-Hot-Water Supply and Return, 200 Deg F and Below:
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

### 3.29 INDOOR FIELD-APPLIED PIPING JACKET SCHEDULE

- A. Piping, concealed: None.
- B. Piping, exposed: PVC, 20 mils thick.

### 3.30 OUTDOOR FIELD-APPLIED PIPING JACKET SCHEDULE

- A. All Piping: Aluminum, Stucco Embossed: Thickness as follows:

| <u>Outer Insulation Diameter<br/>(Inches)</u> | <u>Minimum Aluminum Jacket Thickness (Inch)</u> |                                          |
|-----------------------------------------------|-------------------------------------------------|------------------------------------------|
|                                               | <u>Rigid Insulation</u>                         | <u>Non-Rigid Insulation<br/>(Note 1)</u> |
| 8 and Smaller                                 | 0.024                                           | 0.024                                    |
| Larger Than 8 Thru 11                         | 0.024                                           | 0.024                                    |
| Larger Than 11 Thru 24                        | 0.024                                           | 0.024                                    |
| Larger Than 24 Thru 36                        | 0.024                                           | 0.032                                    |
| Larger Than 36                                | 0.024                                           | 0.040                                    |

- 1. Note 1: Non-rigid Insulation is defined as having a compressive strength of less than 15 psi.

### 3.31 INDOOR DUCT INSULATION SCHEDULE

#### A. Ducts Located Within Building Thermal Envelope:

1. Minimum R-Value = R-4.2.
2. Supply and Return Ducts: Mineral Fiber Blanket, 1-1/2 inches thick, 0.75 lb/cu. ft.

#### B. Ducts Located Within Building Outside Thermal Envelope:

1. Minimum R-Value – R-8.0.
2. Supply and Return Ducts: Mineral Fiber Blanket, 3 inches thick, 0.75 lb/cu. ft.

### 3.32 OUTDOOR DUCT INSULATION SCHEDULE.

#### A. Minimum R-Value = R-8.

#### B. Refer to article, Ductwork, for internal duct lining. Provide 2 inches thick internal duct lining where indicated on Drawings.

### 3.33 INDOOR FIELD-APPLIED DUCT JACKET SCHEDULE

#### A. Insulated ducts in concealed spaces: None.

#### B. Insulated ducts in exposed unconditioned spaces: PVC, 20 mils thick.

### 3.34 EQUIPMENT INSULATION SCHEDULE

#### A. Insulate indoor and outdoor equipment that is not factory insulated.

#### B. Chilled-water pump insulation shall be the following:

1. Mineral-Fiber Board: Thickness equal to insulation thickness for connected pipes and 3-lb/cu. ft. nominal density.

#### C. Heating-hot-water pump insulation shall be the following:

1. Mineral-Fiber Board: Thickness equal to insulation thickness for connected pipes and 3-lb/cu. ft. nominal density.

#### D. Chilled-water expansion/compression tank insulation shall be one of the following:

1. Flexible Elastomeric: Thickness equal to insulation thickness for connected pipes.
2. Mineral-Fiber Board: Thickness equal to insulation thickness for connected pipes and 3-lb/cu. ft. nominal density.
3. Mineral-Fiber Pipe and Tank: Thickness equal to insulation thickness for connected pipes.

#### E. Heating-hot-water expansion/compression tank insulation shall be one of the following:

1. Mineral-Fiber Board: Thickness equal to insulation thickness for connected pipes and 3-lb/cu. ft. nominal density.
2. Mineral-Fiber Pipe and Tank: Thickness equal to insulation thickness for connected pipes.

F. Chilled-water air-separator insulation shall be one of the following:

1. Flexible Elastomeric: Thickness equal to insulation thickness for connected pipes.
2. Mineral-Fiber Board: Thickness equal to insulation thickness for connected pipes and 3-lb/cu. ft. nominal density.
3. Mineral-Fiber Pipe and Tank: Thickness equal to insulation thickness for connected pipes.

G. Heating-hot-water air-separator insulation shall be one of the following:

1. Mineral-Fiber Board: Thickness equal to insulation thickness for connected pipes and 3-lb/cu. ft. nominal density.
2. Mineral-Fiber Pipe and Tank: Thickness equal to insulation thickness for connected pipes.

### 3.35 INDOOR, FIELD-APPLIED EQUIPMENT JACKET SCHEDULE

A. Equipment, Concealed: None.

B. Equipment, Exposed: PVC: 20 mils thick.

### 3.36 OUTDOOR, FIELD-APPLIED EQUIPMENT JACKET SCHEDULE

A. All Equipment: Aluminum, Stucco Embossed. Thickness as follows:

| <u>Outer Insulation Diameter<br/>(Inches)</u> | <u>Minimum Aluminum Jacket Thickness (Inch)</u> |                                          |
|-----------------------------------------------|-------------------------------------------------|------------------------------------------|
|                                               | <u>Rigid Insulation</u>                         | <u>Non-Rigid Insulation<br/>(Note 1)</u> |
| 8 and Smaller                                 | 0.024                                           | 0.024                                    |
| Larger Than 8 Thru 11                         | 0.024                                           | 0.024                                    |
| Larger Than 11 Thru 24                        | 0.024                                           | 0.024                                    |
| Larger Than 24 Thru 36                        | 0.024                                           | 0.032                                    |
| Larger Than 36                                | 0.024                                           | 0.040                                    |

1. Note 1: Non-rigid Insulation is defined as having a compressive strength of less than 15 psi.

END OF SECTION



## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 2025-01-31 - Removed non-applicable language regarding project management and price modification procedures, removed responsibility matrix, etc.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Electrical Designer should coordinate provisions for dedicated electrical rooms for all new construction projects. Designer should make every effort to provide dedicated electrical rooms on modernization projects.
- All training sessions required in Part 3 of any Division 26 specification section shall be recorded in digital format. Confirm format, i.e. MP4, MOV, WMV, AVI with the district. Each specification section that requires training shall include one video file; file name shall include the specification

section and title. Files shall be consolidated on a USB 3.0 flash drive, min. 1TB capacity, and 3 flash drives shall be provided to the district representative upon project completion.

- Refer to individual specification sections for attic stock requirements. In addition, the design team shall consult with the owner's representative to determine possible attic stock requirements for other systems on a project-by-project basis.

## SECTION 26 00 10

## BASIC ELECTRICAL REQUIREMENTS

**PART 1 - GENERAL**

## 1.01 SUMMARY

## A. Table of Contents, Division 26 - Electrical:

| <u>SECTION NO.</u> | <u>SECTION TITLE</u>             |
|--------------------|----------------------------------|
| 260010             | BASIC ELECTRICAL REQUIREMENTS    |
| 260060             | POWER SYSTEM STUDY               |
| 260090             | ELECTRICAL DEMOLITION            |
| 260519             | BUILDING WIRE AND CABLE          |
| 260526             | GROUNDING AND BONDING            |
| 260529             | ELECTRICAL HANGERS AND SUPPORTS  |
| 260531             | CONDUIT                          |
| 260533             | BOXES                            |
| 260543             | UNDERGROUND DUCTS AND STRUCTURES |
| 260553             | ELECTRICAL IDENTIFICATION        |
| 260942             | DIGITAL LIGHTING CONTROL         |
| 262213             | DRY TYPE TRANSFORMERS            |
| 262413             | SWITCHBOARDS                     |
| 262416             | PANELBOARDS                      |
| 262719             | SURFACE RACEWAYS                 |
| 262726             | WIRING DEVICES                   |
| 262736             | ENERGY INFORMATION SYSTEMS       |
| 262816             | OVERCURRENT PROTECTIVE DEVICES   |
| 262819             | DISCONNECT SWITCHES              |
| 263100             | PHOTOVOLTAIC POWER SYSTEMS       |
| 264313             | SURGE PROTECTIVE DEVICES         |
| 265000             | LIGHTING                         |

B. Work included: This Section includes general administrative and procedural requirements for Division 26. The following administrative and procedural requirements are included in this Section to supplement the requirements specified in Division 01.

1. Quality assurance.
2. Definition of terms.
3. Submittals.
4. Coordination.
5. Record documents.
6. Operation and maintenance manuals.
7. Rough-in.
8. Electrical installation.

9. Cutting, patching, painting, and sealing.
  10. Field quality control.
  11. Cleaning.
  12. Project closeout.
- C. Related Work: Consult all other Sections, determine the extent and character of related Work, and properly coordinate Work specified herein with that specified elsewhere to produce a complete and operable installation.
1. General and supplementary conditions: Drawings and general provisions of Contract and Division 01 of the Specifications, apply to all Division 26 Sections.
  2. Earthwork: Include trenching, backfilling, boring and soil compaction as required for the installation of underground conduit, in-grade pull boxes, vaults, lighting pole foundations, etc. Refer to Division 31, Earthwork.
  3. Selective demolition: Nondestructive removal of materials and equipment for reuse or salvage as indicated. Also dismantling electrical materials and equipment made obsolete by these installations. Refer to Division 02, Selective Demolition.
  4. Concrete work: Include forming, steel bar reinforcing, cast-in-place concrete, finishing and grouting as required for underground conduit encasement, light pole foundations, pull box slabs, vaults, housekeeping pads, etc. Also includes setting of floor boxes in existing concrete slabs, saw-cutting of existing slabs and grouting of conduits in saw-cut. Refer to Division 03, Concrete.
  5. Miscellaneous metal work: Include fittings, brackets, backing, supports, rods, welding and pipe as required for support and bracing of raceways, luminaires, panelboards, distribution boards, switchboards, motor control centers, etc. Refer to Division 05, Miscellaneous Metals.
  6. Miscellaneous lumber and framing work: Include wood grounds, nailers, blocking, fasteners and anchorage for support of electrical materials and equipment. Refer to Division 06, Rough Carpentry.
  7. Moisture protection and smoke barrier penetrations: Include membrane clamps, sheet metal flashing, counter flashing, caulking and sealant as required for waterproofing of conduit penetrations and sealing penetrations in or through fire walls, floors, ceiling slabs and foundation walls. All penetrations through vapor barriers at slabs on grade shall be taped and made vapor tight. Refer to Division 07, Thermal and Moisture Protection.
  8. Access panels and doors: Required in walls, ceilings, and floors to provide access to electrical devices and equipment. Refer to Division 08, Access Doors also, Division 05, Metals.
  9. Painting: Include surface preparation, priming and finish coating as required for electrical cabinets, exposed conduit, pull and junction boxes, etc. where indicated as field painted in this Division. Refer to Division 09, Painting.
  10. Luminaire supports: Provide slack support wire for luminaires installed in acoustical tile or lay-in suspended ceilings. Refer to Division 09, Acoustical Treatment.

- D. Work furnished and installed under another Division requiring connections under this Division includes but is not limited to:
1. Electric motors.
  2. Package mechanical equipment: fans, fan coil units, pumps, boilers, compressors, etc.
  3. Flow switches and valve monitors for sprinkler system.
  4. Elevator controllers.
  5. Pre-wired electrified partition furniture.
  6. Temperature control panel(s). (Line voltage only)
  7. Irrigation controller(s). (Line voltage only)
  8. FM-200 control panel. (Line voltage only)
  9. Kitchen equipment and appliances.
  10. Laboratory equipment.
  11. Electric signage.
  12. Electric door locks.
  13. Electric heat trace tape.
  14. Door hold-open/release devices.
  15. Variable frequency drive units.
  16. Chiller starters.
  17. Motorized roll down/sliding doors and grills.
  18. Motorized dock levelers.
  19. Projection screens.
- E. Items furnished under another Division, but installed and connected under this Division includes but is not limited to:
1. Wall mounted control stations for motorized roll down and sliding doors.
  2. Electric fire sprinkler water flow bells.
  3. Speed control switches for ceiling exhaust fans.

## 1.02 QUALITY ASSURANCE

- A. Reference to Codes, Standards, Specifications and recommendations of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to submittal of the bid. Such codes or standards shall be considered a part of this Specification as though fully repeated herein.
- B. When codes, standards, regulations, etc. allow Work of lesser quality or extent than is specified under this Division, nothing in said codes shall be construed or inferred authority for reducing the quality, requirements, or extent of the Contract Documents. The Contract Documents address the minimum requirements for construction.

- C. Work shall be performed in accordance with all applicable requirements of the latest edition of all governing codes, rules and regulations including but not limited to the following minimum standards, whether statutory or not:
1. California Electric Code (CEC).
  2. California Building Code (CBC).
  3. California Fire Code (CFC).
  4. California Mechanical Code (CMC).
- D. Standards: Equipment and materials specified under this Division shall conform to the following standards where applicable:
- |       |                                                         |
|-------|---------------------------------------------------------|
| ACI   | American Concrete Institute                             |
| ANSI  | American National Standards Institute                   |
| ASTM  | American Society for Testing Materials                  |
| CBM   | Certified Ballast Manufacturers                         |
| ETL   | Electrical Testing Laboratories                         |
| FS    | Federal Specification                                   |
| IEEE  | Institute of Electrical and Electronics Engineers, Inc. |
| IPCEA | Insulated Power Cable Engineer Association              |
| NEMA  | National Electrical Manufacturer's Association          |
| UL    | Underwriters' Laboratories                              |
- E. Independent Testing Agency qualifications:
1. Testing Agency shall be an independent testing organization that will function as an unbiased authority, professionally independent of Manufacturer, Supplier and Contractor, furnishing and installing equipment or system evaluated by Testing Agency.
  2. Testing Agency shall be regularly engaged in the testing of electrical equipment, devices, installations, and systems.
  3. Testing Agency shall meet Federal Occupational Safety and Health Administration (OSHA) requirements for accreditation of independent testing laboratories, Title 9, Part 1907.
  4. On-site technical personnel shall be currently certified by the International Electrical Testing Association in electrical power distribution system testing.
  5. Testing Agency shall use technicians who are regularly employed by the firm for testing services.
  6. Contractor shall submit proof of above Testing Agency qualifications with bid documentation upon request.
- F. All base material shall be ASTM and/or ANSI standards.
- G. All electrical apparatus furnished under this Section shall conform to NEMA standards and the CEC and bear the UL label where such label is applicable.
- H. Certify that each welder performing Work has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone re-certification.

### 1.03 DEFINITION OF TERMS

- A. The following list of terms as used in the Division 26 documents shall be defined as follows:
1. "Provide": Shall mean furnish, install, and connect unless otherwise indicated.
  2. "Furnish": Shall mean purchase and deliver to Project site.
  3. "Install": Shall mean to physically install the items in-place.
  4. "Connect": Shall mean make final electrical connections for a complete operating piece of equipment.
  5. "As directed": Shall be as directed by the Owner or their authorized Representative.
  6. "Utility Companies": Shall mean the company providing electrical, telephone or cable television services to the Project.

#### 1.04 SUBMITTALS

- A. Format: Furnish submittal data in electronic format for each Specification Section with a table of contents listing materials by Section and paragraph number.
- B. Submittals shall consist of detailed Shop Drawings, Specifications, block wiring diagrams, "catalog cuts" and data sheets containing physical and dimensional information, performance data, electrical characteristics, materials used in fabrication and material finish. Clearly indicate by arrows or brackets precisely what is being submitted on and those optional accessories which are included and those which are excluded. Furnish quantities of each submittal as noted in Division 01.
- C. Each submittal shall be labeled with the Specification Section Number and shall be accompanied by a cover letter or shall bear a stamp stating that the submittal has been thoroughly reviewed by the Contractor and is in full compliance with the requirements of the Contract Documents or provide a Specification Section line-by-line compliance response statement with detailed exception/ deviation response statements for all applicable provisions for the applicable Specification Section. Any Specification Section lines without a detailed exception/ deviation response statement shall be treated as the Contractor or Vendor is submitting in full compliance with the applicable Specification Section requirements. Cover letters shall list in full the items and data submitted. Failure to comply with this requirement shall constitute grounds for rejection of data.
- D. The Contractor shall submit detailed Drawings of all electrical equipment rooms and closets if the proposed installation layout differs from the construction documents. Physical size of electrical equipment indicated on the Drawings shall match those of the electrical equipment that is being submitted for review, i.e.: switchboards, panelboards, transformers, control panels, etc. Minimum scale: 1/4" = 1'- 0". Revised electrical equipment layouts must be approved prior to release of order for equipment and prior to installation.
- E. As part of the equipment and fixture submittals, the Contractor shall provide anchorage calculations for floor and wall mounted electrical equipment and fixtures, distribution conduits and raceways, in conformance with the 2019 California Building Code (CBC) and ASCE 7-16. Use the Occupancy Category, Ground Accelerations, Site Class, Seismic Design Category, and Seismic Importance Factor as noted in the structural drawings. For components required for Life Safety or containing hazardous materials use  $I_p=1.5$ . Structural Calculations shall be prepared, stamped, and signed by a California Registered Structural Engineer. Specify proof loads for drilled-in anchors, if used.

- F. The Manufacturer shall recommend the method of anchoring the equipment to the mounting surface and shall provide the Contractor with the assembly dimensions, weights, and approximate centers of gravity.
- G. Review of submittals is for general conformance to design concept and general compliance with the Specification Sections. Submittal Review Comments do not imply waiver of Specifications Section requirements unless specifically noted.
- H. All resubmittals shall include a cover letter that lists the action taken and revisions made to each Drawing and equipment data sheet in response to Submittal Review Comments. Resubmittal packages will not be reviewed unless accompanied by this cover letter. Failure to include this cover letter will constitute rejection of the resubmittal package.
- I. Shop Drawings for the following systems must be prepared via a computer aided drafting (CAD) or building information modeling (Revit) system for submission by the Contractor. The Engineer can provide CAD or Revit files of the electrical Contract Documents to the Contractor.
  - 1. Digital Lighting Controls, Section 260942.
  - 2. Photovoltaic Power System, Section 263100.
- J. Independent Testing Agency report:
  - 1. Testing Agency shall provide 3 copies of the complete testing report.
  - 2. Test report shall include the following:
    - a. Summary of Project.
    - b. Description of equipment.
    - c. Equipment used to conduct the test.
      - 1) Type.
      - 2) Manufacturer.
      - 3) Model number.
      - 4) Serial number.
      - 5) Date of last calibration.
      - 6) Documentation of calibration leading to NIST standards.
    - d. Description of test.
    - e. Test results, as compared to Manufacturers or industry accepted standards and tolerances.
    - f. Conclusion and recommendation.
    - g. Signature of responsible test organization authority.
  - 3. Furnish completed test report to Engineer no later than 30-days after completion of testing, unless otherwise directed.
- K. Substitutions:



1. All requests for substitutions shall conform to the general requirements and procedure outlined in Division 01.
2. Where items are noted as "or equal," a product of equal design, construction and performance will be considered. Contractor must submit to the Engineer all pertinent test data, catalog cuts and product information required substantiating that the product is in fact equal to that specified. Only one substitution will be considered for each product specified.
3. Manufacturers' names and model numbers used in conjunction with materials, processes or equipment included in the Contract Documents are used to establish standards of quality, utility, and appearance. Materials, processes, or equipment, which in the opinion of the Engineer is equal in quality, utility, and appearance, will be approved as substitutions to that specified.
4. Whenever any material, process or equipment is specified in accordance with a Federal specification, an ASTM standard, an ANSI specification, UL rating or other association standard, the Contractor shall present an affidavit from the Manufacturer certifying that the product complies with the particular standard specification. When requested by the Engineer, support test data to substantiate compliance shall be submitted by the Contractor at no additional cost.
5. Substitutions shall be equal, in the opinion of the Architect/Engineer, to the specified product. The burden of proof of such shall rest with the Contractor. When the Architect/Engineer in writing accepts a substitution, it is with the understanding that the Contractor guaranteed the substituted article or material to be equal to the one specified and dimensioned to fit within the construction. Approved substitutions shall not relieve the Contractor of responsibilities for the proper execution of the Work or from any provisions of the Specifications.
6. The Contractor shall be responsible for all expenses in connection with the substitution materials, processes, and equipment, including the effect of the substitution on the Contractor, Subcontractor's, or other Contractor's Work. No substitution of material, processes or equipment shall be permitted without written authorization of the Architect/Engineer. Any assumptions on the acceptability of a proposed substitution prior to acceptance by the Engineer are at the sole risk of the Contractor.

#### 1.05 COORDINATION

##### A. Discrepancies:

1. In the event of discrepancies within the Contract Documents, the Engineer shall be so notified, within sufficient time, as delineated in Division 01, prior to the Bid Opening to allow the issuance of an Addendum.
2. If, in the event that time does not permit notification or clarification of discrepancies prior to the Bid Opening, the following shall apply: The Drawings govern in matters of quantity and the Specifications govern in matters of quality. In the event of conflict within the Drawings involving quantities or within the Specifications involving quantities or within the Specifications involving quality, the greater quantity and higher quality shall apply. Such discrepancies shall be noted and clarified in the Contractor's Bid. No

additional allowances will be made because of errors, ambiguities or omissions that reasonably should have been discovered during the preparation of the Bid.

B. Project conditions:

1. Examination of Project site: The Contractor shall visit the Project site and thoroughly review the locale, working conditions, conflicting utilities, and the conditions in which the Electrical Work will take place. Verify all existing conditions in the field. No allowances will be made subsequently for any costs that may be incurred because of any error or omission due to failure to examine the Project site and to notify the Engineer of any discrepancies between Contract Documents and actual Project site conditions.
2. Protection: Keep conduits, junction boxes, outlet boxes and other openings closed to prevent entry of foreign matter. Cover fixtures, equipment, devices, and apparatus and protect them against dirt, paint, water, chemical or mechanical damage, before and during construction period. Prior to final acceptance, restore to original condition any fixture, apparatus or equipment damaged including restoration of damaged factory applied painted finishes. Protect bright finished surfaces and similar items until in service. No rust or damage will be permitted.
3. Supervision: Contractor shall personally or through an authorized and competent representative constantly supervise the Work from beginning to completion and, within reason, keep the same foreman and workmen on the Project throughout the Project duration.

C. Preparation:

1. Drawings:
  - a. Layout: General layout indicated on the Drawings shall be followed except where other Work may conflict with the Drawings.
  - b. Accuracy: Drawings for the Work under this Section are essentially diagrammatic within the constraints of the symbology applied.

D. Utility company contacts:

1. Contact for electrical service:
2. Contact for telephone service:
3. Contact for television service:

1.06 RECORD DOCUMENTS

A. Provide Project Record Drawings as described herein:

1. Drawings shall fully represent installed conditions including actual locations of outlets, true panelboard connections following phase balancing routines, correct conduit, and wire sizing as well as routing, revised luminaire schedule listing Manufacturers and products installed and revised panel schedules. Contractor shall record all changes in the Work during the course of construction on blue or black line prints. These prints shall be made subject of monthly review by the Owner's Representative to ascertain that they are current. If not current, monthly payments may be withheld.

2. Record Drawings shall be the transfer of information on these prints to the construction documents via computer aided drafting (CAD) process. Electronic files of the electrical construction documents will be provided to the Contractor by the Engineer.
  3. Record drawing submissions shall be provided to the Engineer to review upon the completion of the following phases of Work:
    - a. Final electrical installation.
  4. Include in the record drawing submission the following shop drawing submission with all updated installation information:
    - a. Digital Lighting Controls, Section 260942.
    - b. Photovoltaic Power System, Section 263100.
  5. A single set of half size prints of the Record Drawings shall be submitted for review. Upon receipt of the Engineer's review comments, corrections shall be made, and the Contractor shall provide the following:
    - a. One set of full size reproducibles.
    - b. Electronic files of Drawings in PDF and CAD.
- B. Panel schedules:
1. Typewritten panel schedules shall be provided for panelboards indicating the loads served and the correct branch circuit number. Schedules shall be prepared on forms provided by the Manufacturer and inserted in the pocket of the inner door of each panelboard. See Section 262416: Panelboards for requirements.
  2. A single set of the record panel schedules shall be submitted for review. Upon receipt of the Engineer's review comments, corrections shall be made, and the Contractor shall provide the following:
    - a. Fold and insert one copy of the appropriate schedule in the pocket of the inner door of each panelboard.
- C. Field labels, markings, and warning signs: Provide in accordance and as required by:
1. General: CEC Article 110.21.
  2. High-Leg System: CEC Article 110.15.
  3. Arc-Flash Warning: CEC Article 110.16.
  4. Identification of Disconnecting Means: CEC Article 110.22 (A).
  5. Engineered Series Combination Systems: CEC Article 110.22 (B).
  6. Tested Series Combination Systems: CEC Article 110.22 (C).
  7. Available Fault Current: CEC Article 110.24.
  8. Depth of Working Space in Existing Buildings: CEC Article 110.26 (A)(1)(c).
  9. Guarding of Live Parts: CEC Article 110.27 (C).
  10. Locked Rooms or Enclosures: CEC Article 110.34 (C).

11. Manholes: CEC Article 110.75 (E).

**1.07 OPERATION AND MAINTENANCE MANUALS**

- A. Prior to Project closeout furnish to the Owner, six (6) hard back 3-ring binders containing all bulletins, operation and maintenance instructions, part lists, service telephone numbers and other pertinent information as noted in each Section all equipment furnished under Division 26. Binders shall be indexed into Division Sections and labeled for easy reference. Bulletins containing more information than the equipment concerned shall be properly stripped and assembled.

**PART 2 - PRODUCTS (NOT APPLICABLE)**

**PART 3 - EXECUTION**

**3.01 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION**

- A. All work shall be installed in a neat, workmanlike manner in accordance with ANSI/NECA 1-2015.
- B. Comply with the requirements of all listed codes and standards.
- C. All materials and equipment provided under this contract shall be new (except where otherwise noted) and shall be listed, labeled or certified by a Nationally Recognized Testing Laboratory (NRTL) to meet Underwriters Laboratories, Inc. (UL), standards where test standards have been established. Materials and equipment which are not covered by UL standards will be accepted, providing that materials and equipment are listed, labeled, certified or otherwise determined to meet the safety requirements of a NRTL.
- D. All equipment of the same type and capacity shall be by the same manufacturer.
- E. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.
- F. During construction the contractor shall at all times maintain electrical utilities of the building without interruption. Should it be necessary to interrupt any electrical service or utility, the contractor shall secure permission in writing from the owner's representative for such Interruption at least ten (10) business days in advance. Any interruption shall be made with minimum amount of inconvenience and any shut-down time shall have to be on a premium time basis and such time to be included in the contractor's bid. Arrange to provide and pay for temporary power source as required by project conditions.
- G. Working clearance around equipment shall not be less than that specified in the CEC for all voltages specified.
- H. The locations of switches, receptacles, lights, motors, etc. outlets shown are approximate. The contractor shall use good judgment in placing the preceding items to eliminate all interference with ducts, piping, etc. The contractor shall check all door swings so that light switches are not located behind doors. Relocate switches as required, with approval from the Design Professional. The owner's representative may direct relocation of outlets before installation, up to five (5) feet from the position indicated on the Drawings, without additional cost.

- I. 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. Normal maintenance shall not require the removal of protective guards from adjacent equipment. Install equipment as close as practical to the locations shown on the Drawings.
  - 1. Where the owner's representative determines that the Contractor has installed equipment not conveniently accessible for operations and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the owner.
  - 2. "Conveniently Accessible" is defined as being capable of being reached without climbing or crawling over or under obstacles such as motors, pumps, belt guards, transformers, racks, piping, ductwork, raceways or similar.
- J. Owner furnished equipment: Equipment furnished by the District shall be received, stored, uncrated, protected, and installed by the Contractor with all appurtenances required to place the equipment in operation, ready for use. The Contractor shall be responsible for the equipment as if he had purchased the equipment himself and shall hold the warranty

### 3.02 ROUGH-IN

- A. Contractor shall verify lines, levels and dimensions indicated on the Drawings and shall be responsible for the accuracy of the setting out of Work and for its strict conformance with existing conditions at the Project site.
- B. Verify final locations for rough ins with field measurements and with the requirements for the actual equipment to be connected.
- C. Refer to equipment specification in Divisions 22 through 33 for rough-in requirements.

### 3.03 ELECTRICAL INSTALLATION

- A. Preparation, sequencing, handling, and installation shall be in accordance with Manufacturer's written instructions and technical data particular to the product specified and/or accepted equal except as otherwise specified. Comply with the following requirements:
  - 1. Shop Drawings prepared by Manufacturer.
  - 2. Verify all dimensions by field measurements.
  - 3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
  - 4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
  - 5. Sequence, coordinate and integrate installations of electrical materials and equipment for efficient flow of the Work. Give attention to large equipment requiring positioning prior to closing in the building.
  - 6. Where mounting height is not detailed or dimensioned, contact the Architect for direction prior to proceeding with rough-in.

7. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with approved submittal data, including coordination Drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are indicated only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.
9. Install systems, materials, and equipment level and plumb, parallel, and perpendicular to other building systems and components, where installed exposed in finished spaces.
10. Install electrical equipment to facilitate servicing, maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
11. Coordinate electrical systems, equipment, and materials installations with other building components.
12. Provide access panel or doors where devices or equipment are concealed behind finished surfaces. Furnish and install access doors per the requirements of Division 08.
13. Install systems, materials and equipment giving right-of-way priority to other systems that are required to maintain a specified slope.
14. Conform to the National Electrical Contractors Association "Standard of Installation" for general installation practice.

#### 3.04 CUTTING, PATCHING, PAINTING AND SEALING

- A. Structural members shall in no case be drilled, bored, or notched in such a manner that will impair their structural value. Cutting of holes, if required, shall be done with core drill and only with the approval of the Architect and Structural Engineer.
- B. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
- C. Cut, remove, and legally dispose of selected electrical equipment, components and materials as indicated, including but not limited to removal of electrical items indicated to be removed and items made obsolete by the new work.
- D. Protect the structure, furnishings, finishes and adjacent materials not indicated or scheduled to be removed.
- E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
- F. Patch existing surfaces and building components using experienced installers and new materials matching existing materials and the original installation. For installers' qualifications refer to the materials and methods required for the surface and building components being patched.
- G. Application of joint sealers:

1. General: Comply with joint sealer Manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
2. Installation of fire-stopping sealant: Install sealant, including forming, packing and other accessory materials, to fill openings around electrical services penetrating floors and walls, to provide fire-stops and fire-resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.

### 3.05 FIELD QUALITY CONTROL

#### A. General testing requirements:

1. The purpose of testing is to ensure that all tested electrical equipment, both Contractor and Owner supplied, is operational and within industry and Manufacturer's tolerances and is installed in accordance with design Specifications.
2. Tests and inspections shall determine suitability for energization.
3. Perform tests in presence of the Owner's Representative and furnish test equipment, facilities and technical personnel required to perform tests.
4. Tests shall be conducted during the construction period and at completion to determine conformity with applicable codes and with these Specifications.

#### B. Tests: In addition to specific system test described elsewhere, tests shall include:

1. Equipment operations: Test motors for correct operation and rotation.
2. Lighting control circuits: Test lighting circuits for correct operation through their control devices.
3. Alarm and interlock systems: Produce malfunction symptoms in operating systems to test alarm and interlock systems. In addition, all specific tests described in the fire alarm system shall be performed.
4. Circuit numbering verification: Select on a random basis, various circuit breakers within the panelboards and cycle them on and off to verify compliance of the typed panel directories with actual field wiring.
5. Voltage check:
  - a. At completion of job, check voltage at several points of utilization on the system that has been installed under this Contract. During test, energize all installed loads.
  - b. Adjust taps on transformers to give proper voltage, which is 118 to 122volts for 120volt nominal systems and proportionately equivalent for higher voltage systems. If proper voltage cannot be obtained, inform the Owner and the serving Utility Company.

#### C. Contractor shall provide test power required when testing equipment before service energization and coordinate availability of test power with General Contractor after service energization. The Contractor shall provide any specialized test power as needed or specified herein.

#### D. Testing safety and precautions:

1. Safety practices shall include the following requirements:
    - a. Applicable State and Local safety operating procedures.
    - b. OSHA.
    - c. NSC.
    - d. NFPA 70E.
  2. All tests shall be performed with apparatus de-energized and grounded except where otherwise specifically required ungrounded by test procedure.
- E. Calibration of test equipment:
1. Testing Agency shall have calibration program that assures test instruments are maintained within rated accuracy.
  2. 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: 12-months.
    - c. Leased specialty equipment: 12-months where accuracy is guaranteed by lessor.
  3. Dated calibration labels shall be visible on test equipment.
  4. Records, which show date and results of instruments calibrated or tested, must be kept up to date.
  5. Up-to-date instrument calibration instructions and procedures shall be maintained for test instrument.
  6. Calibration standards shall be of higher accuracy than instrument tested.
  7. Equipment used for field testing shall be more accurate than instrument being tested.
- F. Coordinate with General Contractor regarding testing schedule and availability of equipment ready for testing.
- G. Notify Owner and Engineer one week in advance of any testing.
- H. Any products which fail during the tests or are ruled unsatisfactory by the Owner's Representative shall be replaced, repaired, or corrected as prescribed by the Owner's Representative at the expense of the Contractor. Tests shall be performed after repairs, replacements or corrections until satisfactory performance is demonstrated.
- I. Testing Agency shall maintain written record of tests and shall assemble and certify final test report.
- J. Include all test results in the maintenance manuals.

### 3.06 CLEANING

- A. Prior to energizing of electrical equipment, the Contractor shall thoroughly clean the interior of enclosures from construction debris, scrap wire, etc. using Manufacturer's approved methods and materials.



- B. Upon completion of Project, prior to final acceptance, the Contractor shall thoroughly clean both the interior and exterior of all electrical equipment per Manufacturers approved methods and materials. Remove paint splatters and other spots, dirt, and debris.
- C. Touch-up paint any marks, blemishes or other finish damage suffered during installation.

### 3.07 PROJECT CLOSEOUT

- A. Training:
  - 1. At the time of completion, a period of not less than 4-hours shall be allotted by the Contractor for instruction of building operating and maintenance personnel in the use of all systems. This 4-hour training is in addition to any instruction time called out in the Specifications for specific systems. All personnel shall be instructed at one time, the Contractor making all necessary arrangements with Manufacturer's Representative. The equipment Manufacturer shall be requested to provide product literature and application guides for the users' reference. Costs, if any, for the above services shall be paid by the Contractor.
  - 2. All training sessions shall be video recorded. Confirm file type, i.e. MOV, AVI, MP4, etc. with the district. Each specification section that requires training shall include one file, and all Division 26 specifications shall be stored on a flash drive (USB3.0, 1TB min.) 3 flash drives shall be provided to the district representative with closeout documentation.
- B. Special tools: Provide one of each tool type required for proper operation and maintenance of the equipment provided under this Section. All tools shall be delivered to the Owner at the Project completion.
- C. Keying: Provide two keys for each lock furnished under this Section and turn over to Owner.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

SECTION 260060

POWER SYSTEM STUDY

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work included: Services necessary to complete the system analysis studies required for the item specified under this Division, including but not limited to:
  - 1. Short circuit study.
  - 2. Protective device evaluation study.
  - 3. Protective device coordination study.
  - 4. Arc flash and shock risk assessment.
- B. Related Work: Consult all other Sections, determine the extent and character of related Work, and properly coordinate Work specified herein with equipment specified elsewhere to perform a complete analysis study.

**1.02 REFERENCES**

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:
  - 1. American National Standards Institute, Inc. (ANSI):  
ANSI Z535.4;                      Product Safety Signs and Labels
  - 2. Institute of Electrical and Electronic Engineers (IEEE):  
IEEE 1584;                      Guide for Performing Arc-Flash Hazard Calculations
  - 3. National Fire Protection Association (NFPA):  
NFPA 70E;                      Standard for Electrical Safety in the Workplace

**1.03 SUBMITTALS**

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
  - 1. The results of the Power System Study shall be summarized in a final report. Three (3) bound copies of the final report shall be submitted.
  - 2. The report shall include the following Sections:
    - a. Description, purpose, basis and scope of the study and a single line diagram of that portion of the power system, which is included within the scope of the study.
    - b. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties and commentary regarding it.
    - c. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection and commentary regarding it.

- d. Fault current calculations including a definition of terms and guide for interpretation of computer printout.
  - e. Recommended size for power fuses and recommended settings for ground fault relays and for all adjustable trip relays.
  - f. Confirmation in writing of compliance with Arc Energy Reduction per CEC Articles 240.67 and 240.87.
  - g. Tabulations of arc flash and shock risk assessment results and commentary regarding results.
  - h. Sample arc flash and shock hazard warning label.
3. Contractor shall also provide an electronic copy of the report as part of the Record Document process. Electronic copy of the report shall be in PDF format and its native file format (e.g. XXX.PRJ).
- B. The study shall be submitted prior to final review of the distribution equipment Shop Drawings, prior to release of equipment for manufacture. If formal completion of the study may cause delay in equipment manufacture, approval from the Architect may be obtained for a preliminary submittal of sufficient data to ensure that the selection of device ratings and characteristics will be satisfactory. Then the formal study will be provided to verify the preliminary findings.

#### 1.04 QUALITY ASSURANCE

- A. The system analysis studies shall be performed by the Switchboard/Switchgear Manufacturer or by an approved Independent Testing Company. The analysis shall be stamped by a professional engineer licensed in the State of California.

### **PART 2 - PRODUCTS (NOT APPLICABLE)**

### **PART 3 - EXECUTION**

#### 3.01 GENERAL

- A. The studies shall include all portions of the electrical distribution system from the main normal power services down to and including the 208volt AC distribution system. Normal system connections and those that result in maximum fault conditions shall be adequately covered in the study.

#### 3.02 SHORT CIRCUIT STUDY AND PROTECTIVE DEVICE EVALUATION STUDY

- A. The short circuit study shall be performed with the aid of a computer program and shall be in accordance with the latest applicable IEEE and ANSI standards.
- B. The study input data shall include the maximum available short circuit contribution, resistance and reactance components of the branch impedance, the X/R ratios, base quantities selected and other source impedance.
- C. Short circuit close and latch duty values and interrupting duty values shall be calculated on the basis of maximum available current at each substation bus, switchgear bus, medium voltage controller, switchboard, low voltage motor control center, distribution panelboard, pertinent branch circuit panel and other significant locations through the system. The short

circuit tabulations shall include asymmetrical fault currents, symmetrical fault currents and X/R ratios. For each fault location, the total duty on the bus, as well as the individual contribution from each connected branch, shall be listed with its respective X/R ratio.

- D. A protective device evaluation study shall be performed to determine the adequacy of circuit breakers, switches, transfer switches and fuses by tabulating and comparing the short circuit ratings of these devices with the calculated fault currents. Appropriate multiplying factors based on system X/R ratios and protective device rating standards shall be applied. Any problem areas or inadequacies in the equipment due to short circuit currents shall be promptly brought to the Architect's attention.

### 3.03 PROTECTIVE DEVICE COORDINATION STUDY

- A. A protective device coordination study shall be performed to provide the necessary calculations and logic decisions required to select or to check the selection of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated current transformers, ground fault relays and low voltage breaker trip characteristics and settings. The studies shall be in accordance with the latest applicable IEEE and ANSI standards.
- B. The coordination study shall include all medium and low-voltage classes of equipment from the building or plant service protective devices down to and including low voltage motor control centers and panelboards. The phase and ground overcurrent protection shall be included as well as settings of all other adjustable protective devices
- C. The time-current characteristics of the specified protective devices shall be drawn on log-log paper. The plots shall include complete titles, representative one-line diagram and legends, significant motor starting characteristics, complete parameters of transformers, complete operating bands of low voltage circuit breaker trip curves and fuses, phase cable damage curves, ground cable damage curves, medium-voltage cable shield damage curves, ground resistor damage curves, etc. as appropriate for the project. The coordination plots shall indicate the types of protective devices selected, proposed relay taps, time dial and instantaneous trip settings, transformer magnetizing inrush and ANSI transformer withstand parameters, cable thermal overcurrent withstand limits and significant symmetrical and asymmetrical fault currents. All restrictions of the National Electrical Code shall be adhered to and proper coordination intervals and separation of characteristic curves shall be maintained. The coordination plots for phase and ground protective devices shall be provided on a system basis. A sufficient number of separate curves shall be used to clearly indicate the coordination achieved.
- D. The selection and settings of the protective devices shall be provided separately in a tabulated form listing circuit identification, IEEE device number, current transformer ratios and connection, Manufacturer and type, range of adjustment and recommended settings. A tabulation of the recommended power fuse selection shall be provided for the medium voltage fuses where applied in the system. Any discrepancies, problem areas or inadequacies shall be promptly brought to the Architect's attention.

### 3.04 ARC FLASH AND SHOCK RISK ASSESSMENT

- A. An arc flash and shock risk assessment shall be performed in accordance with NFPA 70E (utilizing IEEE 1584 calculation method for incident energy analysis method) at each switchboard, distribution board, panelboard, etc. in accordance with the referenced standards. NFPA 70E hazard/ risk tables for arc flash PPE category method are not acceptable for compliance with this section.
- B. The arc flash and shock risk assessment shall include all voltage classes of equipment from the service entrance down to and including the panelboards, etc. in addition to all possible scenario configurations from alternate power sources (e.g. generators, etc.).
- C. The company performing the arc flash and shock risk assessment shall provide arc flash and shock hazard warning labels for all equipment evaluated in accordance with NFPA 70E and ANSI Z535.4. Labeling shall be as follows:
  - 1. Label type:
    - a. White vinyl or polyester with the following warning symbol color and black text:
      - 1) Incident energy below  $40 \text{ cal/cm}^2$  = Orange.
      - 2) Incident energy for  $40 \text{ cal/cm}^2$  and above = Red with DANGER symbol in lieu of WARNING.
    - b. Industrial grade self-adhesive backing.
    - c. Suitable for indoor or outdoor environments for a minimum of 3-years without fading or degrading.
  - 2. Label information (minimum):
    - a. Nominal system voltage.
    - b. Arc flash boundary (inches).
    - c. Available incident energy and the corresponding working distance (inches).
    - d. Limited approach boundary (inches).
    - e. Restricted approach boundary (inches).
    - f. Equipment identification.
    - g. Date.
  - 3. Labels shall be affixed to all equipment covered under the risk assessment by the company performing the arc flash and shock risk assessment.
  - 4. Prior to printing and affixing labels, coordinate with the Owner and Architect, which scenario will be used for the labels.

### 3.05 PROTECTIVE DEVICE TESTING, CALIBRATION AND ADJUSTMENT

- A. The equipment Manufacturer shall provide the services of a qualified field Engineer and necessary tools and equipment to test and calibrate the protective relays, ground fault relays and circuit breaker trip devices as recommended in the Power System Study.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

SECTION 26 00 90  
ELECTRICAL DEMOLITION

**PART 1 - GENERAL**

1.01 SUMMARY

- A. Work included: Labor and equipment necessary to complete the demolition required for the item specified under this Division, including but not limited to:
  - 1. Electrical demolition

1.02 SYSTEM DESCRIPTION

- A. Disconnection, removal and relocation of all wiring, luminaires, outlets, conduit, and all other types of electrical equipment as described on Drawings.
- B. Purpose is to remove, relocate and extend existing installations to accommodate new construction.

**PART 2 - PRODUCTS**

2.01 MATERIALS AND EQUIPMENT

- A. Materials and equipment necessary for patching and extending Work, as specified in other Sections.

**PART 3 - EXECUTION**

3.01 EXAMINATION

- A. Contractor shall thoroughly review conditions in the area of demolition prior to commencing Work to ensure complete understanding of existing installation in relationship to demolition Work.

3.02 GENERAL REQUIREMENTS

- A. Remove all wiring, luminaires, outlets, conduit, and all other types of electrical equipment indicated to be removed. Devices that are to be removed may require reworking conduit and wiring in order to maintain service to other devices. If removed devices are on walls or ceilings that are to remain, blank coverplates are to be installed on outlet boxes.
- B. Where remodeling interferes with circuits in areas that are otherwise undisturbed, circuits shall be reworked as required.
- C. Existing devices and circuiting that are indicated are indicated only for informational purposes. Contractor shall visit the Project site and shall verify conditions as they exist and shall remove, relocate, and/or rework any electrical equipment or circuits affected (whether indicated or not) due to removal of existing walls, ceilings, etc. Coordinate all Work with that of other trades.
- D. All equipment, luminaires, devices, etc., which are removed shall be delivered to the Owner for disposition. All items which are removed and not wanted by the Owner and which are



not reused shall become the property of the Contractor and shall be legally removed from the Project site.

- E. Cutting and patching necessary for the removal of Electrical Work shall be included.
- F. Remove and replace luminaires, rework, relocate or replace conduit and wiring and do other Work required by the installation of new ductwork, piping, etc., above the ceiling. Coordinate with other trades and verify the extent of the Work.

### 3.03 LUMINAIRES

- A. Disconnect and remove abandoned luminaires. Remove conduits, wiring, boxes, brackets, stems, hangers, and other accessories.

### 3.04 OUTLETS

- A. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

### 3.05 CONDUIT

- A. Remove abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors and patch surfaces.

### 3.06 WIRING

- A. Remove abandoned wiring to source of supply.

### 3.07 EXISTING SYSTEMS

- A. Electrical distribution system: Disable system only to make switchovers and connections. Obtain permission from Owner's designated representative at least 24-hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to Work area.

### 3.08 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment that shall remain.
- B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
- C. Luminaires: Remove lenses and lamps and clean all exposed surfaces. Also clean the lenses or replace if discolored. Provide all new lamping when re-assembling.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 2025-01-31 – Clarification that use of MC Cable is acceptable only for “fixture whips”.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District’s intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Use of MC Cable is prohibited, except for fixture whips. Obtain special permission to utilize for VE applications.
- Use of aluminum wire and cable is prohibited. Obtain special permission to utilize for VE applications.
- Use stranded wire for all applications.
- Do not use push-in connectors (wagos).

SECTION 26 05 19

BUILDING WIRE AND CABLE

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work included: Labor, materials, and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
  - 1. Building wire.
  - 2. Cable.
  - 3. Wiring connections and terminations.
- B. Related Work: Consult all other Sections, determine the extent and character of related Work, and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.

**1.02 REFERENCES**

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:
  - 1. Underwriters Laboratories, Inc. (UL):
    - UL 4; Armored Cable.
    - UL 44; Thermoset-Insulated Wires and Cables.
    - UL 62; Flexible Cord and Fixture Wire.
    - UL 83; Thermoplastic-Insulated Wires and Cables.
    - UL 183; Manufactured Wiring Systems.
    - UL 310; Electrical Quick-Connect Terminals.
    - UL 486A & B; Wire Connectors.
    - UL 486C; Splicing Wire Connectors.
    - UL 486D; Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations.
    - UL 493; Thermoplastic-Insulated Underground Feeder and Branch Circuit Cables.
    - UL 510; Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape.
    - UL 854; Service-Entrance Cables.
    - UL 1569; Metal-Clad Cables.
    - UL 1581; Reference Standard for Electrical Wires, Cables and Flexible Cords.
    - UL 2196; Standard for Tests of Fire Resistive Cables.
  - 2. National Electrical Manufacturer Association (NEMA):

NEMA WC-70; Power Cables Rated 2,000 V or Less for the Distribution of Electrical Energy.

3. Institute of Electrical and Electronic Engineers (IEEE):

IEEE 82; Test Procedure for Impulse Voltage Tests on Insulated Conductors.

IEEE 576; Recommended Practice for Installation, Termination, and Testing of Insulated Power Cable as Used in Industrial and Commercial Applications.

### **1.03 SUBMITTALS**

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
  2. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
  3. Submit Manufacturer's installation instructions.
  4. Final test results.

### **1.04 QUALITY ASSURANCE**

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused, and currently under production.
- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.
- C. Independent Testing Agency qualifications: Refer to Section 260010: Basic Electrical Requirements.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.
1. Building wire:
    - a. Cerrowire
    - b. General Cable
    - c. Southwire Company
    - d. Stabiloy (aluminum only)
    - e. United Wire and Cable
  2. Flexible cords and cables:
    - a. Carol Cable Company

- b. Cerrowire
- c. PWC Corp
- 3. Wiring connectors and terminations:
  - a. 3M Company.
  - b. Ideal.
  - c. Blackburn-Holub.
  - d. Burndy.
  - e. Thomas & Betts Corp.
  - f. Beau Barrier.
- B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

## **2.02 BUILDING WIRE**

- A. Conductor material:
  - 1. Provide annealed copper for all wire, conductor, and cable, unless otherwise indicated.
  - 2. All building wire shall be stranded, unless otherwise indicated.
- B. Insulation material:
  - 1. All insulated wire, conductor and cable shall be 600volt rated, unless otherwise noted on the Drawings.
  - 2. Thermoplastic-insulated building wire.
  - 3. Rubber-insulated building wire.
  - 4. Copper feeders and branch circuits larger than #6 AWG: Type THW, XHHW or dual rated THHN/THWN.
  - 5. Copper feeders and branch circuits #6 AWG and smaller: Type TW, THW, XHHW or dual rated THHN/THWN.
  - 6. Feeders and branch circuits for direct-current (DC) in wet locations: Type XHHW-2.
  - 7. Conductors for variable frequency drives (VFD): Type XHHW-2.
  - 8. Service Entrance: Type RHW or THWN.
  - 9. Control Circuits: Type THW or dual rated THHN/THWN.
  - 10. Identify system conductors as to voltage and phase connections by means of color-impregnated insulation.

## **2.03 FLEXIBLE CORDS AND CABLES (TYPE'S')**

- A. Provide flexible cords and cables of size, type and arrangement as indicated on the Drawings.
- B. Type 'S' flexible cords and cables shall be manufactured in accordance with CEC Article 400 and composed of two or more conductors and a full size green insulated ground wire with an outer jacket of rubber or neoprene as noted.

- C. Flexible cords and cables shall be fitted with wire mesh strain relief grips either as an integral component of the connector or as an independently supported unit.
- D. Suspended flexible cords and cables shall incorporate safety spring(s) unless otherwise noted.

#### **2.04 WIRING CONNECTIONS AND TERMINATIONS**

- A. Bolted pressure connectors: Provide wide range-taking connectors with cast bronze compression bolts, designed for parallel taps, tees, crosses or end-to-end connections.
- B. Electrical spring wire connectors:
  - 1. Provide multi-part construction incorporating a non-restricted, zinc coated square cross-section steel spring enclosed in a steel sheet with an outer jacket of plastic and insulating skirt.
  - 2. Self-striping pigtail and tap U-contact connectors shall not be used.
- C. Compression type terminating lugs:
  - 1. Provide tin-plated copper high-compression type lugs for installation with hand or hydraulically operated circumference-crimping tools and dies as stipulated by the lug Manufacturer or as indicated on Drawings. Notch or single point type crimping is NOT acceptable.
  - 2. Two-hole, long barrel lugs shall be provided for size #4/0 and larger wire where terminated to bus bars. Use minimum of three crimps per lug, on sizes where possible.
- D. Splicing and insulating tape: Provide black, ultraviolet proof, self-extinguishing, 7-mil thick vinyl general purpose electrical tape with a dielectric strength of 10,000volts suitable for temperatures from minus 18-degrees C to 105-degrees C.
- E. Insulating putty:
  - 1. Provide pads or rolls of non-corrosive, self-fusing, one-eighth inch thick rubber putty with PVC backing sheet. Scotch vinyl mastic pads and roll or equal.
  - 2. Use putty suitable for temperatures from minus 17.8-degrees C to 37.8-degrees C with a dielectric strength of 570volts/mil minimum.
- F. Insulating resin:
  - 1. Provide two-part liquid epoxy resin with resin and catalyst in pre-measured, sealed mixing pouch. Scotchcast 4 or equal for wet or underground vaults, boxes, etc. splices or terminations.
  - 2. Use resin with a set up time of approximately 30-minutes at 21.1-degrees C and with thermal and dielectric properties equal to the insulating properties of the cables immersed in the resin.
- G. Terminal strips:
  - 1. Provide box type terminal strips in the required quantity plus 25% spare. Install in continuous rows in terminal cabinets.
  - 2. Use the box type terminal strips with barrier open backs and with ampere ratings as required.

3. Identify all terminals with numbering sequence being used for a system.
- H. Crimp type connectors:
1. Provide insulated fork or ring crimp terminals with tinned electrolytic copper-brazed barrel with funnel wire entry and insulation support
  2. Fasten crimp type connectors or terminals using a crimping tool recommended by the connector Manufacturer.
  3. Provide insulated overlap splices with tinned seamless electrolytic copper barrel with funnel wire entry and insulation support.
  4. Provide insulated butt splices with tinned seamless electrolytic copper barrel with center stop, funnel wire entry and insulation support.
- I. Cable ties: Provide harnessing and point-to-point wire bundling with nylon cable ties. All cable ties shall be installed using tool supplied by Manufacturer of ties.
- J. Wire lubricating compound:
1. UL listed for the wire insulation and conduit type and shall not harden or become adhesive.
  2. Shall not be used on wire for isolated type electrical power systems.
- K. Bolt termination hardware:
1. Bolts shall be plated, medium carbon steel heat-treated, quenched and tempered equal to ASTM A-325 or SAE grade 5; or silicon bronze alloy ASTM B-9954 Type B.
  2. Nuts shall be heavy semi-finished hexagon, conforming to ANSI B18.2.2, threads to be unified coarse series (UNC), class 2B steel or silicon bronze alloy.
  3. Flat washers shall be steel or silicon bronze, Type A plain standard wide series, confirming to ANSI B27.2. SAE or narrow series shall not be used.
  4. Belleville conical spring washers shall be hardened steel, cadmium plated or silicon bronze.
  5. Each bolt connecting lug(s) to a terminal or bus shall not carry current exceeding the following values:
    - a. 1/4" bolt: 125amps
    - b. 5/16" bolt: 175amps
    - c. 3/8" bolt: 225amps
    - d. 1/2" bolt: 300amps
    - e. 5/8" bolt: 375amps
    - f. 3/4" bolt: 450amps

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Contractor shall thoroughly examine Project site conditions for acceptance of wire and cable installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

### **3.02 APPLICATION**

- A. All wire, conductor and cable with their respective connectors, fittings and supports shall be UL listed for the installed application and ambient condition.
- B. Feeders and branch circuits in wet locations shall be rated 75-degree C.
- C. Feeders and branch circuits in dry locations shall be rated 90-degree C.
- D. Feeders and branch circuits for direct-current (DC) systems, such as PV installations, in wet locations shall be type XHHW-2 copper conductors.
- E. For wiring of the following, refer to the indicated Code Articles:
  - 1. Fire pump systems shall comply with CEC Article 695.
  - 2. Emergency systems shall comply with CEC Article 700.
  - 3. Fire alarm systems shall comply with CEC Article 760.
  - 4. Where the any above are required to be fire-resistive, refer to CEC Article 728.
- F. Minimum conductor size:
  - 1. Provide minimum AWG #12 for all power and lighting branch circuits.
  - 2. Provide minimum AWG #14 for all line voltage signal and control wiring unless otherwise indicated.
- G. Color coding:
  - 1. For 120/208volt, 3-phase, 4-wire systems:
    - a. Phase A - Black
    - b. Phase B - Red
    - c. Phase C - Blue
    - d. Neutral - White
    - e. Ground - Green
  - 2. For 277/480volt, 3-phase, 4-wire systems:
    - a. Phase A - Brown
    - b. Phase B - Orange
    - c. Phase C - Yellow
    - d. Neutral - Gray
    - e. Ground - Green
  - 3. Switch leg individually installed shall be the same color as the branch circuit to which they are connected, unless otherwise noted.



4. Travelers for 3-way and 4-way switches shall be a distinct color and pulled with the circuit switch leg or neutral.

### 3.03 WIRING METHODS

- A. Install wires and cables in accordance with Manufacturer's written instructions, as indicated on Drawings and as specified herein.
- B. Install all single conductors in raceway system, unless otherwise noted.
- C. Parallel circuit conductors and terminations shall be equal in length and identical in all ways.
- D. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than #10 AWG cabled in individual circuits. Make terminations so there is no bare conductor at the terminal.
- E. 20amp power and lighting branch circuit containing no more than four (4) current carrying conductors (phases and neutrals). Use #10 AWG conductor for 120/208volt circuits located outside a 75-foot radius of panel source and for 277/480volt branch circuits located outside a 200-foot radius of panel source, unless otherwise noted.
- F. 20amp power and lighting branch circuits containing no more than eight (8) current carrying conductors (phases and neutrals). Use #10 AWG conductors for 120/208volt circuits located outside a 65-foot radius of panel source and for 277/480volt circuits located outside a 150-foot radius of panel source.
- G. Provide #10 AWG pig tails on all 20amp and 30amp wiring devices served by #8 AWG conductors and larger.
- H. Splice cables and wires only in outlet boxes, junction boxes, pull boxes, manholes or handholes. Group and bundle with tie wrap each neutral with its associated phase conductor where more than one neutral is present in a conduit.
- I. Install cable supports for all vertical feeders in accordance with the CEC Article 300. Provide split wedge type fittings, which firmly clamp each individual cable and tighten due to cable weight.
- J. Neatly form, train, and tie the cables in individual circuits. For panelboards, cabinets, wireways, switches, and equipment assemblies.
- K. Seal cable or wire, entering a building from underground or exiting walk-in cold box or freezer, between the wire or cable and conduit, where it exits the conduit, with a non-hardening approved compound, i.e. duct seal or equal.
- L. Provide UL-listed factory-fabricated, solderless metal connectors of size, ampacity rating, material, type, and class for applications and for services indicated. Use connectors with temperature ratings equal to or greater than the wires that are being terminated.
- M. Stranded wire shall be terminated using fitting, lugs or devices listed for the application. However, in no case shall stranded wire be terminated solely by wrapping it around a screw or bolt.
- N. Flexible cords and cables supplied, as part of a pre-manufacturer fixture or unit assembly shall be installed according to Manufacturers published installation instructions.

**3.04 WIRING INSTALLATION IN RACEWAYS**

- A. Install wire in raceway in accordance with IEEE 576, Manufacturer's written instructions, as indicated on the Drawings and as specified herein after interior of building has been physically protected from the weather and all mechanical Work likely to injure conductors has been completed. Pull all conductors into a raceway at the same time. Exercise care in pulling conductors so that insulation is not damaged. Use UL listed, non-petroleum base and insulating type pulling compound as needed.
- B. Completely mandrel all underground or concrete encased conduits prior to installing conductors.
- C. Completely and thoroughly swab raceway system before installing conductors.
- D. Do not use block and tackle, power driven winch or other mechanical means for pulling conductors of size smaller than #1 AWG.
- E. Wire pulling:
  - 1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
  - 2. Use rope made of nonmetallic material for pulling feeders.
  - 3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors.
  - 4. Pull in together multiple conductors or cables in a single conduit.
  - 5. Pulling tensions and sidewall pressures shall not exceed 60% of the manufacturer's recommended maximum values. Pulling tension shall be continuously monitored during the pull by a calibrated dynamometer. If pulling tension is exceeded during the pull, immediately notify the engineer to determine if the cables will be considered damaged and require contractor replacement.
- F. Install and test all cables in accordance with Manufacturer's instructions and warranty.

**3.05 MC CABLE INSTALLATION**

- A. Use of MC Cable is restricted to installation above accessible ceiling space, for lighting installed in the t-bar ceiling, i.e. fixture whips.
- B. Install MC cable in accordance with Manufacturer's instructions and in strict accordance with CEC Article 330. Secure and support MC cable with straps, independent hanger wire per CEC 300.11 (B), or cable ties listed for the purpose. Follow Manufacturer's explicit instructions when connecting the cable to fittings and boxes. Connectors shall be firmly secured to the cable, but not over-tightened. Connector shall be firmly attached to the metal boxes.
- C. Support cables every 6-feet and within 12-inches of boxes, per CEC Article 330, using separate spring metal clip or metal cable ties (not steel tie wire) for each cable. Cables shall not be bundled together.
- D. Hanger wire used to support suspended ceilings may not be used to directly support MC cables.
- E. Do not rest cables on ceiling tiles or allow contact with mechanical piping systems.

- F. Bend the cable per CEC Article 330.
- G. Provide separate sleeves and/or fire barriers where cable penetrated firewalls, unless cable is UL listed for the application.

### **3.06 WIRE SPLICES, JOINTS AND TERMINATION**

- A. Join and terminate wire, conductors, and cables in accordance with UL 486A, C, CEC and Manufacturer's instructions.
- B. Thoroughly clean wires before installing lugs and connectors.
- C. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.
- D. Splices and terminations shall be made mechanically and electrically secure.
- E. Where it's determined that unsatisfactory splice or terminations have been installed, remove the devices and install approved devices at no addition cost.
- F. Terminate wires in Terminal Cabinets, relay, and contactor panels, etc. using terminal strip connectors.
- G. Insulate spare conductors with electrical tape and leave sufficient length to terminate anywhere in the panel or cabinet.
- H. Install cable ties and maintain harnessing.
- I. Encapsulate splices in exterior outlets, pull boxes and junction boxes using specified insulating resin kits. Make all splices watertight for exterior equipment and equipment in pump rooms.
- J. Make up all splices and taps in accessible junction or outlet boxes with connectors as specified herein. Pigtails and taps shall be the same color as the feed conductor. Form conductor prior to cutting and provide at least 6-inches of tail and neatly packed in box after splice is made up.
- K. Branch circuits (#10 AWG and smaller):
  - 1. Connectors: Solderless, screw-on, reusable spring pressure cable type, 600volt, 105-degree C. with integral insulation, approved for copper conductors.
  - 2. The integral insulator shall have a skirt to completely cover the stripped wires.
  - 3. The number, size and combination of conductors as listed on the Manufacturers packaging shall be strictly complied with.
- L. Feeder circuits: (#6 to 750 kCMIL)
  - 1. Join or tap conductors from #6 AWG to 750 kCMIL using bolted pressure connectors or insulate mechanical compression (hi-press) taps with pre-molded, snap-on insulating boots or specified conformable insulating pad and over wrapped with two half-lapped layers of vinyl insulating tape starting and ending at the middle of the joint.
  - 2. Terminate conductors from size #6 AWG to 750 kCMIL copper using bolted pressure or mechanical compression lugs in accordance with Manufacturer recommendation or as specified elsewhere.

3. Field installed compression connectors for cable sizes 250 kCMIL and larger shall have not less than two clamping elements or compression indents per wire.
4. Insulate splices and joints with materials approved for the particular use, location, voltage, and temperature. Insulate with not less than that of the conductor level that is being joined.

M. Termination hardware assemblies:

1. AL/CU lugs connected to aluminum plated or copper buss, shall be secured using a steel bolt, flat washer (two per bolt), Belleville washer and nut.
2. Copper lugs connected to copper bus, shall be secured using silicon bronze alloy bolt, flat washer (two per bolt), Belleville washer and nut.
3. The crown of Belleville washers shall be under the nut.
4. Bolt assemblies shall be torque to Manufacturer recommendation. Where manufacture recommendations are not obtainable, the following values shall be used:
  - a. 1/4" - 20 bolt at 80-inch pounds torque.
  - b. 5/16" - 18 bolt at 180-inch pounds torque.
  - c. 3/8" - 16 bolt at 20-foot pounds torque.
  - d. 1/2" - 13 bolt at 40-foot pounds torque.Fp
  - e. 5/8" - 11 bolt at 55-foot pounds torque.
  - f. 3/4" - 10 bolt at 158-foot pounds torque.

### 3.07 IDENTIFICATION

- A. Refer to Section 260553: Electrical Identification for additional requirements.
- B. Securely tag all branch circuits. Mark conductors with specified vinyl wrap-around markers. Where more than two conductors run through a single outlet, mark each conductor with the corresponding circuit number.
- C. Color code conductors' size #8 and larger using specified phase color markers and identification tags, with exception of the grounded conductor which must have a continuous white or gray jacket if #6 or smaller.
- D. Provide all terminal strips with each individual terminal identified using specified vinyl markers.
- E. In manholes, pull boxes and handholes, provide tags of the embossed brass type and show the cable type and voltage rating. Attach the tags to the cables with slip-free plastic cable lacing units.

### 3.08 FIELD QUALITY CONTROL

- A. Independent testing: Contractor shall arrange and pay for the services of an independent Testing Agency to perform all quality control electrical testing required herein. Independent Testing Agency shall meet the requirements as outlined in Section 260010: Basic Electrical Requirements.
- B. Prefunctional testing:

1. Visual and mechanical inspection:
  - a. Compare cable data with Contract Documents.
  - b. Inspect exposed sections of wires and cables for physical damage and proper connections.
  - c. Verify tightness of accessible bolted connections with calibrated torque wrench in accordance with Manufacturer's published data.
  - d. Inspect compression applied connectors for correct cable match and indentation.
  - e. Verify visible cable bend meet or exceed ICEA and Manufacturer's minimum allowable bending radius.
  - f. If cables are terminated through window type current transformers, inspect to verify neutral and ground conductors are correctly placed for operation of protective devices.
  - g. Ensure wire and cable identification has been installed as specified herein.
2. Electrical testing:
  - a. Contractor shall perform feeder and branch circuit insulation test after installation and prior to connection to utilization devices such as fixtures, motors, or appliances. Testing shall be as follows:
    - 1) 100% of all feeders 100amp rated and above.
    - 2) 50% of all feeders smaller than 100amps.
    - 3) 10% of all branch circuits at each individual panelboard.
  - b. Perform insulation-resistance test using megohm meter with applied potential of 1000volt DC for a continuous duration of 60-seconds. Test conductors' phase-to-phase and phase-to-ground. Conductors shall test free from short-circuit and ground faults.
  - c. Perform continuity test of all feeder and branch circuits to ensure correct cable connections. Test all neutrals for improper grounds.
  - d. Contractor shall furnish instruments, materials, and labor for these tests.
3. Test values: Investigate resistance values less than 50-megohms.
4. Furnish test results in typewritten report form for review and inclusion in the operation and maintenance manuals.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

## SECTION 26 05 26

## GROUNDING AND BONDING

**PART 1 - GENERAL****1.01 SUMMARY**

- A. Work included: Labor, materials, and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
  - 1. Power system grounding.
  - 2. Site lighting grounding.
  - 3. Electrical equipment and raceway grounding and bonding.
- B. Related Work: Consult all other Sections, determine the extent and character of related Work, and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.
  - 1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
  - 2. Division 05: Building Steel.
  - 3. Division 22: Cold Water Piping.

**1.02 REFERENCES**

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:
  - 1. Underwriters Laboratories, Inc. (UL):
    - UL 467;                      Grounding and Bonding Equipment.
  - 2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
    - IEEE No. 142;              Recommended Practice for Grounding of industrial and Commercial Power Systems.
    - IEEE No. 81                Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.

**1.03 SYSTEM DESCRIPTION**

- A. Ground the electrical service system neutral at service entrance equipment as described herein and indicated on Drawings.
- B. Ground each separately derived system neutral as described herein and indicated on Drawings.
- C. Except as otherwise indicated, the complete electrical installation including the neutral conductor, metallic conduits and raceways, cable trays, boxes, cabinets and equipment shall be completely and effectively grounded in accordance with all code requirements, whether or not such connections are specifically indicated or specified.
- D. Resistance:

1. Resistance from the main switchboard ground bus through the ground electrode to earth shall not exceed 5-OHMS unless otherwise noted.
2. Resistance from the farthest panelboard, switchboard, etc. ground bus through the ground electrode to earth shall not exceed 20-OHMS

#### 1.04 SUBMITTALS

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
  1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
  2. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
  3. Submit Manufacturer's installation instructions.

#### 1.05 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused, and currently under production.
- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.

### **PART 2 - PRODUCTS**

#### 2.01 MANUFACTURERS

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.
  1. Ground Rods:
    - a. Weaver.
    - b. Erico "Cadweld" Products, Inc.
  2. Ground Wells:
    - a. Christy Concrete Products, Inc.
    - b. Forni Corp.
  3. Ground Bushings, Connectors, Jumpers and Bus:
    - a. O-Z/Gedney.
    - b. Thomas & Betts Corp.
- B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

#### 2.02 GROUND CONDUCTORS

- A. Refer to Specification Section 260519: Building Wire and Cable for conductor specifications.
- B. General purpose insulated:



1. UL approved and code sized copper conductor, with dual rated THHN/THWN insulation, color identified green.
  2. Where continuous color-coded conductors are not commercially available, provide a minimum 4" long color band with green, non-aging, plastic tape in accordance with CEC.
  - C. Bare conductors in direct contact with earth or encased in concrete: #4/0 AWG copper minimum, U.O.N.
  - D. Bonding pigtails: Insulated copper conductor, identified green, sized per code, and provide with termination screw or lug. Provide solid conductors for #10 AWG or smaller and stranded conductors for #8 AWG or larger.
- 2.03 DRIVEN (GROUND) RODS
- A. Copper clad steel, minimum 3/4-inch diameter by 8 feet long, unless otherwise noted.
- 2.04 GROUND WELL BOXES FOR GROUND RODS
- A. Precast concrete box nominal 9" throat diameter x 14" deep with light duty concrete cover for non-traffic areas or steel plate for traffic areas. Cover shall be embossed or engraved with "GROUND ROD".
- 2.05 INSULATED GROUNDING BUSHINGS
- A. Plated malleable iron or steel body with 150-degree Centigrade molded plastic insulating throat and lay-in grounding lug.
- 2.06 CONNECTIONS TO PIPE
- A. For cable to pipe: UL and CEC approved bolted connection.
- 2.07 CONNECTIONS TO STRUCTURAL STEEL, GROUND RODS OR SPLICES
- A. Where required by the Drawings, grounding conductors shall be spliced together, connected to ground rods or connected to structural steel using exothermic welds or high-pressure compression type connectors.
    1. Exothermic welds shall be used for cable-to-cable and cable-to-ground rod and for cable to structural steel surfaces. Exothermic weld kits shall be as manufactured by Cadweld or equal. Each particular type of weld shall use a kit unique to that type of weld.
    2. High-pressure compression type connectors shall be used for cable-to-cable and cable-to-ground rod connections.
- 2.08 EXTRA FLEXIBLE, FLAT BONDING JUMPERS
- A. Where required by Code, indicated on the Drawing, and specified herein.
- 2.09 BUILDING GROUND BUS REQUIREMENTS
- A. Main building power system ground bus:
    1. Provide one 24" wide x 4" high x 1/4" thick copper bus bar as a minimum. Mount on wall in main electrical room utilizing insulating stand-offs at 18" above finished floor.

2. Furnish complete with cast copper alloy body lugs for connecting grounding system conductors. Attach lugs to bus with appropriate size cadmium bronze bolt, flat washer, and Belleville washer. Torque all lug connections.
  3. All holes shall be drilled and tapped for single-hole lugs. Provide 6 spare lugs and lug spaces.
- B. Building power system reference ground bus:
1. The reference ground bus is furnished as part of the main electrical switchboard for the building, along with neutral disconnect and bus, and is in addition to the main building power system ground bus outlined above. The building grounding electrode shall make a direct connection to the building referenced ground bus in the main switchboard.
  2. Provide a #4/0 AWG copper ground conductor connection between the building reference ground bus in switchboard and the main building ground bus wall mounted in main electrical room.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Contractor shall thoroughly examine Project site conditions for acceptance of grounding system installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

#### **3.02 INSTALLATION**

- A. Grounding electrodes:
1. Metal underground water pipe: Cold water metal piping system: Where the underground cold water service line is metal, indirect contact with the earth for 10-feet or more, the Contractor shall install a grounding electrode conductor from the main incoming cold water line ahead of the meter and extend to the main building reference ground bus in the main electrical room. The electrode shall be sized per CEC Article 250. Electrode connection should be accessible.
  2. Concrete encased grounding electrode (UFER ground): Provide a #4/0 AWG minimum bare copper conductor encased along the bottom of concrete foundation or footings which are in direct contact with the earth and where there is no impervious water-proofing membrane between the footing and the soil. The electrode shall extend through a horizontal length of 30 feet minimum and shall be encased in not less than 2 or more than 5 inches of concrete separating it from surrounding soils. The electrode shall emerge from the concrete slab through a protective non-metallic sleeve and shall be extended to the main building reference ground bus.
  3. Supplementary grounding electrode (ground ring, grid and driven rods): Provide, as indicated on the Drawings, driven ground rod(s) installed in listed ground well box(s) and filled with gravel after connection is made. Interconnect ground rod with structural steel and adjacent rods with minimum #2 AWG bare copper conductor. Ground rod shall not be less than 10 foot from any other electrode of another electrical system or from adjacent ground rod(s).
- B. Grounding electrode conductor: Provide grounding electrode conductor as indicated on the Drawings or sized per CEC Article 250, whichever is greater.
- C. Power system grounding:

1. Provide, unless otherwise indicated, a main building power system ground bus mounted on the wall in the main electrical room. Connect the following items using CEC sized copper grounding conductors to lugs on the main building ground bus:
    - a. Grounding conductor from building reference ground bus in main service switchboard.
    - b. Bonding conductor to metallic cold-water piping system.
    - c. Bonding conductor to building structural steel.
    - d. Separately derived system grounding conductors in same room.
  2. At the building power system reference ground bus in the main service switchboard, connect the grounding electrode conductor from concrete encased UFER ground or other grounding electrode systems as indicated on the Drawing or herein.
- D. Separately derived electrical system grounding:
1. Ground each separately derived system per requirements in CEC Article 250 as a minimum, unless greater requirements are required elsewhere in the Contract Documents.
  2. Transformers: Provide copper terminal bar for grounding and bonding the transformer in accordance with CEC Articles 250.30 and 450.10. Bond the terminal bar to the enclosure and connect the following to the terminal bar:
    - a. Primary feeder equipment ground conductor(s).
    - b. Secondary feeder supply-side bonding jumper(s).
    - c. Grounding electrode conductor.
    - d. Main bonding jumper to neutral (when present).
    - e. Supplemental grounding electrodes.
- E. Equipment bonding/grounding:
1. Provide a CEC sized insulated copper ground conductor in all 120volt AC through 600volt AC feeder and branch circuit distribution conduits and cables.
  2. Provide a separate grounding bus at panelboards, switchboards. Connect all metallic enclosed equipment so that with maximum fault current flowing, shall be maintained at not more than 35volts above ground.
  3. Conduit terminating in concentric, eccentric, or oversized knockouts at panelboards, cabinets, gutters, etc. shall have grounding bushings and bonding jumpers installed interconnecting all such conduits.
  4. Provide bonding jumpers across expansion and deflection couplings in conduit runs, pipe connections to water meters, dielectric couplings in metallic cold-water piping system.
  5. Provide internal ground wire in flexible conduit connected at each end via grounding bushing.
- F. Site lighting grounding: Bond all metallic light poles and bollards. Provide ground rods where indicated on the Drawings.

### 3.03 FIELD QUALITY CONTROL

- A. Independent Testing: Contractor shall arrange and pay for the services of an independent Testing Agency to perform all quality control electrical testing required herein.
- B. Prefunctional testing:
  - 1. Provide Testing Agency with Contract Documents for their review prior to the commencement of ground testing.
  - 2. Visual and mechanical inspection:
    - a. The Testing Agency shall inspect the grounding electrode and connections prior to concrete encasement, burial, or concealment.
    - b. Check tightness and welds of all ground conductor terminations.
    - c. Verify installation complies with the intent of the Contract Documents
  - 3. Obtain and record ground resistance measurements both from electrical equipment ground bus to the ground electrode and from the ground electrode to earth. Furnish and install additional bonding and add grounding electrodes as required complying with resistance limits specified under this Section of the Specification.
  - 4. A typewritten record of measured resistance values shall be submitted for review and included with the operation and maintenance manual furnished to the Owner at the time of Project closeout and before certificate of final payment is issued.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

## SECTION 260529

## ELECTRICAL HANGERS AND SUPPORTS

**PART 1 - GENERAL****1.01 SUMMARY**

- A. Work included: Labor, materials, and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
  - 1. Conduit supports.
  - 2. Equipment supports.
  - 3. Fastening hardware.
- B. Related Work: Consult all other Sections, determine the extent and character of related Work, and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.
  - 1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
  - 2. Division 03: Cast-in-place concrete. Concrete equipment pads.
  - 3. Division 05: Miscellaneous metals. Hangers for electrical equipment.
  - 4. Division 09: Ceiling suspension systems. Slack support wires.

**1.02 REFERENCES**

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:
  - 1. Underwriters Laboratories, Inc. (UL):
    - UL 2239; Hardware for the Supports of Conduit, Tubing and Cable.

**1.03 SYSTEM DESCRIPTION**

- A. Provide devices specified in this Section and related Sections for support of electrical equipment furnished and installed under Division 26.
- B. Provide support systems that are adequate for the weight of equipment, conduit and wiring to be supported.

**1.04 SUBMITTALS**

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
  - 1. Data/catalog cuts for each product and component specified herein.
  - 2. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
  - 3. Submit Manufacturer's installation instructions.

**1.05 QUALITY ASSURANCE**

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused, and currently under production.
- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.
  - 1. Concrete fasteners:
    - a. Phillips "Red-Head".
    - b. Remington.
    - c. Ramset.
  - 2. Concrete inserts and construction channel:
    - a. Unistrut Corp.
    - b. GS Metals "Globe Strut."
    - c. Thomas & Betts "Kindorf" Corp.
  - 3. Conduit straps:
    - a. O-Z/Gedney.
    - b. Erico "Caddy" Fastening Products.
    - c. Thomas & Betts "Kindorf" Corp.
- B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

### **2.02 CONCRETE FASTENERS**

- A. Provide expansion-shield type concrete anchors.
- B. Provide powder driven concrete fasteners with washers. Obtain approval by Architect and Structural Engineer prior to use.

### **2.03 CONCRETE INSERTS**

- A. Provide pressed galvanized steel, concrete spot insert, with oval slot capable of accepting square or rectangular support nuts of ¼ inch to ½ inch diameter thread for rod support.

### **2.04 THREADED ROD**

- A. Provide steel threaded rod, sized for the load unless otherwise noted on the Drawings or in the Specifications.

### **2.05 CONSTRUCTION CHANNEL**

- A. Provide 1.5-inch by 1.5-inch, 12-gauge galvanized steel channel with 17/32-inch diameter bolt holes and 1-1/2 inch on center in the base of the channel.

### **2.06 CONDUIT STRAPS**

- A. One-hole strap, steel, or malleable iron, with malleable iron clamp-back spacer for surface mounted wall and ceiling applications.
  - 1. Use malleable strap with spacers for exterior and wet locations.
  - 2. Use steel strap without spacers for interior locations.
- B. Steel channel conduit strap for support from construction channel.
- C. Steel conduit hanger for pendant support with threaded rod
- D. Steel wire conduit support strap for support from independent #12-gauge hanger wires.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Contractor shall thoroughly examine Project site conditions for acceptance of supporting device installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

#### **3.02 PREPARATION**

- A. Coordinate size, shape, and location of concrete pads with Division 03, Cast-in-place concrete.
- B. Layout support devices to maintain headroom, neat mechanical appearance and to support the equipment loads.
- C. Where indicated on the Contract Documents, install freestanding electrical equipment on concrete pads.

#### **3.03 INSTALLATION**

- A. Furnish and install supporting devices as noted throughout Division 26.
- B. Electrical device and conduit supports shall be independent of all other system supports that are not structural elements of the building, unless otherwise noted.
- C. Fasten hanger rods, conduit clamps, outlet, and junction boxes to building structure using precast inserts, expansion anchors, preset inserts, or beam clamps.
- D. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster or gypsum board partitions and walls.
- E. Use expansion anchors or preset inserts in solid masonry walls.
- F. Use self-drilling anchors, expansion anchor or preset inserts on concrete surfaces.
- G. Use sheet metal screws in sheet metal studs and wood screws in wood construction.
- H. Do not fasten supports to piping, ductwork, mechanical equipment, conduit, or acoustical ceiling suspension wires.
- I. Do not drill structural steel members unless first approved in writing by the Architect or Structural Engineer.
- J. Fabricate supports from structural steel or steel channel, rigidly welded, or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.



- K. Install surface-mounted cabinets and panelboards with minimum of four anchors. Provide additional support backing in stud walls prior to sheet rocking as required to adequately support cabinets and panels.
- L. Bridge studs top and bottom with channels to support flush mounted cabinets and panelboards in stud walls.

#### 3.04 ERECTION OF METAL SUPPORTS

- A. Cut, fit and place miscellaneous metal fabrications accurately in location, alignment and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS "Structural Welding Code."

#### 3.05 WOOD SUPPORTS

- A. Cut, fit, and place wood grounds, nailers, blocking and anchorage accurately in location, alignment and elevation to support and anchor electrical materials and equipment.

#### 3.06 ANCHORAGE

- A. All floor mounted, free standing electrical equipment such as transformers, switchboards, distribution boards, etc. shall be securely fastened to the floor structure.
- B. Anchorage of electrical equipment shall comply with the seismic requirements as outlined in Section 260010: Basic Electrical Requirements.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- As noted in 260519 Building Wire and Cable, use of MC Cable is not allowed except for lighting branch above accessible ceiling spaces. All other line voltage wiring is to be routed in conduit.
- With the exception of electrical, mechanical, IT rooms, do not allow installation of exposed conduit unless there is absolutely no alternatives. The designer should make every effort to identify conditions which may lead to the need to install exposed and consider alternatives in their design; for example, where ceiling is a fluted metal deck exposed to structure, conceal conduits above the deck, below the insulation, and penetrate where necessary. Where conduit cannot be installed concealed in finishes spaces (for example, a modernization) utilize surface raceway instead. Where

exposed conduit is routed at building exterior (which is to be avoided if at all possible) utilize galvanized rigid conduit only.

- PVC conduit (specified in 260543 Underground Ducts and Structures) may be utilized for branch circuiting underslab (note special requirements for PVC coated GRC at penetration) or when routed vertically and concealed in CMU construction.
- Conduit (and related infrastructure) installed for mechanical controls (BMS/EMS) shall be installed per Div. 26 requirements.
- Minimum conduit size for interior applications is 3/4", exterior and underground is 1".

SECTION 260531

CONDUIT

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work included: Labor, materials, and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
  - 1. Rigid steel conduit and fittings.
  - 2. PVC insulated rigid steel conduit and fittings.
  - 3. Intermediate metal conduit and fittings.
  - 4. Electrical metallic tubing and fittings.
  - 5. Flexible metallic conduit and fittings.
  - 6. Liquidtight flexible metallic conduit and fittings.
  - 7. Miscellaneous conduit fittings and products.
- B. Related Work: Consult all other Sections, determine the extent and character of related Work, and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.
  - 1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
  - 2. Division 01: Cutting and patching.
  - 3. Division 07: Sheet metal flashing and trim.
  - 4. Division 09: Painting. Exposed conduit and other devices.

**1.02 REFERENCES**

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:
  - 1. American National Standards Institute, Inc. (ANSI):
    - ANSI C80.1; Rigid Steel Conduit, Zinc-Coated.
    - ANSI C80.3; Electrical Metallic Tubing, Zinc Coated.
    - ANSI C80.5; Rigid Aluminum Conduit.
    - ANSI/ TIA-569-D Telecommunications Pathways and Spaces.
  - 2. Underwriters Laboratories, Inc. (UL):
    - UL 1; Flexible Metal Conduit.
    - UL 6; Rigid Metal Conduit.
    - UL 360; Liquid-Tight Flexible Steel Conduit.
    - UL 514B; Conduit, Tubing and Cable Fittings.

- UL 635;                      Insulating Bushings.
- UL 797;                     Electrical Metallic Tubing - Steel.
- UL 1242;                   Intermediate Metal Conduit - Steel.
- 3. National Electrical Manufacturer Association (NEMA):
  - NEMA RN1;                PVC Externally coated Galvanized Rigid Steel Conduit.

**1.03 SUBMITTALS**

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements the following items:
  - 1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
  - 2. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
  - 3. Submit Manufacturer's installation instruction. Provide written instructions for raceway products requiring glues, special tools, or specific installation techniques.

**1.04 QUALITY ASSURANCE**

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused, and currently under production.
- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted and approved.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURERS**

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.
  - 1. Metal conduit:
    - a. Allied Tube and Conduit Co.
    - b. Triangle PWC, Inc.
    - c. Western Tube and Conduit Corp.
    - d. Spring City Electrical Manufacturing Co.
    - e. Alflec Corp.
    - f. American Flexible Metal Conduit Co.
    - g. Anaconda.
  - 2. Fittings:
    - a. Appleton Electric Co.
    - b. OZ/Gedney.
    - c. Thomas & Betts Corp.

d. Spring City Electrical Manufacturing Co.

B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

2.02 GALVANIZED RIGID STEEL CONDUIT (GRS)

- A. Conduit: Full weight, threaded, hot-dip galvanized steel, conforming to ANSI C80.1 and UL 6.
- B. Standard threaded couplings, locknuts, bushings, and elbows: Only materials of steel or malleable iron are acceptable. Locknuts shall be bonding type with sharp edges for digging into the metal wall of an enclosure; provide two locknuts at each box or can, inside and outside.
- C. Three-piece couplings: Hot dip galvanized, cast malleable iron.
- D. Insulating bushings: Threaded polypropylene or thermosetting phenolic rated 150-degree C minimum.
- E. Insulated grounding bushings: Threaded cast malleable iron body with insulated throat and steel "lay-in" ground lug with compression screw.
- F. Insulated metallic bushings: Threaded cast malleable iron body with plastic insulated throat rated 150-degrees C.
- G. All fittings and connectors shall be threaded.

2.03 PVC INSULATED GALVANIZED RIGID STEEL CONDUIT (PVC GRS)

- A. Conduit: Full weight, threaded, hot-dip galvanized steel, conforming to ANSI C80.1 and NEMA RN-1 with nominal 20 or 40 mil thermoplastic vinyl coating, heat fused and bonded to the exterior of the conduit.
- B. Fittings: Conduit couplings and connectors shall be as specified for galvanized rigid steel conduit and shall be factory PVC coated with an insulating jacket equivalent to that of the coated material.

2.04 INTERMEDIATE METAL CONDUIT (IMC)

- A. Conduit: Hot dip galvanized steel meeting the requirements of CEC Article 345 and conforming to ANSI C80.6 and UL 1242.
- B. Fittings: Conduit couplings, connector and bushing shall be as specified for galvanized rigid steel conduit. Integral retractable type IMC couplings are also acceptable.

2.05 ELECTRICAL METALLIC TUBING (EMT)

- A. Conduit: Shall be formed of cold rolled strip steel, electrical resistance welded continuously along the longitudinal seam and hot dip galvanized after fabrication. Conduit shall conform to ANSI C80.3 Specifications and shall meet UL requirements.
- B. Set screw type couplings: Hot dip galvanized, steel, UL listed concrete tight. Use set screw type couplings with four setscrews each of conduit sizes over 2 inches. Setscrews shall be of case-hardened steel with hex-head and cup point to firmly seat in wall of conduit for positive grounding.

- C. Set screw type connectors: Hot dip galvanized, steel, UL listed concrete tight with male hub and insulated plastic throat, 150-degree C temperature rated. Setscrew shall be same as for couplings.
- D. Raintight couplings: Hot dip galvanized, steel; UL listed raintight and concrete tight, using gland and ring compression type construction.
- E. Raintight connectors: Hot dip galvanized, steel, UL listed raintight and concrete tight, with insulated throat, using gland and ring compression type construction.

2.06 FLEXIBLE METALLIC CONDUIT (FMC)

- A. Conduit: Shall be fabricated in continuous lengths from galvanized steel strip, spirally wound and formed to provide an interlocking design and conforming to UL 1.
- B. Fittings: Connectors shall be of the single screw clamp variety with steel or cast malleable iron bodies and threaded male hubs with insulated throats. Exception: Pressure cast screw-in connectors shall be acceptable for luminaire connection in suspended ceilings and cut-in outlet boxes within existing furred walls.

2.07 LIQUIDTIGHT FLEXIBLE METALLIC CONDUIT (LFMC)

- A. Conduit: Shall be fabricated in continuous lengths from galvanized steel strips, interlocking spirally wound, covered with extruded liquidtight jacket of polyvinyl chloride (PVC) and conforming to UL 360. Provide conduit with a continuous copper-bonding conductor wound spirally between the convolutions.
- B. Fittings: Connector body and gland nut shall be of cadmium plated steel or cast malleable iron, with tapered, male, threaded hub; insulated throat and neoprene "O" ring gasket recessed into the face of the stop nut. The clamping gland shall be of molded nylon with an integral brass push-in ferrule.

2.08 MISCELLANEOUS CONDUIT FITTINGS AND PRODUCTS

- A. Watertight conduit entrance seals: Steel or cast malleable iron bodies and pressure clamps with PVC sleeve, neoprene sealing grommets and PVC coated steel pressure rings. Fittings shall be supplied with neoprene sealing rings between the body and PVC sleeve.
- B. Watertight cable sealing bushings: One piece, compression molded sealing ring with PVC coated steel pressure disks, stainless steel sealing screws and zinc plated cast malleable iron locking collar.
- C. Expansion fittings: Multi-piece unit comprised of a hot dip galvanized malleable iron or steel body and outside pressure bussing designed to allow a maximum of 4" conduit movement (2" in either direction). Furnish with external braid tinned copper bonding jumper. Unit shall be UL listed for wet or dry locations.
- D. Expansion/deflection couplings: Multi-piece unit comprised of a neoprene sleeve with internal flexible tinned copper braid attached to bronze end couplings with stainless steel bands. Coupling shall accommodate 0.75-inch deflection, expansion or contraction in any direction and allow 30-degree angular deflections. Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber jacket and stainless-steel jacket clamps. Unit shall comply with UL467 and UL514. Manufacturer shall be OZ/Gedney Type DX, Steel City Type EDF or equal.

- E. Fire rated penetration seals:
  - 1. UL building materials directory classified.
  - 2. Conduit penetrations in fire rated separation shall be sealed with a UL classified fill, void or cavity material.
  - 3. The fire rated sealant material shall be the product best suited for each type of penetration and may be a caulk, putty, composite sheet, or wrap/strip.
- F. Standard products not herein specified:
  - 1. Provide listing of standard electrical conduit hardware and fittings not herein specified for approval prior to use or installation, i.e. locknuts, bushings, etc.
  - 2. Listing shall include Manufacturers name, part numbers and a written description of the item indicating type of material and construction.
  - 3. Miscellaneous components shall be equal in quality, material and construction to similar items herein specified.
- G. Hazardous area fittings: UL listed for the application.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Contractor shall thoroughly examine Project site conditions for acceptance of conduit system installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

#### **3.02 APPLICATION**

- A. Galvanized rigid steel conduit (GRS) can be used in the following applications:
  - 1. For feeders and branch circuits located indoors, concealed or exposed above suspended ceilings, in damp/wet locations, in crawl spaces, in attics, chases, furred spaces, equipment rooms, loading docks or in hazardous locations in accordance with CEC and local Codes.
  - 2. For feeders and branch circuits concealed in concrete floors and walls when not in contact with earth.
  - 3. For use where conduit is subject to physical damage.
  - 4. For feeders and branch circuits installed exposed on the roof.
- B. PVC insulated galvanized rigid steel conduit can be used in the following applications:
  - 1. Use 40-mil coating for feeders and branch circuits in damp or wet locations.
  - 2. Use 20- or 40-mil for feeders and branch circuits concealed in concrete walls or slabs in contact with earth.
  - 3. Use 20- or 40-mil for runs beneath floor slabs on grade.
  - 4. Use 40-mil for all below grade penetrations through floor slabs on grade or exterior walls.



- C. Intermediate metal conduit (IMC): Can be used for the same application as galvanized rigid steel conduit as specified herein, except for hazardous locations prohibited by CEC or Local Codes.
- D. Electrical metallic tubing (EMT): Can be used exposed or concealed for interior electrical feeders 4" and smaller, interior power and lighting branch circuits and low tension distribution system where run above suspended ceilings, in concrete slabs and walls not in contact with earth; in stud walls, furred spaces and crawl spaces. EMT shall not be installed exposed below 8 feet above the finish floor except within electrical, communication or signal rooms or closets (subject to physical damage).
- E. Flexible metallic conduit (FMC): Can be used only in dry locations for connections from an adjacent outlet box or conduit to all motors, transformers, vibrating equipment or machinery, controllers, solenoid valves, float and flow switches or similar devices and to luminaires installed in suspended ceilings.
- F. Liquidtight flexible metallic conduit (LFMC): Can be used in wet or damp locations for connections from adjacent outlet box or conduit to all motors, transformers, vibrating equipment or machinery, controllers, solenoid valves, float and flow switches or similar devices. These areas are typically food preparation and dishwashing areas, sump wells, loading docks, pump rooms, exterior areas, etc.
- G. Fire-Resistive Systems: Refer to CEC Article 728. All devices utilized, mountings, and supports shall be listed as part of the fire-resistive system.

### 3.03 PREPARATION

- A. Locations of conduit runs shall be planned in advance of the installation and coordinated with ductwork, plumbing, ceiling and wall construction in the same areas and shall not unnecessarily cross other conduits or pipe, nor prevent removal of ceiling tiles or panels, nor block access to mechanical or electrical equipment.
- B. Where practical, install conduits in groups in parallel vertical or horizontal runs and at elevations that avoid unnecessary offsets.
- C. All conduits shall be run parallel or at right angles to the centerlines of columns and beams, whether routed exposed, concealed above suspended ceiling or in concrete slabs.
- D. Conduits shall not be placed closer than 12-inches to a flue, parallel hot water, steam line or other heat producing source or three inches from such lines when crossing perpendicular to the runs.
- E. Communications conduits shall not be placed closer than 12 inches to power, a flue, parallel hot water, steam line or other heat producing source or three inches from such lines when crossing perpendicular to the runs.
- F. Exposed conduit installation shall not encroach into the ceiling height headroom of walkways or doorways. Where possible, install horizontal raceway runs above water and below steam piping.
- G. The largest trade size conduits in concrete floor and wall slabs shall not exceed 1/3 the floor or wall thickness and conduits shall be spaced a minimum of three conduit diameters apart unless otherwise noted on the Drawings. All conduits shall be installed in the center of

concrete slabs or wall and shall not be placed between reinforcing steel and the bottom of floor slabs.

- H. In long runs of conduit, provide sufficient pull boxes inside buildings to facilitate pulling wires and cables, with spacing not to exceed 150-feet. Support pull boxes from structure independent of conduit supports. These pull boxes are not indicated on the Drawings.
- I. Provide all reasonably inferred standard conduits fitting and products required to complete conduit installation to meet the intended application whether noted, indicated, or specified in the Contract Documents or not.
- J. Connect recessed luminaires to conduit runs with maximum six feet of flexible metal conduit.

### 3.04 INSTALLATION

- A. Install conduit in accordance with Manufacturer's written instructions, as indicated on Drawings and as specified herein.
- B. Minimum Conduit Size: Unless otherwise noted herein or on Drawings, minimum conduit size shall be 3/4" for interior applications and 1" for exterior and underground applications.
- C. Minimum Communication and Signal Conduit Size: Unless otherwise noted herein or on Drawings, minimum conduit size shall be 1" for interior applications and 2" for exterior and underground applications.
- D. All conduit sizes indicated on the Drawings are sized for copper conductors with THHN/THWN insulation. If conductor type or size is changed the Contractor shall be responsible for resizing conduits upward to meet Code.
- E. All communication and signal conduit sizes indicated on the Drawings are sized for 40% fill or less for category 6 or 6A cable. If cable type or size is changed the Contractor shall be responsible for resizing conduits upward to meet a maximum 40% fill.
- F. In general, all conduit work shall be concealed where possible. Exceptions shall be electrical, communication and mechanical rooms, exposed ceiling areas, and parking garages.
- G. Conduit connections to motors and surface cabinets shall be concealed, except for electrical, communication and mechanical rooms, or unless exposed Work is clearly called for on the Drawings.
- H. Install conduits in complete runs before pulling in cables or wires.
- I. Install conduit free from dented, bruises or deformations. Remove and replace any damaged conduits with new undamaged material.
- J. Conduits shall be well protected and tightly covered during construction using metallic bushings and bushing "pennies" to seal open ends.
- K. In making joints in rigid steel conduit, ream conduit smooth after cutting and threading. Coat all field-threaded joints with UL approved conductive type compound to ensure low resistance ground continuity through conduit and to prevent seizing and corrosion.
- L. Clean any conduit in which moisture or any foreign matter has collected before pulling in conductors. Paint all field-threaded joints to prevent corrosion.

- M. In all empty conduits or ducts, install a “True Tape” conduit measuring tape line to provide overall conduit length for determining length of cables/conductors for future use.
- N. Conduit systems shall be mechanically and electrically continuous throughout. Install code size, insulated, copper, green-grounding conductors in all conduit runs for branch circuits and feeders. This conductor is not indicated on the Drawings. Refer to Section 260526: Grounding and Bonding.
- O. Metallic conduit shall not be in contact with other dissimilar metal pipes (i.e. plumbing).
- P. Make bends with standard conduit bending hand tool or machines. The use of any item not specifically designed for the bending of electrical conduit is strictly prohibited.
- Q. A run of conduit between terminations at wire pulling points shall not contain more than the equivalent of four quarter bends (360-degrees, total).
- R. A run of communications and signal conduit between terminations at wire pulling points shall not contain more than the equivalent of two quarter bends (180-degrees, total).
- S. Emergency power raceway system: Install entirely independent of other raceway systems, except where specifically allowed by CEC Article 517.

### 3.05 PENETRATIONS

- A. Locate penetrations and holes in advance where they are proposed in the structural sections such as footings, beams, wall, etc. Penetrations are acceptable only when the following occurs:
  - 1. Where indicated on the Structural Drawings.
  - 2. As approved by the Structural Engineer prior to construction and after submittal of Drawing showing location, size, and position of each penetration.
- B. Cutting or holes:
  - 1. Cut holes through concrete, masonry block or brick floors and floors of structure with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed, except where permitted by the Structural Engineer as required by limited working space. Obtain the approval of the Structural Engineer prior to drilling through structural sections.
  - 2. Provide sleeves or “can outs” for cast-in-place concrete floors and walls. Following conduit installation, seal all penetrations using non-iron bearing, chloride free, non-shrinking, dry-pack grouting compounds; or fire rated penetration-sealing materials.
  - 3. Cut holes for conduit penetrations through non-concrete and non-masonry walls, partitions, or floors with a hole saw. The hole shall be only as large as required to accommodate the size of the conduit.
  - 4. Provide single piece escutcheon plates around all exposed conduit penetrations in public places.
- C. Sealing:
  - 1. Non-rated penetrations: Pack opening around conduits with non-flammable insulating material and seal with gypsum wallboard taping compound.

2. Fire stop: Where conduits, wireways and other electrical raceways pass through fire rated partitions, walls, smoke partitions or floor; install a UL classified fire stop material to provide an effective barrier against the spread of fire, smoke, and gases. Completely fill and seal clearances between raceways and openings with the fire stop material.
- D. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight as specified in Division 07: Sealants and Caulking.
1. Install specified watertight conduit entrance seals at all below grade wall and floor penetrations. Conduits penetrating exterior building walls and building floor slab shall be PVC coated rigid galvanized steel.
  2. For roof penetrations furnish and install roof flashing, counter flashing and pitch-pockets as specified under Roofing and Sheet Metal Sections of the Specifications.
  3. Provide membrane clamps and cable sealing fittings for any conduit that horizontally penetrates the waterproof membrane.
  4. Conduits that horizontally penetrate a waterproof membrane shall fall away from and below the penetration on the exterior side a minimum of two times the conduit diameters.

### 3.06 CONCEALED IN CONCRETE

- A. Install conduits approximately in the center of the slab so that there will be a minimum of 3/4-inch of concrete around the conduits.
- B. Installation of conduit in structural concrete that is less than three inches thick is prohibited. Topping slabs, maintenance pads and curbs are exempted.
- C. Tie conduits to reinforcing rods or otherwise secure them to prevent sagging or shifting during concrete placement. Run conduit larger than 1-inch trade size, parallel with or at right angles to the main reinforcement; where at right angles to the reinforcement, the conduit shall be close to one of the supports of the slab.
- D. Where nonmetallic conduit or tubing is used, raceways must be converted to PVC coated rigid steel conduit before rising above floor.
- E. Make couplings and connections watertight.
- F. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so curved portion of bends is not visible above the finished slab.

### 3.07 TERMINATIONS AND JOINTS

- A. Use raceway fittings that are of types compatible with the associated raceway and suitable for the use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings except as otherwise indicated.
- B. Raceways shall be joined using specified couplings or transition couplings where dissimilar raceway systems are joined.
- C. Conduits shall be securely fastened to cabinets, boxes and gutters using two locknuts and an insulating bushing or specified insulated connectors. Where joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system. Where

- terminations are subject to vibration, use bonding bushings or wedges to assure electrical continuity. Where subject to vibration or dampness, use insulating bushings to protect conductors. Install grounding bushings or bonding jumpers on all conduits terminating at concentric or eccentric knockouts.
- D. Conduit terminations exposed at weatherproof enclosures and cast outlet boxes shall be made watertight using specified connectors and hubs.
  - E. Stub-up connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used 6 inches above the floor. Where equipment connections are not made under this contract, install screwdriver operated threaded flush plugs with floor.
  - F. Install specified cable sealing bushings on all conduits originating outside the building walls and terminating in switchgear, cabinets, or gutters inside the building. Install cable sealing bushings or raceway seal for conduit terminations in all grade level or below grade exterior pull, junction, or outlet boxes.
  - G. Raceway seal: Inject into wire filled raceways, a pre-formulated rigid 2 lbs. density polyurethane foam which expands a minimum 35 times its original bulk. Foam shall have the physical properties of water vapor transmission of 1.2 to 3.0 perms: water absorption less than 2% by volume, fungus and bacterial resistant. Foam shall permanent seal against water, moisture, insects, and rodents. Install raceway sealing foam at the following points:
    - 1. Where conduits pass from warm locations to cold locations to prevent passage of water vapor (such as refrigerated spaces, constant temperature rooms, air-conditioned spaces, etc.).
    - 2. Where conduits enter buildings from below grade.
  - H. Install expansion couplings where any conduit crosses a building separation or expansion joint as follows:
    - 1. Conduits three inches and larger, shall be rigidly secured to the building structure on opposite sides of a building expansion joint and provided with expansion or deflection couplings. Install the couplings in accordance with the Manufacturer's recommendations.
    - 2. Conduits smaller than three inches shall be rigidly secured to the building structure on opposite sides of a building expansion joint with junction boxes on both sides of the joint. Connect conduits to junction boxes with 15 inches of slack flexible conduit. Flexible conduit shall have a green copper ground-bonding jumper installed. For concrete embedded conduit, use expansion and deflection couplings as specified above for three inches and larger conduits.
  - I. Use short length (maximum of 6ft) of the appropriate FMC or LFMC conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission. Provide liquidtight flexible metal conduit for installation in exterior locations, moisture or humidity-laden atmosphere, corrosive atmosphere, water hose or spray wash-down operations and locations subject to seepage or dripping of oil, grease, or water. Provide a green ground wire with FMC or LFMC conduit.

### 3.08 HAZARDOUS LOCATIONS

- A. Use rigid steel conduit only.
- B. Install UL approved sealing fittings that prevent passage of explosive vapors in accordance with the Manufacturers written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank coverplate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points and elsewhere as indicated:
  - 1. Where conduits enter or leave hazardous locations.
  - 2. At luminaires, switches, receptacles and as required by the CEC.

### 3.09 SUPPORTS

- A. Provide supports for raceways as specified in Section 260529: Electrical Hangers and Supports.
- B. All raceways systems shall be secured to building structures using specified fasteners, clamps and hangers spaced according to the CEC.
- C. Support single runs of conduit using one-hole pipe straps. Where run horizontally on walls in damp or wet locations, install "clamp backs" to space conduit off the surface.
- D. Multiple conduit runs shall be supported using "trapeze" hangers fabricated from specified construction channel, mounted to 3/8-inch diameter, threaded steel rods secured to building structures. Fasten conduit to construction channel with standard one-hole pipe clamps or the equivalent. Provide lateral seismic bracing for hangers.
- E. Individual 1/2" and 3/4" conduits installed above suspended ceilings may be attached to the ceiling's hanger wire using spring steel support clips provided that not more than two conduits are attached to any single support wire.
- F. Support exposed vertical conduit runs at each floor level, independent of cabinets or switches to which they run, by means of acceptable supports.
- G. Fasteners and supports in solid masonry and concrete:
  - 1. Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
  - 2. After concrete installation:
    - a. Steel expansion anchors not less than ¼ inch bolt size and not less than 1-1/8" embedment.
    - b. Power set fasteners not less than ¼ inch diameter with depth of penetration not less than three inches.
    - c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.
- H. Hollow masonry: Toggle bolts are permitted. Bolts supported only by masonry block are not acceptable.
- I. Metal structures: Use machine screw fasteners or other devices specifically designed and approved for the application.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 2025-01-31 – Added requirements for painting of conduit.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- As noted in 260519 Building Wire and Cable, use of MC Cable is not allowed except for lighting branch above accessible ceiling spaces. All other line voltage wiring is to be routed in conduit.
- With the exception of electrical, mechanical, IT rooms, do not allow installation of exposed conduit unless there is absolutely no alternatives. The designer should make every effort to identify conditions which may lead to the need to install exposed and consider alternatives in their design; for example, where ceiling is a fluted metal deck exposed to structure, conceal conduits above the deck, below the insulation, and penetrate where necessary. Where conduit cannot be installed concealed in finishes spaces (for example, a modernization) utilize surface raceway instead. Where



exposed conduit is routed at building exterior (which is to be avoided if at all possible) utilize galvanized rigid conduit only.

- PVC conduit (specified in 260543 Underground Ducts and Structures) may be utilized for branch circuiting underslab (note special requirements for PVC coated GRC at penetration) or when routed vertically and concealed in CMU construction.
- Conduit (and related infrastructure) installed for mechanical controls (BMS/EMS) shall be installed per Div. 26 requirements.
- Minimum conduit size for interior applications is 3/4", exterior and underground is 1".

SECTION 260531

CONDUIT

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work included: Labor, materials, and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
  - 1. Rigid steel conduit and fittings.
  - 2. PVC insulated rigid steel conduit and fittings.
  - 3. Intermediate metal conduit and fittings.
  - 4. Electrical metallic tubing and fittings.
  - 5. Flexible metallic conduit and fittings.
  - 6. Liquidtight flexible metallic conduit and fittings.
  - 7. Miscellaneous conduit fittings and products.
- B. Related Work: Consult all other Sections, determine the extent and character of related Work, and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.
  - 1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
  - 2. Division 01: Cutting and patching.
  - 3. Division 07: Sheet metal flashing and trim.
  - 4. Division 09: Painting. Exposed conduit and other devices.

**1.02 REFERENCES**

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:
  - 1. American National Standards Institute, Inc. (ANSI):
    - ANSI C80.1; Rigid Steel Conduit, Zinc-Coated.
    - ANSI C80.3; Electrical Metallic Tubing, Zinc Coated.
    - ANSI C80.5; Rigid Aluminum Conduit.
    - ANSI/ TIA-569-D Telecommunications Pathways and Spaces.
  - 2. Underwriters Laboratories, Inc. (UL):
    - UL 1; Flexible Metal Conduit.
    - UL 6; Rigid Metal Conduit.
    - UL 360; Liquid-Tight Flexible Steel Conduit.
    - UL 514B; Conduit, Tubing and Cable Fittings.

- UL 635;                      Insulating Bushings.
- UL 797;                     Electrical Metallic Tubing - Steel.
- UL 1242;                   Intermediate Metal Conduit - Steel.
- 3. National Electrical Manufacturer Association (NEMA):
  - NEMA RN1;                PVC Externally coated Galvanized Rigid Steel Conduit.

**1.03 SUBMITTALS**

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements the following items:
  - 1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
  - 2. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
  - 3. Submit Manufacturer's installation instruction. Provide written instructions for raceway products requiring glues, special tools, or specific installation techniques.

**1.04 QUALITY ASSURANCE**

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused, and currently under production.
- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted and approved.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURERS**

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.
  - 1. Metal conduit:
    - a. Allied Tube and Conduit Co.
    - b. Triangle PWC, Inc.
    - c. Western Tube and Conduit Corp.
    - d. Spring City Electrical Manufacturing Co.
    - e. Alflec Corp.
    - f. American Flexible Metal Conduit Co.
    - g. Anaconda.
  - 2. Fittings:
    - a. Appleton Electric Co.
    - b. OZ/Gedney.
    - c. Thomas & Betts Corp.

d. Spring City Electrical Manufacturing Co.

B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

2.02 GALVANIZED RIGID STEEL CONDUIT (GRS)

- A. Conduit: Full weight, threaded, hot-dip galvanized steel, conforming to ANSI C80.1 and UL 6.
- B. Standard threaded couplings, locknuts, bushings, and elbows: Only materials of steel or malleable iron are acceptable. Locknuts shall be bonding type with sharp edges for digging into the metal wall of an enclosure; provide two locknuts at each box or can, inside and outside.
- C. Three-piece couplings: Hot dip galvanized, cast malleable iron.
- D. Insulating bushings: Threaded polypropylene or thermosetting phenolic rated 150-degree C minimum.
- E. Insulated grounding bushings: Threaded cast malleable iron body with insulated throat and steel "lay-in" ground lug with compression screw.
- F. Insulated metallic bushings: Threaded cast malleable iron body with plastic insulated throat rated 150-degrees C.
- G. All fittings and connectors shall be threaded.

2.03 PVC INSULATED GALVANIZED RIGID STEEL CONDUIT (PVC GRS)

- A. Conduit: Full weight, threaded, hot-dip galvanized steel, conforming to ANSI C80.1 and NEMA RN-1 with nominal 20 or 40 mil thermoplastic vinyl coating, heat fused and bonded to the exterior of the conduit.
- B. Fittings: Conduit couplings and connectors shall be as specified for galvanized rigid steel conduit and shall be factory PVC coated with an insulating jacket equivalent to that of the coated material.

2.04 INTERMEDIATE METAL CONDUIT (IMC)

- A. Conduit: Hot dip galvanized steel meeting the requirements of CEC Article 345 and conforming to ANSI C80.6 and UL 1242.
- B. Fittings: Conduit couplings, connector and bushing shall be as specified for galvanized rigid steel conduit. Integral retractable type IMC couplings are also acceptable.

2.05 ELECTRICAL METALLIC TUBING (EMT)

- A. Conduit: Shall be formed of cold rolled strip steel, electrical resistance welded continuously along the longitudinal seam and hot dip galvanized after fabrication. Conduit shall conform to ANSI C80.3 Specifications and shall meet UL requirements.
- B. Set screw type couplings: Hot dip galvanized, steel, UL listed concrete tight. Use set screw type couplings with four setscrews each of conduit sizes over 2 inches. Setscrews shall be of case-hardened steel with hex-head and cup point to firmly seat in wall of conduit for positive grounding.

- C. Set screw type connectors: Hot dip galvanized, steel, UL listed concrete tight with male hub and insulated plastic throat, 150-degree C temperature rated. Setscrew shall be same as for couplings.
- D. Raintight couplings: Hot dip galvanized, steel; UL listed raintight and concrete tight, using gland and ring compression type construction.
- E. Raintight connectors: Hot dip galvanized, steel, UL listed raintight and concrete tight, with insulated throat, using gland and ring compression type construction.

2.06 FLEXIBLE METALLIC CONDUIT (FMC)

- A. Conduit: Shall be fabricated in continuous lengths from galvanized steel strip, spirally wound and formed to provide an interlocking design and conforming to UL 1.
- B. Fittings: Connectors shall be of the single screw clamp variety with steel or cast malleable iron bodies and threaded male hubs with insulated throats. Exception: Pressure cast screw-in connectors shall be acceptable for luminaire connection in suspended ceilings and cut-in outlet boxes within existing furred walls.

2.07 LIQUIDTIGHT FLEXIBLE METALLIC CONDUIT (LFMC)

- A. Conduit: Shall be fabricated in continuous lengths from galvanized steel strips, interlocking spirally wound, covered with extruded liquidtight jacket of polyvinyl chloride (PVC) and conforming to UL 360. Provide conduit with a continuous copper-bonding conductor wound spirally between the convolutions.
- B. Fittings: Connector body and gland nut shall be of cadmium plated steel or cast malleable iron, with tapered, male, threaded hub; insulated throat and neoprene "O" ring gasket recessed into the face of the stop nut. The clamping gland shall be of molded nylon with an integral brass push-in ferrule.

2.08 MISCELLANEOUS CONDUIT FITTINGS AND PRODUCTS

- A. Watertight conduit entrance seals: Steel or cast malleable iron bodies and pressure clamps with PVC sleeve, neoprene sealing grommets and PVC coated steel pressure rings. Fittings shall be supplied with neoprene sealing rings between the body and PVC sleeve.
- B. Watertight cable sealing bushings: One piece, compression molded sealing ring with PVC coated steel pressure disks, stainless steel sealing screws and zinc plated cast malleable iron locking collar.
- C. Expansion fittings: Multi-piece unit comprised of a hot dip galvanized malleable iron or steel body and outside pressure bussing designed to allow a maximum of 4" conduit movement (2" in either direction). Furnish with external braid tinned copper bonding jumper. Unit shall be UL listed for wet or dry locations.
- D. Expansion/deflection couplings: Multi-piece unit comprised of a neoprene sleeve with internal flexible tinned copper braid attached to bronze end couplings with stainless steel bands. Coupling shall accommodate 0.75-inch deflection, expansion or contraction in any direction and allow 30-degree angular deflections. Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber jacket and stainless-steel jacket clamps. Unit shall comply with UL467 and UL514. Manufacturer shall be OZ/Gedney Type DX, Steel City Type EDF or equal.

- E. Fire rated penetration seals:
  - 1. UL building materials directory classified.
  - 2. Conduit penetrations in fire rated separation shall be sealed with a UL classified fill, void or cavity material.
  - 3. The fire rated sealant material shall be the product best suited for each type of penetration and may be a caulk, putty, composite sheet, or wrap/strip.
- F. Standard products not herein specified:
  - 1. Provide listing of standard electrical conduit hardware and fittings not herein specified for approval prior to use or installation, i.e. locknuts, bushings, etc.
  - 2. Listing shall include Manufacturers name, part numbers and a written description of the item indicating type of material and construction.
  - 3. Miscellaneous components shall be equal in quality, material and construction to similar items herein specified.
- G. Hazardous area fittings: UL listed for the application.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Contractor shall thoroughly examine Project site conditions for acceptance of conduit system installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

#### **3.02 APPLICATION**

- A. Galvanized rigid steel conduit (GRS) can be used in the following applications:
  - 1. For feeders and branch circuits located indoors, concealed or exposed above suspended ceilings, in damp/wet locations, in crawl spaces, in attics, chases, furred spaces, equipment rooms, loading docks or in hazardous locations in accordance with CEC and local Codes.
  - 2. For feeders and branch circuits concealed in concrete floors and walls when not in contact with earth.
  - 3. For use where conduit is subject to physical damage.
  - 4. For feeders and branch circuits installed exposed on the roof.
- B. PVC insulated galvanized rigid steel conduit can be used in the following applications:
  - 1. Use 40-mil coating for feeders and branch circuits in damp or wet locations.
  - 2. Use 20- or 40-mil for feeders and branch circuits concealed in concrete walls or slabs in contact with earth.
  - 3. Use 20- or 40-mil for runs beneath floor slabs on grade.
  - 4. Use 40-mil for all below grade penetrations through floor slabs on grade or exterior walls.

- C. Intermediate metal conduit (IMC): Can be used for the same application as galvanized rigid steel conduit as specified herein, except for hazardous locations prohibited by CEC or Local Codes.
- D. Electrical metallic tubing (EMT): Can be used exposed or concealed for interior electrical feeders 4" and smaller, interior power and lighting branch circuits and low tension distribution system where run above suspended ceilings, in concrete slabs and walls not in contact with earth; in stud walls, furred spaces and crawl spaces. EMT shall not be installed exposed below 8 feet above the finish floor except within electrical, communication or signal rooms or closets (subject to physical damage).
- E. Flexible metallic conduit (FMC): Can be used only in dry locations for connections from an adjacent outlet box or conduit to all motors, transformers, vibrating equipment or machinery, controllers, solenoid valves, float and flow switches or similar devices and to luminaires installed in suspended ceilings.
- F. Liquidtight flexible metallic conduit (LFMC): Can be used in wet or damp locations for connections from adjacent outlet box or conduit to all motors, transformers, vibrating equipment or machinery, controllers, solenoid valves, float and flow switches or similar devices. These areas are typically food preparation and dishwashing areas, sump wells, loading docks, pump rooms, exterior areas, etc.
- G. Fire-Resistive Systems: Refer to CEC Article 728. All devices utilized, mountings, and supports shall be listed as part of the fire-resistive system.

### 3.03 PREPARATION

- A. Locations of conduit runs shall be planned in advance of the installation and coordinated with ductwork, plumbing, ceiling and wall construction in the same areas and shall not unnecessarily cross other conduits or pipe, nor prevent removal of ceiling tiles or panels, nor block access to mechanical or electrical equipment.
- B. Where practical, install conduits in groups in parallel vertical or horizontal runs and at elevations that avoid unnecessary offsets.
- C. All conduits shall be run parallel or at right angles to the centerlines of columns and beams, whether routed exposed, concealed above suspended ceiling or in concrete slabs.
- D. Conduits shall not be placed closer than 12-inches to a flue, parallel hot water, steam line or other heat producing source or three inches from such lines when crossing perpendicular to the runs.
- E. Communications conduits shall not be placed closer than 12 inches to power, a flue, parallel hot water, steam line or other heat producing source or three inches from such lines when crossing perpendicular to the runs.
- F. Exposed conduit installation shall not encroach into the ceiling height headroom of walkways or doorways. Where possible, install horizontal raceway runs above water and below steam piping.
- G. The largest trade size conduits in concrete floor and wall slabs shall not exceed 1/3 the floor or wall thickness and conduits shall be spaced a minimum of three conduit diameters apart unless otherwise noted on the Drawings. All conduits shall be installed in the center of

concrete slabs or wall and shall not be placed between reinforcing steel and the bottom of floor slabs.

- H. In long runs of conduit, provide sufficient pull boxes inside buildings to facilitate pulling wires and cables, with spacing not to exceed 150-feet. Support pull boxes from structure independent of conduit supports. These pull boxes are not indicated on the Drawings.
- I. Provide all reasonably inferred standard conduits fitting and products required to complete conduit installation to meet the intended application whether noted, indicated, or specified in the Contract Documents or not.
- J. Connect recessed luminaires to conduit runs with maximum six feet of flexible metal conduit.

### 3.04 INSTALLATION

- A. Install conduit in accordance with Manufacturer's written instructions, as indicated on Drawings and as specified herein.
- B. Minimum Conduit Size: Unless otherwise noted herein or on Drawings, minimum conduit size shall be 3/4" for interior applications and 1" for exterior and underground applications.
- C. Minimum Communication and Signal Conduit Size: Unless otherwise noted herein or on Drawings, minimum conduit size shall be 1" for interior applications and 2" for exterior and underground applications.
- D. All conduit sizes indicated on the Drawings are sized for copper conductors with THHN/THWN insulation. If conductor type or size is changed the Contractor shall be responsible for resizing conduits upward to meet Code.
- E. All communication and signal conduit sizes indicated on the Drawings are sized for 40% fill or less for category 6 or 6A cable. If cable type or size is changed the Contractor shall be responsible for resizing conduits upward to meet a maximum 40% fill.
- F. In general, all conduit work shall be concealed where possible. Exceptions shall be electrical, communication and mechanical rooms, exposed ceiling areas, and parking garages.
- G. Conduit connections to motors and surface cabinets shall be concealed, except for electrical, communication and mechanical rooms, or unless exposed Work is clearly called for on the Drawings.
- H. Install conduits in complete runs before pulling in cables or wires.
- I. Install conduit free from dented, bruises or deformations. Remove and replace any damaged conduits with new undamaged material.
- J. Conduits shall be well protected and tightly covered during construction using metallic bushings and bushing "pennies" to seal open ends.
- K. In making joints in rigid steel conduit, ream conduit smooth after cutting and threading. Coat all field-threaded joints with UL approved conductive type compound to ensure low resistance ground continuity through conduit and to prevent seizing and corrosion.
- L. Clean any conduit in which moisture or any foreign matter has collected before pulling in conductors. Paint all field-threaded joints to prevent corrosion.



- M. In all empty conduits or ducts, install a “True Tape” conduit measuring tape line to provide overall conduit length for determining length of cables/conductors for future use.
- N. Conduit systems shall be mechanically and electrically continuous throughout. Install code size, insulated, copper, green-grounding conductors in all conduit runs for branch circuits and feeders. This conductor is not indicated on the Drawings. Refer to Section 260526: Grounding and Bonding.
- O. Metallic conduit shall not be in contact with other dissimilar metal pipes (i.e. plumbing).
- P. Make bends with standard conduit bending hand tool or machines. The use of any item not specifically designed for the bending of electrical conduit is strictly prohibited.
- Q. A run of conduit between terminations at wire pulling points shall not contain more than the equivalent of four quarter bends (360-degrees, total).
- R. A run of communications and signal conduit between terminations at wire pulling points shall not contain more than the equivalent of two quarter bends (180-degrees, total).
- S. Emergency power raceway system: Install entirely independent of other raceway systems, except where specifically allowed by CEC Article 517.

### 3.05 PENETRATIONS

- A. Locate penetrations and holes in advance where they are proposed in the structural sections such as footings, beams, wall, etc. Penetrations are acceptable only when the following occurs:
  - 1. Where indicated on the Structural Drawings.
  - 2. As approved by the Structural Engineer prior to construction and after submittal of Drawing showing location, size, and position of each penetration.
- B. Cutting or holes:
  - 1. Cut holes through concrete, masonry block or brick floors and floors of structure with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed, except where permitted by the Structural Engineer as required by limited working space. Obtain the approval of the Structural Engineer prior to drilling through structural sections.
  - 2. Provide sleeves or “can outs” for cast-in-place concrete floors and walls. Following conduit installation, seal all penetrations using non-iron bearing, chloride free, non-shrinking, dry-pack grouting compounds; or fire rated penetration-sealing materials.
  - 3. Cut holes for conduit penetrations through non-concrete and non-masonry walls, partitions, or floors with a hole saw. The hole shall be only as large as required to accommodate the size of the conduit.
  - 4. Provide single piece escutcheon plates around all exposed conduit penetrations in public places.
- C. Sealing:
  - 1. Non-rated penetrations: Pack opening around conduits with non-flammable insulating material and seal with gypsum wallboard taping compound.

2. Fire stop: Where conduits, wireways and other electrical raceways pass through fire rated partitions, walls, smoke partitions or floor; install a UL classified fire stop material to provide an effective barrier against the spread of fire, smoke, and gases. Completely fill and seal clearances between raceways and openings with the fire stop material.
- D. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight as specified in Division 07: Sealants and Caulking.
1. Install specified watertight conduit entrance seals at all below grade wall and floor penetrations. Conduits penetrating exterior building walls and building floor slab shall be PVC coated rigid galvanized steel.
  2. For roof penetrations furnish and install roof flashing, counter flashing and pitch-pockets as specified under Roofing and Sheet Metal Sections of the Specifications.
  3. Provide membrane clamps and cable sealing fittings for any conduit that horizontally penetrates the waterproof membrane.
  4. Conduits that horizontally penetrate a waterproof membrane shall fall away from and below the penetration on the exterior side a minimum of two times the conduit diameters.

### 3.06 CONCEALED IN CONCRETE

- A. Install conduits approximately in the center of the slab so that there will be a minimum of 3/4-inch of concrete around the conduits.
- B. Installation of conduit in structural concrete that is less than three inches thick is prohibited. Topping slabs, maintenance pads and curbs are exempted.
- C. Tie conduits to reinforcing rods or otherwise secure them to prevent sagging or shifting during concrete placement. Run conduit larger than 1-inch trade size, parallel with or at right angles to the main reinforcement; where at right angles to the reinforcement, the conduit shall be close to one of the supports of the slab.
- D. Where nonmetallic conduit or tubing is used, raceways must be converted to PVC coated rigid steel conduit before rising above floor.
- E. Make couplings and connections watertight.
- F. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so curved portion of bends is not visible above the finished slab.

### 3.07 TERMINATIONS AND JOINTS

- A. Use raceway fittings that are of types compatible with the associated raceway and suitable for the use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings except as otherwise indicated.
- B. Raceways shall be joined using specified couplings or transition couplings where dissimilar raceway systems are joined.
- C. Conduits shall be securely fastened to cabinets, boxes and gutters using two locknuts and an insulating bushing or specified insulated connectors. Where joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system. Where

- terminations are subject to vibration, use bonding bushings or wedges to assure electrical continuity. Where subject to vibration or dampness, use insulating bushings to protect conductors. Install grounding bushings or bonding jumpers on all conduits terminating at concentric or eccentric knockouts.
- D. Conduit terminations exposed at weatherproof enclosures and cast outlet boxes shall be made watertight using specified connectors and hubs.
  - E. Stub-up connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used 6 inches above the floor. Where equipment connections are not made under this contract, install screwdriver operated threaded flush plugs with floor.
  - F. Install specified cable sealing bushings on all conduits originating outside the building walls and terminating in switchgear, cabinets, or gutters inside the building. Install cable sealing bushings or raceway seal for conduit terminations in all grade level or below grade exterior pull, junction, or outlet boxes.
  - G. Raceway seal: Inject into wire filled raceways, a pre-formulated rigid 2 lbs. density polyurethane foam which expands a minimum 35 times its original bulk. Foam shall have the physical properties of water vapor transmission of 1.2 to 3.0 perms: water absorption less than 2% by volume, fungus and bacterial resistant. Foam shall permanent seal against water, moisture, insects, and rodents. Install raceway sealing foam at the following points:
    - 1. Where conduits pass from warm locations to cold locations to prevent passage of water vapor (such as refrigerated spaces, constant temperature rooms, air-conditioned spaces, etc.).
    - 2. Where conduits enter buildings from below grade.
  - H. Install expansion couplings where any conduit crosses a building separation or expansion joint as follows:
    - 1. Conduits three inches and larger, shall be rigidly secured to the building structure on opposite sides of a building expansion joint and provided with expansion or deflection couplings. Install the couplings in accordance with the Manufacturer's recommendations.
    - 2. Conduits smaller than three inches shall be rigidly secured to the building structure on opposite sides of a building expansion joint with junction boxes on both sides of the joint. Connect conduits to junction boxes with 15 inches of slack flexible conduit. Flexible conduit shall have a green copper ground-bonding jumper installed. For concrete embedded conduit, use expansion and deflection couplings as specified above for three inches and larger conduits.
  - I. Use short length (maximum of 6ft) of the appropriate FMC or LFMC conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission. Provide liquidtight flexible metal conduit for installation in exterior locations, moisture or humidity-laden atmosphere, corrosive atmosphere, water hose or spray wash-down operations and locations subject to seepage or dripping of oil, grease, or water. Provide a green ground wire with FMC or LFMC conduit.

### 3.08 HAZARDOUS LOCATIONS

- A. Use rigid steel conduit only.
- B. Install UL approved sealing fittings that prevent passage of explosive vapors in accordance with the Manufacturers written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank coverplate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points and elsewhere as indicated:
  - 1. Where conduits enter or leave hazardous locations.
  - 2. At luminaires, switches, receptacles and as required by the CEC.

### 3.09 SUPPORTS

- A. Provide supports for raceways as specified in Section 260529: Electrical Hangers and Supports.
- B. All raceways systems shall be secured to building structures using specified fasteners, clamps and hangers spaced according to the CEC.
- C. Support single runs of conduit using one-hole pipe straps. Where run horizontally on walls in damp or wet locations, install "clamp backs" to space conduit off the surface.
- D. Multiple conduit runs shall be supported using "trapeze" hangers fabricated from specified construction channel, mounted to 3/8-inch diameter, threaded steel rods secured to building structures. Fasten conduit to construction channel with standard one-hole pipe clamps or the equivalent. Provide lateral seismic bracing for hangers.
- E. Individual 1/2" and 3/4" conduits installed above suspended ceilings may be attached to the ceiling's hanger wire using spring steel support clips provided that not more than two conduits are attached to any single support wire.
- F. Support exposed vertical conduit runs at each floor level, independent of cabinets or switches to which they run, by means of acceptable supports.
- G. Fasteners and supports in solid masonry and concrete:
  - 1. Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
  - 2. After concrete installation:
    - a. Steel expansion anchors not less than ¼ inch bolt size and not less than 1-1/8" embedment.
    - b. Power set fasteners not less than ¼ inch diameter with depth of penetration not less than three inches.
    - c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.
- H. Hollow masonry: Toggle bolts are permitted. Bolts supported only by masonry block are not acceptable.
- I. Metal structures: Use machine screw fasteners or other devices specifically designed and approved for the application.

3.10 PAINTING AND FINISHING

- A. Brush and clean work prior to concealing, painting and acceptance. Perform in stages if directed.
- B. Clean and repair soiled or damaged painted exposed work and match adjoining work before final acceptance.
- C. Clean, prepare, and paint all exposed conduit, junction boxes, Unistrut, fittings and accessories except rooftop mounted rigid steel conduit. Refer to specification sections 09 91 00 for requirements.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Use 2-1/8" deep boxes, minimum.

SECTION 26 05 33

BOXES

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work included: Labor, materials, and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
  - 1. Wall and ceiling outlet boxes.
  - 2. Pull and junction boxes.
- B. Related Work: Consult all other Sections, determine the extent and character of related Work, and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.
  - 1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
  - 2. Division 08: Access doors. Wall and ceiling access doors.

**1.02 REFERENCES**

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified.
  - 1. American National Standards Institute/National Electrical Manufacturer Association:
    - ANSI/NEMA OS-1; Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports.
    - ANSI/NEMA OS-2; Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports.
    - NEMA 250; Enclosures for Electrical Equipment (1000 volts maximum).
  - 2. Underwriters Laboratories (UL):
    - UL 50; Enclosures for Electrical Equipment.
    - UL 514A; Metallic Outlet Boxes.
    - UL 1773; Termination Boxes.

**1.03 SUBMITTALS**

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
  - 1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
  - 2. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
  - 3. Submit Manufacturer's installation instructions.

**1.04 QUALITY ASSURANCE**

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused, and currently under production.
- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.

- 1. Outlet and junction boxes:
  - a. Spring City Electrical Manufacturing Co.
  - b. Thomas & Betts Corp.
  - c. Racco, Inc.
- 2. Cast boxes:
  - a. Appleton Electric Co.
  - b. Crouse-Hinds.
- 3. Floor boxes:
  - a. Legrand.
  - b. Hubbell Inc.
  - c. Raceway Components, Inc.
- 4. Pullboxes:
  - a. Circle AW Products.
  - b. Hoffman Engineering Co.

- B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

### **2.02 OUTLET BOXES**

- A. Standard outlet box:
  - 1. Provide galvanized, one-piece die formed or drawn steel or welded, knockout type box of size and configuration best suited to the application indicated on the Drawings.
  - 2. 4-inch square by 2-1/4-inch deep shall be minimum box size.
  - 3. ANSI/NEMA OS 1.
- B. Concrete box:
  - 1. Provide galvanized steel, 4-inch octagon rings with mounting lugs, backplate and adapter ring as required.
  - 2. Select height as necessary to position knockouts above concrete reinforcing steel.
  - 3. ANSI/NEMA OS 1.



- C. Tile box:
  - 1. Provide outlet boxes for installation in tile or concrete block walls.
  - 2. Standard outlet boxes with raised, square corners and device covers are acceptable.
  - 3. ANSI/NEMA OS 1.
- D. Cast metal outlet body:
  - 1. Provide 4-inch round, galvanized cast iron alloy with threaded hubs and mounting lugs as required.
  - 2. Provide boxes with cast cover plates of the same material as the box and neoprene cover gaskets.
- E. Conduit outlet body: Provide malleable iron, oblong conduit outlet bodies with threaded conduit hubs and neoprene gasket, cast iron covers.

## 2.03 PULL AND JUNCTION BOXES

- A. Sheet metal pull and junction box:
  - 1. Provide standard outlet or concrete ring boxes wherever possible; otherwise use minimum 16-gauge galvanized sheet metal, NEMA 1 boxes, sized to Code requirements with covers secured by cadmium plated machine screws located 6 inches on centers.
  - 2. ANSI/NEMA OS 1.
- B. Flush mounted pullboxes and junction boxes: Provide overlapping covers with flush head cover retaining screws, prime coated.

## 2.04 FLOOR BOXES

- A. Refer to Section 262726: Wiring Devices for floor mounted service boxes.

# PART 3 - EXECUTION

## 3.01 EXAMINATION

- A. Contractor shall thoroughly examine Project site conditions for acceptance of box installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

## 3.02 PREPARATION

- A. Install all outlet boxes flush with building walls, ceilings, and floors except where boxes are installed in mechanical and electrical rooms, in cabinetry, above accessible ceilings or where exposed Work is called for on the Drawings.
- B. Locate pullboxes and junction boxes in concealed locations above removable ceilings or exposed in electrical rooms, utility rooms or storage areas.
- C. Install outlet boxes at the locations and elevations indicated on the Drawings or specified herein. Make adjustments to locations as required by structural conditions and to suit coordination requirements of other trades.
- D. Locate switch outlet boxes on the latch side of doorways unless otherwise indicated.

- E. Locate outlet boxes above hung ceilings having concealed suspension systems, adjacent to openings for removable recessed luminaires.
- F. Do not install outlet boxes back-to-back, separate boxes by at least 6". In fire-rated walls separate boxes by at least 24" and wall stud.
- G. Adjust position of outlet boxes in finished masonry walls to suit masonry course lines. Coordinate cutting of masonry walls to achieve neat openings for boxes.

### 3.03 INSTALLATION

- A. Install boxes in accordance with Manufacturer's written instructions, as indicated on Drawings and as specified herein.
- B. Locate electrical boxes as indicated on Drawings and as required for splices, taps, wire pulling, equipment connections and Code compliance.
- C. Install junction or pullboxes where required to limit bends in conduit runs to not more than 360 degrees or where pulling tension achieved would exceed the maximum allowable for the cable to be installed. Note that these boxes are not indicated on the Drawings.
- D. Install raised covers (plaster rings) on all outlet boxes in stud walls or in furred, suspended, or exposed concrete ceilings. Covers shall be of a depth to suit the wall or ceiling finish.
- E. Leave no unused openings in any box. Install close-up plugs as required to seal openings.
- F. Provide cast metal boxes with gasketed cast metal cover plates where boxes are exposed in damp or wet locations.
- G. Welded outlet boxes shall only be used in concealed interior installations.
- H. Provide precast concrete boxes in exterior planting areas, walkways, roads etc.
- I. Provide an access panel in permanent ceiling or wall where boxes are installed and will be inaccessible.
- J. For boxes mounted in exterior walls, make sure that there is insulation behind outlet boxes to prevent condensation in boxes.
- K. For outlets mounted above counters, benches or backsplashes, coordinate location and mounting heights with built-in units. Adjust mounting height to agree with required location for equipment served.
- L. Use conduit outlet bodies to facilitate pulling of conductors or to make changes in conduit direction only. Do not make splices in conduit outlet bodies.
- M. Add additional sheet rock as necessary to maintain original fire rating of walls where boxes are installed.
- N. Install galvanized steel coverplates on boxes in unfinished areas, above accessible ceilings and on surface mounted outlets.

### 3.04 SUPPORTS

- A. Provide boxes installed in metal stud walls with brackets designed for attaching directly to the studs or mount boxes on specified box supports.

- B. Mount boxes, installed in suspended ceilings of gypsum board or lath and plaster construction, to 16-gauge metal channel bars attached to main ceiling runners.
- C. Support boxes independently of conduit system.
- D. Support boxes, installed in suspended ceilings supporting acoustical tiles or panels, directly from the structure above wherever pendant mounted luminaires are to be installed from the box.
- E. Support boxes mounted above suspended acoustical tile ceilings, directly from the structure above.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

## SECTION 26 05 43

## UNDERGROUND DUCTS AND STRUCTURES

**PART 1 - GENERAL****1.01 SUMMARY**

- A. Work included: Labor, materials, and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
  - 1. Underground conduits and ducts.
  - 2. Handhole and pullboxes.
  - 3. Excavation, trenching and backfill.
- B. Related Work: Consult all other Sections, determine the extent and character of related Work, and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.
  - 1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
  - 2. Division 31 - Earthwork: General requirements for Excavation and Backfill and related items for ducts, manholes, pullboxes and handholes.
  - 3. Division 03 - Cast-in-place concrete: Protective envelope for ducts.

**1.02 REFERENCES**

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:
  - 1. American Concrete Institute (ACI):
    - ACI 318; Building Code Requirements for Structural Concrete
  - 2. American National Standards Institute, Inc. (ANSI):
  - 3. American Society for Testing And Materials (ASTM):
    - ASTM C31; Standard Practice for Making and Curing Concrete Test Specimens in the Field
    - ASTM C39; Test Method for Compressive Strength of Cylindrical Concrete Specimens
    - ASTM C172; Standard Practice for Sampling Freshly Mixed Concrete
    - ASTM C192; Practice for Making and Curing Concrete Test Specimens in the Laboratory
    - ASTM C231; Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
    - ASTM C478; Specification for Precast Reinforced Concrete Manhole Sections

- |             |                                                                                                                        |
|-------------|------------------------------------------------------------------------------------------------------------------------|
| ASTM C805;  | Test Method for Rebound Number of Hardened Concrete                                                                    |
| ASTM C857;  | Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures                     |
| ASTM C858;  | Specification for Underground Precast Concrete Utility Structures                                                      |
| ASTM C877;  | Specification for External Sealing Bands for Concrete Pipe, Manholes and Precast Box Sections                          |
| ASTM C891;  | Practice for Installation of Underground Precast Concrete Utility Structures                                           |
| ASTM C990;  | Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants |
| ASTM C1037; | Practice for Inspection of Underground Precast Concrete Utility Structures                                             |
| ASTM C1064; | Standard Test Method for Temperature of Freshly Mixed Concrete                                                         |
| ASTM C1231; | Standard Practice for Use of Unbonded Caps in Determination of Compressive Strength of Hardened Concrete Cylinder      |
| ASTM C1611; | Standard Test Method for Slump Flow of Self-Consolidating Concrete                                                     |
4. Underwriters Laboratories, Inc. (UL):
 

|         |                                       |
|---------|---------------------------------------|
| UL 651; | Schedule 40 and 80 Rigid PVC Conduit. |
|---------|---------------------------------------|
  5. National Electrical Manufacturer Association (NEMA):
 

|            |                                                       |
|------------|-------------------------------------------------------|
| NEMA RN1;  | PVC Externally-coated Galvanized Rigid Steel Conduit. |
| NEMA TC 2; | Electrical Plastic Tubing and Conduit.                |
| NEMA TC 3; | PVC Fittings for use with Rigid PVC Conduit.          |
| NEMA TC6;  | PVC Plastic Utilities Duct (EB and BD Type).          |

### 1.03 DEFINITIONS

- A. Duct: Electrical conduit and other raceway, either metallic or nonmetallic, used underground embedded in earth.
- B. Duct bank: Two or more conduits or another raceway installed underground in same trench.
- C. Handhole: An underground junction box in a duct or duct bank.

### 1.04 SUBMITTALS

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
  1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
  2. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.

3. Shop Drawings showing details and design calculations for precast handholes, including reinforced steel.
4. Submit Manufacturer's installation instructions.
5. Complete bill of material listing all components.

#### 1.05 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused, and currently under production.
- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted and approved.
- C. Precast concrete vaults shall be designed and fabricated by an experienced and acceptable precast concrete manufacturer. The manufacturer shall have been regularly and continuously engaged in the manufacture of precast concrete units similar to that indicated in the project specifications or drawings for at least 10 years.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.
  1. Underground precast concrete utility structures:
    - a. Oldcastle Enclosure Solutions.
    - b. Jensen Precast.
  2. Conduits, ducts and fittings:
    - a. Prime Conduit.
    - b. JM Eagle.
    - c. Cantex.
    - d. Occidental Coating Company (OCAL).
- B. Substitution: Under provisions of Section 260010: Basic Electrical Requirements.

#### 2.02 CONDUIT AND DUCT

- A. Refer to Section 260531: Conduit.
- B. Galvanized rigid steel conduit (GRS) in underground installations:
  1. PVC insulated galvanized rigid steel conduit (PVC GRS):
    - a. Conduit: Full weight, threaded, hot-dip galvanized steel, conforming to ANSI C80.1 and NEMA RN-1 with nominal 20 or 40 mil thermoplastic vinyl coating, heat fused and bonded to the exterior of the conduit.
    - b. Fittings: Conduit couplings and connectors shall be steel or malleable iron as required with factory PVC coating and insulated jacket equivalent to that of the coated material.

2. Tape insulated galvanized rigid steel conduit (Tape GRS):
    - a. Conduit: Full weight, threaded, hot-dip galvanized steel, conforming to ANSI C80.1 and NEMA RN-1 with half lapping of PVC 10 mil tape over the exterior of the conduit. Half lap all raceways a minimum of one time and extend to 12-inches above grade.
    - b. Fittings: Conduit couplings and connectors shall be steel or malleable iron as required with half lapping of PVC 10 mil tape over the exterior of the fittings. Half lap shall extend to 12-inches above grade.
  - C. Rigid non-metallic conduit (PVC):
    1. Conduit:
      - a. Rigid polyvinylchloride, schedule 40 or 80 conforming to NEMA TC2 and UL 651. UL listed for exposed and direct-burial applications and for 90 degrees C conductor insulation. Conduit shall include an integral bell fitting at one end.
      - b. Rigid polyvinylchloride, type EB or DB conforming to NEMA TC 6 and UL 651. UL listed for concrete encased burial and direct burial applications and for 90 degree C conductor insulation. Conduit shall include an integral bell fitting at one end.
    2. Fittings: Couplings, adaptors, transition fittings, bell ends, etc., shall be molded PVC, slip on and solvent weld type. Schedule 40 or 80 conforming to NEMA TC 3 and type EB or DB conforming to NEMA TC 9.
  - D. Elbows:
    1. Low voltage systems (1000 volts and less):
      - a. Minimum radius bends shall be 18" for conduits up to 2" diameter, 36" for conduits greater than 2" diameter, or greater if indicated on the drawings or required by the cable manufacturer.
  - E. Duct supports: Rigid PVC spacers selected to provide minimum duct spacing and concrete cover depths, while supporting ducts during concrete pour.
  - F. Duct sealing compound: Non-hardening, safe for human skin contact, not deleterious to cable insulation, workable at temperatures as low as 35 degree F, withstands temperature of 300 degrees F without slump and adheres to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, cable sheaths and jackets, etc.
- 2.03 PULLBOXES AND HANDHOLES
- A. Construction: High densities precast reinforced concrete box, extension, base, and cover. Furnish box with end and side knockouts and non-settling shoulders. Cover shall have hold-down bolts and two lifting eyes.
  - B. Size: As indicated on the Drawings.
  - C. Cover markings: Covers shall read "ELECTRICAL", "COMMUNICATIONS", or "SIGNAL" as appropriate.
  - D. Rated covers: Use cast iron lid with H20 traffic rating when subject to vehicular traffic.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**



- A. Contractor shall thoroughly examine Project site conditions for acceptance of duct and manhole installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

### 3.02 EARTHWORK

- A. Excavation and backfill: Conform to Division 31, Earthwork.
- B. Excavation for underground electrical structures: Conform to elevations and dimensions indicated within a tolerance of plus or minus 0.10 foot; plus, a sufficient distance to permit placing and removal of concrete formwork, installation or services, other construction and for inspection.
  - 1. Excavate, by hand, areas within dripline of large trees. Protect the root system for damage and dry-out. Maintain moist conditions for root system and over exposed roots with burlap. Paint root cuts of 1 inch in diameter and larger with emulsified asphalt tree paint.
  - 2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.
- C. Trenching: Excavate trenches for electrical installation as follows:
  - 1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches clearances on both sides of raceways and equipment.
  - 2. Excavate trenches to depth indicated or required.
  - 3. Limit the length of open trench to that in which installations can be made and the trench backfilled within the same day.
  - 4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of raceways and equipment. Provide a minimum of 6 inches of stone or gravel cushion between rock bearing surface and electrical installations.
- D. Backfilling and filling: Place soil materials in layers to required sub-grade elevations for each area classification, using materials and methods specified in Division 31: Earthwork.
  - 1. Under building slabs, use drainage fill materials.

### 3.03 CONDUIT AND DUCT INSTALLATION

- A. Install duct lines in accordance with Manufacturer's written instructions, as indicated on the Drawings and as specified herein.
- B. Application:
  - 1. Direct burial ducts: Schedule 40, minimum 24-inches below finished grade.
  - 2. Below building slab-on-grade: Schedule 40, minimum 4-inches below bottom of slab except that bends and penetrates through floor slab shall be insulated galvanized rigid steel conduit.
  - 3. Below roads and paved surfaces:
    - a. Schedule 80, minimum 36-inches below finished grade.
  - 4. Utility pole riser: Schedule 80.
  - 5. Penetrations of building and equipment slabs: Insulated galvanized rigid steel conduit .

- C. Slope duct to drain towards handholes and away from building and equipment entrances. Pitch not less than 4-inches per 100-feet.
- D. Curved sections in duct lines shall consist of long sweep bends with a minimum radius of 25-feet in the horizontal and vertical directions. The use of manufactured bends is limited to building entrances and equipment stub-ups.
- E. For communications and signal conduits, do not exceed a combined bend radius of greater than 180 degrees between pull points.
- F. Underground conduit stub-ups to inside of building and exterior equipment shall be insulated galvanized rigid steel conduit.
- G. Make joints in ducts and fittings watertight according to Manufacturer's instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.
- H. Terminate duct lines at handholes with end bells spaced 10-inches on center for 5-inch ducts and varied proportionately for other duct sizes. Change from regular spacing to end-bell spacing 10-feet from the end bell without reducing duct line slope and without forming trap in the line.
- I. Separation between direct buried duct lines shall be 3-inches minimum for like systems and 12-inches minimum between power and signal ducts.
- J. For direct burial installations install continuous warning strip of heavy gage plastic imprinted "electrical ducts below", approximately 12-inch wide at 12-inches above ducts.
- K. Mandrel all ducts upon completion of installation and prior to pulling cables.

#### 3.04 HANDHOLE AND PULL BOX INSTALLATION

- A. Install handholes in accordance with Manufacturer's written instructions, as indicated on Drawings and as specified herein.
- B. Handholes shall be installed flush with finished grade or surface. Install on a level 6-inch bed of well-tamped gravel or crushed stone.
- C. Orientation of handholes shall be coordinated in advance with Landscape Architect and arranged to minimize connecting duct bends and deflections.

#### 3.05 FIELD QUALITY CONTROL

- A. Testing: Demonstrate capability and compliance with requirements upon completion of installation of underground duct and structures.
  - 1. Duct integrity: Rod ducts with a mandrel 1/4-inch smaller in diameter than internal diameter of ducts. Where rodding indicates obstructions in ducts, remove the obstructions and retest.

#### 3.06 CLEANING

- A. Pull brush through full length of ducts. Use round bristle brush with a diameter 1/2-inch greater than internal diameter of duct.
- B. Clean internal surfaces of handholes. Remove foreign material.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

## SECTION 26 05 53

## ELECTRICAL IDENTIFICATION

**PART 1 - GENERAL****1.01 SUMMARY**

- A. Work included: Labor, materials, and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
  - 1. Electrical equipment nameplates.
  - 2. Panelboard directories.
  - 3. Wire and cable identification.
  - 4. Buried electrical line warnings.
  - 5. Junction box identification.
  - 6. Warning and caution signs.
  - 7. Inscribed device coverplates.
- B. Related Work: Consult all other Sections, determine the extent and character of related Work, and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.
  - 1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
  - 2. Division 09: Painting.

**1.02 SUBMITTALS**

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
  - 1. Data/catalog cuts for each product and component specified herein.
  - 2. Schedules for nameplates to be furnished.

**PART 2 - PRODUCTS****2.01 MANUFACTURERS**

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.
  - 1. Conduit and wire markers:
    - a. Thomas & Betts Corp.
    - b. Brady.
    - c. Griffolyn.
  - 2. Inscription Tape:

- a. Kroy.
- b. Merlin.

B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

## 2.02 NAMEPLATES

- A. Type NP: Engraved, plastic laminated labels, signs, and instruction plates. Engrave stock melamine plastic laminate 1/16-inch minimum thickness for signs up to 20-square inches or 8-inches in length; 1/8-inch thick for larger sizes. Engraved nameplates shall have white letters and be punched for mechanical fasteners.
- B. Color and letter height as specified in Part 3: Execution.

## 2.03 LEGEND PLATES

- A. Type LP: Die-stamped metal legend plate with mounting hole and positioning key for panel mounted operator devices, i.e. motor control pilot devices, hand-off-auto switches, reset buttons, etc.
- B. Stamped characters to be paint filled.

## 2.04 BRASS TAGS

- A. Type BT: Metal tags with die-stamped legend, punched for fastener.
- B. Dimensions: 2" diameter 19 gauge.

## 2.05 PANELBOARD DIRECTORIES (400 AMP OR LESS)

- A. Directories: A 6" x 8" minimum size circuit directory frame and card with clear plastic covering shall be provided inside the inner panel door.
- B. Circuit numbering: Starting at the top, odd numbered circuits in sequence down the left-hand side and even numbered circuits down the right-hand side. Multi-section panelboards shall have continuous consecutive circuit numbers, i.e. Section 1 (circuit numbers 1-42), Section 2 (circuit numbers 43-84), Section 3 (circuit numbers 85-126) for all 42-pole panelboards. For 84-pole panelboards the numbering is Section 1 (circuit numbers 1-84), Section 2 (circuit numbers 85-168), etc.

## 2.06 WIRE AND TERMINAL MARKERS

- A. Provide self-adhering, pre-printed, machine printable or write-on, self-laminating vinyl wrap around strips.
- B. Blank markers shall be inscribed using the printer or pen recommended by Manufacturer for this purpose.

## 2.07 CONDUCTOR PHASE MARKERS

- A. Colored vinyl plastic electrical tape, 3/4" wide, for identification of phase conductors. Scotch 35 Brand Tape or equal.

## 2.08 UNDERGROUND CONDUIT MARKER

- A. 6-inch wide, yellow polyethylene tape, with continuous black imprinting reading "Caution - Buried Electric Line Below".

**2.09 INSCRIBED DEVICE COVERPLATES**

- A. Coverplate material shall be as specified in Section 262726: Wiring Devices.
- B. Methods of inscription: (Unless otherwise noted)
  - 1. Type-on-tape:
    - a. Imprinted or thermal transfer characters onto tape lettering system.
    - b. Tape trimmer.
    - c. Matte finish spray-on clear coating.
  - 2. Engraving:
    - a. 1/8" high letters.
    - b. Paint filled letters finished in black.

**PART 3 - EXECUTION****3.01 EXAMINATION**

- A. Contractor shall thoroughly examine Project site conditions for acceptance of identification device installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

**3.02 NAMEPLATES**

- A. Installation:
  - 1. Degrease and clean surfaces to receive nameplates.
  - 2. Install nameplates parallel to equipment lines.
  - 3. Secure nameplates to equipment fronts using machine screws.
- B. Provide type 'NP' color coded nameplates that present, as applicable, the following information:
  - 1. Equipment or device designation:
    - a. Equipment designations shall conform to the following:
      - 1) Building number designation – 1.
      - 2) Power source:
        - a) Normal - \_\_
        - b) Emergency – E
      - 3) Equipment description:
        - a) Main switchboard – MS
        - b) 277/480volt distribution board – HD
        - c) 277/480volt panelboard – H
        - d) 120/208volt distribution board – LD
        - e) 120/208volt panelboard – L

- f) Transformer – TX
- 4) Floor number where equipment is located – 03
- 5) Equipment designation – B
- b. Example: 2EHD03A
  - 1) Building number 2.
  - 2) Emergency source.
  - 3) 277/480volt distribution board.
  - 4) Floor level 03.
  - 5) Board designation A
- 2. Amperage, KVA or horsepower rating, where applicable.
- 3. Voltage or signal system name.
- 4. Source of power or control.
- 5. Examples:
  - a. Boards: 2EHD03A; 1200A, 277/480volt, 3-phase, 4-wire; Served from 2EATS03A
  - b. Transformers: 2ETX03A; 150KVA, 480volt primary, 120/208volt, 3-phase, 4-wire secondary; Served from 2EHD03A; Load Served: 2EL03A
  - c. Disconnects or Individual Motor Starters: EF-1; 20HP; 480volt, 3-phase,3-wire; Served from 2EHD03A
- C. Nameplates for power system distribution equipment and devices are to be black.
- D. Nameplates for signal systems equipment and devices are to be black except as follows:
  - 1. Fire alarm and life safety - Red.
- E. Minimum letter height shall be as follows:
  - 1. For panelboards, switchboards, battery panels, etc.: ½ inch letters to identify equipment designation. Use ¼ inch letters to identify voltage, phase, wires, etc.
  - 2. For individual circuit breakers, switches and motor starters in panelboards, distribution boards, and switchboards use 3/8-inch letters to identify equipment designation. Use 1/8-inch letters to identify all other.
  - 3. For individual mounted circuit breakers, disconnect switches, enclosed switches and motor starters use 3/8-inch letters to identify equipment designation. Use 1/8" letters to identify all other.
  - 4. For transformers use ½-inch letters to identify equipment designation. Use ¼-inch letters to identify primary and secondary voltages, etc.
  - 5. For equipment cabinets, terminal cabinets, control panels and other cabinet enclosed apparatus use 3/8-inch letters to identify equipment designation.

### 3.03 LEGEND PLATES

- A. Provide panel-mounted operators devices such as pilot lights, reset buttons, "HAND-OFF-AUTO" switches, etc.
- 3.04 BRASS TAGS
  - A. Provide type BT tags for individual ground conductors to exposed ground bus indicating connection i.e. "UFER", "Cold water bond", etc.
  - B. Provide tags for all feeder cables in underground vaults and pull boxes.
  - C. Provide tags for empty conduits in underground vault, pull boxes and stubs.
- 3.05 PANELBOARD DIRECTORIES (400AMP OR LESS)
  - A. Provide typewritten directories arranged in numerical order denoting loads served by room number or area for each circuit.
  - B. Verify room numbers or area designation with Project Manager.
  - C. Mount panelboard directories in a minimum 6" x 8" metal frame under clear plastic cover inside every panelboard.
- 3.06 WIRE AND CABLE IDENTIFICATION
  - A. Provide wire markers on each conductor in panelboards, pull boxes, outlet, and junction boxes and at load connection. Identify with branch circuit or feeder number for power and lighting circuits and with control wire number as indicated on equipment Manufacturer's Shop Drawings for control wiring.
  - B. Provide colored phase markers for conductors as noted in Section 260519: Building Wire and Cable. Apply colored, pressure sensitive plastic tape in half-lapped turns for a distance of 3-inches from terminal points and in boxes where splices or taps are made. Apply the last two laps of tape with no tension to prevent possible unwinding. Do not cover cable identification markings by taping.
- 3.07 UNDERGROUND CONDUIT MARKERS
  - A. During trench backfilling, for exterior underground power, signal, and communications lines, install continuous underground plastic line marker, located directly above line at 6 to 8 inches below finished grade. Where multiple lines installed in a common trench or concrete envelope, do not exceed an overall width of 16 inches; install a single line marker.
- 3.08 JUNCTION BOX IDENTIFICATION
  - A. The cover of junction, pull and connection boxes for both power and signal systems, located above suspended ceilings and below ceilings in non-public areas, shall be clearly marked with a permanent ink felt pen. Identify the circuit(s) (panel designation and circuit numbers) contained in each box, unless otherwise noted or specified.
- 3.09 WARNING, CAUTION, AND INSTRUCTION SIGNS
  - A. Provide warning, caution or instruction signs where required by CEC, where indicated or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.



- B. Emergency Operating Signs: Install engraved laminate signs with white letters on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding or other emergency operations.
- C. Elevator Machine Rooms(s): Provide warning sign for each elevator controller disconnect to read "Warning - Part of the Control Panel is not De-energized by this Switch."
- D. Elevator car light and fan switch: Provide signage indicating elevator number serving and function of each switch.

### 3.10 INSCRIBED DEVICE COVERPLATE

#### A. General:

- 1. Lettering type: Helvetica, 12 point or 1/8" high.
- 2. Color of characters shall be black.
- 3. Locate the top of the inscription 1/2" below the top edge of the coverplate.
- 4. Inscription shall be centered and square with coverplate.

#### B. Application:

- 1. Type-on-tape inscriptions shall be provided for the following devices:
  - a. Receptacles.
  - b. Outlets in surface raceways.
  - c. Telecommunication outlets.
- 2. Engraved inscriptions shall be provided for the following devices:
  - a. Multi-ganged switches.
  - b. Special purpose switches.
- 3. Type-on-tape installation:
  - a. Tape shall be trimmed to the height of the letters.
  - b. Trim tape length to 1/4-inch back from each edge of coverplate.
  - c. Contractor hands shall be clean or covered with surgical type glove prior to application of tape. Tape installations with visible fingerprints or smudges will not be acceptable.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 2025-02-07 – Modified list of approved manufacturers to reflect district preference, use of devices that require batteries is prohibited.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- District preference is for simple, stand-alone lighting controls that do not require servers, software, or head-end equipment, installation, and not a complex lighting control system. Unless required by code, provide stand-alone lighting controls. Use of lighting control systems that require a dedicated server, or software that may not be supported beyond the warranty period, is prohibited.
- Use of wireless lighting controls, consisting of luminaires with integral sensors, wireless controllers, line-powered dimmers and sensors, etc. are acceptable.
- Use of components that require batteries are prohibited, unless special permission is granted.

SECTION 26 09 42  
DIGITAL LIGHTING CONTROL

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work included: Labor, materials, and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
  - 1. Lighting control modules.
  - 2. Plug load control modules.
  - 3. Control stations.
  - 4. Occupancy sensors.
  - 5. Daylight sensors.
  - 6. Relay panels.
  - 7. Emergency bypass relays or transfer device.
  - 8. Network communication cabling.
  - 9. Startup and field quality control.
  - 10. Commissioning.
- B. Related Work: Consult all other Sections, determine the extent and character of related Work, and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.
  - 1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
  - 2. Division 25 – Building Automation System (BAS): Lighting control interface.

**1.02 REFERENCES**

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:
  - 1. National Electrical Manufacturer Association (NEMA):
    - NEMA 250;                      Enclosures for Electrical Equipment.
    - NEMA ICS 1;                      Industrial Control and Systems.
    - NEMA ICS 4;                      Terminal Blocks and Industrial use.
    - NEMA ICS 6;                      Enclosures for Industrial Controls and Systems.
  - 2. Underwriters Laboratories, Inc. (UL):
    - UL 50;                              Cabinets and Boxes.
    - UL 773A;                              Nonindustrial Photoelectric Switches for Lighting Control.

|         |                                                      |
|---------|------------------------------------------------------|
| UL 916; | Energy Management.                                   |
| UL 924  | Standard for emergency lighting and power equipment. |
| UL1008  | Transfer switch equipment.                           |

### 1.03 SYSTEM DESCRIPTION

- A. A standalone digital lighting control system that interconnects and lighting components such as occupancy and daylight sensors, control stations, etc. to control luminaires connected to the system. All components are locally connected and function independently of any central control software.
- B. Control of luminaries will come from distributed control modules capable of "ON/OFF" control and 0-10volt dimming. The system shall be capable of dimming other loads such as electronic low voltage (ELV) and magnetic low voltage (MLV).
- C. The lighting control components shall be capable of adjusting their specific parameters such as dimming presets, time delays, etc. per the device type. Handheld or computer-based commissioning tools shall be available during startup to reduce the time required at startup and commissioning. These tools shall be available to the Owner after startup and commissioning.
- D. The control system is connected independent of electrical lighting circuits.
- E. The system shall utilize either hardwired or wireless components.

### 1.04 SUBMITTALS

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
  - 1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
  - 2. Describe system operation, equipment and dimensions and indicate features of each component.
  - 3. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
  - 4. Furnish structural calculations for equipment anchorage as described in Section 260010: Basic Electrical Requirements.
  - 5. Submit Manufacturer's installation instructions.
  - 6. Complete bill of materials listing all components.
  - 7. Warranty.

### 1.05 OPERATION AND MAINTENANCE MANUAL

- A. Supply operation and maintenance manuals in accordance with the requirements of Section 260010: Basic Electrical Requirements to include the following:
  - 1. Operation and maintenance manuals shall include the following:
    - a. A detailed explanation of the operation of the system.
    - b. Instructions for routine maintenance.
    - c. Pictorial parts list and part numbers.

2. Telephone numbers for the authorized parts and service distributors.

3. Final testing report.

#### 1.06 QUALITY ASSURANCE

A. All materials, equipment and parts comprising the units specified herein shall be new, unused, and currently under production.

B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.

#### 1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery: Digital lighting control components shall not be delivered to the Project site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable. Equipment damaged during shipment shall be replaced and returned to Manufacturer at no cost to Owner.

B. Storage: Store in a clean, dry, ventilated space free from temperature extremes. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris and traffic. Provide heat where required to prevent condensation.

C. Handling: Handle in accordance with Manufacturer's written instructions. Be careful to prevent internal component damage, breakage, denting and scoring. Damaged units shall not be installed. Replace damaged units and return equipment to Manufacturer.

#### 1.08 WARRANTY

A. Units and components offered under this Section shall be covered by a minimum 2-year parts and labor warranty for malfunctions resulting from defects in materials and workmanship. Warranty shall begin upon acceptance by the Owner.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.

1. Network addressable lighting control system:

~~a. Wattstopper "DLM".~~

a. Acuity "nLight" and/or "nLight Air"

b. Wattstopper Plus wire and/or wireless.

~~c. Douglas "Dialog".~~

~~d. ETC "Echo".~~

~~e. Eaton "Greengate Room Controller".~~

B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

#### 2.02 GENERAL

A. The lighting control system shall be standalone with no central control software. Lighting components shall tie together and communicate directly with each other as required for the device type.

B. Control stations, occupancy sensors, and daylight sensors shall tie into dimming and relay modules to control luminaires.

- C. The control parameters shall be set within each device, either as dip switches or dials on the device itself or with handheld or computer-based commissioning tools. The parameters remain set until they are manually changed.
- D. Daylight sensors shall rationalize changes to light levels when daylight is available and shall maintain a steady light level when subjected to fluctuating ambient conditions.
- E. Where required in a sequence of operation an astronomical time clock function shall be integrated into the control modules or relay panels.
- F. During an emergency condition (loss of normal power), the system shall not impede the emergency lighting to function properly, i.e. the control system shall control emergency lighting to turn on at full light output and lock out user controls.
- G. The control system shall allow occupancy sensor, when relaying a vacant status to either turn lights off or dim lights to a preset level.
- H. The control system components shall comply with the latest edition of the California Building Energy Efficiency Standards, California Building Code, Part 6 and be certified by The California Energy Commission.

## 2.03 LIGHTING CONTROL MODULES

- A. General:
  - 1. Lighting control modules provide an interface between the control system and luminaires. Modules take inputs from the system and convert the commands through the power and control wiring to the fixture providing "ON/OFF/DIMMING" functions.
  - 2. Lighting control modules contain a 16amp minimum rated relay(s) for "ON/OFF" control as well as a 0-10volt dimming signal. Modules shall also have the capability of two wire phase dimming (MLV or ELV).
  - 3. In the event of a power failure, control modules connected to luminaires shall default to the "on" state at full light output.
- B. The following lighting control modules shall be available with the system, at a minimum:
  - 1. Single zone 0-10volt control module with a relay.
  - 2. Multi-zone 0-10volt control module with one relay per 0-10volt zone ("Room Controller").
  - 3. Single zone two wire dimming module (Incandescent, MLV, or ELV) with a relay.
  - 4. Multi-zone two wire dimming module (Incandescent, MLB, or ELV with one relay per zone ("Room controller")
- C. Mounting:
  - 1. Single zone modules shall have a ½" nipple to mount directly to a ½" knockout on a junction box.
  - 2. Multi-zone modules shall mount stand alone or onto a 4 square junction box.

## 2.04 PLUG LOAD CONTROL MODULES

- A. General:

1. Plug load Control modules provide an interface between the control system and controlled outlets. Modules take inputs from the system and convert the commands through the power wiring to the receptacle(s) being controlled.
2. Control modules contain a 20amp rated relay(s) for "ON/OFF" control.

B. Mounting:

1. Modules shall have a ½" nipple to mount directly to a ½" knockout on a junction box.

2.05 CONTROL STATIONS

A. General:

1. The controllers are configurable wall mounted devices that provide local "ON/OFF/DIMMING" control to lighting zones.
2. Each device can be set-up and modified through the control systems software interface.

B. Dimmer switch controller:

1. Software configurable dimmer switch that provides "ON/OFF" switching and the capability to dim.
2. Dimming to be continuous over the full range of the driver or ballast it is controlling.

C. Dimming scene controller:

1. Multi-button controller allowing the end user to recall zones or scenes for "ON/OFF/DIMMING" control.
2. Scenes are made up of multiple zones, where each zone is dimmed to a specific light output.
3. Scene configuration can be changed via control systems software.
4. The scene controller shall also allow for a custom labeling feature that allows scene labels on the controller to be easily modified.

D. Specifics:

1. Mounting:
  - a. Controllers utilize a standard single-gang device strap configuration for ease in mounting. Where multiple controllers are ganged together, they shall allow for a single multi-gang cover plat to be used.
  - b. Mounts to standard switch box or cut-in ring.
2. Controllers shall tie to the system in one of the following ways:
  - a. Hardwired low voltage, wiring and connections per manufacturer's requirements.
  - b. Wireless with line-power connection. Use of devices that require batteries are prohibited, a 10-year minimum battery life. Mechanically triggered wireless switches shall not be allowed unless approved by The Owner.

2.06 OCCUPANCY SENSOR

A. General:

1. Occupancy sensors shall automatically detect movement within a space, reporting the state of occupancy to the control modules for "ON/OFF/DIMMING" control of lighting zones and "ON/OFF" control of the controlled receptacle circuits within that space.
  2. All setpoints for the occupancy sensor shall be accessible on the device or through the commissioning tool.
  3. Sensors shall be capable of being linked together via hard wired connections to provide a larger coverage area.
  4. Provide enough occupancy sensors as required for complete area coverage they are installed in, regardless of how many sensors are shown on the Drawings.
- B. Specifics:
1. Sensor shall have a coverage of 1,000 square feet. Manufacturer to provide additional sensors if coverage is less than 1,000 square feet.
  2. Sensors shall be infrared or dual technology or microphonic. Dual technology sensors shall be capable of disabling either infrared or ultrasonic sensing.

## 2.07 DAYLIGHT SENSOR

A. General:

1. Daylight sensors shall automatically measure the amount of ambient light within a space, reporting the state of occupancy to the control modules for "ON/OFF/DIMMING" control of lighting zones.
2. Setpoints for the sensors shall be adjusted directly on the device or through commissioning tool. The setpoints refer to the range at which electric lighting will dim in response to the amount of light the sensor detects.
3. Daylight sensors shall continuously monitor the ambient light level.
4. Interior daylight sensors shall operate on a "closed loop" protocol, measuring both daylight and electric light contributions.
5. Exterior daylight sensors shall operate on an "open loop" protocol, measuring only daylight contributions.

B. Specifics:

1. Sensor shall mount directly to any surface, no junction box required.
2. Integrated sensors on luminaires shall be installed at the lighting manufacturer's factory.
3. Sensors shall tie to the system in one of the following ways:
  - a. Hardwired low voltage, wiring and connections per manufacturer's requirements.
  - b. Wireless with line-power connection. Use of devices that require batteries is prohibited. a 10-year minimum battery life.
4. Exterior sensors shall be outdoor rated.

## 2.08 RELAY PANEL

- A. Addressable relay panel that fully integrates with the addressable control system, consisting of individual relays, control module, power supplies, network connection interface, etc.



- B. Cabinet: NEMA 1 enclosure sized to accept the quantity of relays as noted on the Drawings.
- C. Control relays: Heavy-duty momentary pulsed mechanically latching contactors. Operating voltage is 24volt AC; contacts are rated at 20amp at 120 or 277volt AC. Power supply: 120/277volt AC input transformer with 24volt AC, 60Hz, 1.6amp (40 VA) Class II power supplies output.
- D. Network connection: Per manufacturer.
- E. Panel shall be UL924 rated. Systems which integrate a UL924 sensing module for the entire panel or system shall not require the panel to be UL924 rated.
- F. Panel shall allow for barriers between voltage classes, 120volt, 277volt, normal, and emergency.

## 2.09 EMERGENCY BYPASS RELAYS

- A. General:
  - 1. System manufacturer shall provide emergency bypass relays as shown on the Drawings.
  - 2. The bypass relay device shall take an uncontrolled normal sensing hot, uncontrolled emergency hot, and controlled normal circuit as inputs.
  - 3. The device shall bypass the controlled normal hot and control signal at the loss of power from the normal sensing hot and allow the uncontrolled emergency hot to power the downstream luminaires.
  - 4. The device shall be capable of accepting a 0-10volt control signal and breaking if the downstream fixtures are 0-10volt controlled.
- B. Specifics:
  - 1. Mounting: directly onto a junction box or integral to the luminaire.
  - 2. UL924 rated for switched and dimmed loads.
  - 3. Where more than six bypass relays are located in a central location provide an enclosure to mount all devices.

## 2.10 EMERGENCY TRANSFER DEVICE

- A. General:
  - 1. System manufacturer shall provide emergency transfer devices as shown on the Drawings.
  - 2. The transfer devices shall take an uncontrolled normal sensing hot, uncontrolled emergency hot, and controlled normal circuit as inputs.
  - 3. The device shall transfer be an open transition "make before break" type. The normal controlled circuit shall transfer to emergency circuit at the loss of power from the normal sensing hot and allow the uncontrolled emergency hot to power the downstream luminaires.
  - 4. The device shall be capable of accepting a 0-10volt control signal and breaking if the downstream fixtures are 0-10volt controlled.
- B. Specifics:
  - 1. Mounting: directly onto a junction box.
  - 2. UL1008 rated for switched and dimmed loads.

3. Where more than six transfer devices are located in a central location, provide either an enclosure or panel housing to mount all devices within.

## 2.11 DEVICE COMMUNICATION CABLING

### A. General:

1. The device communication cabling integrates devices such as occupancy sensors, photocell sensors, control modules and control stations with each other to provide a complete standalone system.
2. The network communication cabling provides low-voltage power to all devices on the network, eliminating the need for external power supplies and power packs for devices such as occupancy sensors. Where a device requires 120volt power it shall be noted on the submittal.
3. Cabling shall be topology free.
4. Cabling shall be plenum rated.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Contractor shall thoroughly examine Project site conditions for acceptance of low-voltage lighting control installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

### 3.02 INSTALLATION

- A. Install the addressable lighting control system in accordance with the Manufacturer's written instructions, as indicated on the drawings and as specified herein.
- B. Locate relay panel(s) where indicated on the plans.
- C. All interior luminaires shall be controlled via the control system unless otherwise noted on the plans. Refer to the drawing symbols list for the differentiation between networked luminaire devices and standalone devices.

### 3.03 ATTIC STOCK

- A. Spare Parts: Provide spare parts totaling 5 percent of the quantity specified, or two total, whichever is greater, of the following:
  1. Control Modules (provide for each type used on the project):
  2. Occupancy Sensors:
  3. Daylight Sensors:
  4. Dimmer Switches (provide for each type used on the project):

### 3.04 OCCUPANCY SENSOR

- A. Occupancy sensors shall be placed in a location that provides maximum coverage and minimizes false positives such as being triggered through an open door.
- B. Refer to the architectural RCPs and locate sensors as shown or if not shown, locate in line with other ceiling devices while still maximizing area coverage.

- C. Where the coverage of a sensor is inadequate for the space it is being installed in, the manufacturer shall provide additional sensors for the contractor to install. The cost of these sensors and installation shall be included at the time of bid.

### 3.05 DAYLIGHT SENSORS

- A. Locate daylight sensors per the manufacturer's requirements in order to provide accurate electric and daylight light levels.
- B. Coordinate the final location of the sensor with other devices in the area.

### 3.06 CONTROL MODULES

- A. Install all control modules per the shop drawings and manufacturer's requirements. Ensure devices are in an accessible location. Avoid locations where the devices are visible to the public.

### 3.07 AUXILIARY DEVICES

- A. Where devices, not covered under these Division 26 specifications, are required to provide a complete lighting control system, furnish and install such devices per the manufacturer's instructions.

### 3.08 STARTUP AND FIELD QUALITY CONTROL

- A. General:
  - 1. All work related to the startup of the addressable lighting control system shall be by a factory-authorized agent of the Manufacturer of the system along with the assistance of the electrical contractor.
  - 2. All programming, testing, trouble shooting, etc. shall be included in this contract.
- B. Prefunctional testing:
  - 1. Visual and mechanical inspection:
    - a. Inspect for physical damage, defects alignment and fit.
    - b. Perform mechanical operational tests in accordance with Manufacturer's instructions.
    - c. Compare nameplate information and connections to Contract Documents.
    - d. Check tightness of all control and power connections.
    - e. Check that all covers, barriers, and doors are secure.
  - 2. Contractor shall provide all necessary programming assistance to set up and program the lighting control parameters.
  - 3. Electrical tests:
    - a. The system shall be completely tested in accordance with operational parameters, tolerances, and Manufacturer's instructions. Any problem shall be documented and corrected.
    - b. Test all control circuits and verify proper operation of all lighting circuits throughout the control system.
    - c. Ensure the lighting zone controls match that of the Contract Documents.

- d. Verify the proper integration with the mechanical control system for override control and monitoring of low-voltage lighting control system.
  - e. Provide a complete report listing every device, the date it was tested, the results and the date retested (if failure occurred during the previous test). The test report shall indicate that every device tested successfully.
- C. Contractor shall replace at no costs to the Owner all devices which are found defective or do not operate within factory specified tolerances.
- D. Contractor shall submit the testing final report for review prior to Project closeout and final acceptance by the Owner. Test report shall indicate test dates, devices tested, results, observation, deficiencies, and remedies. Test report shall be included in the operation and maintenance manuals.

### 3.09 COMMISSIONING

#### A. General:

- 1. Once startup of the system is complete and no defects to the system are detected the commissioning process shall begin; furthermore, it is acceptable to program the system per the commissioning requirements during the startup phase.
- 2. All work related to the commissioning of the digital lighting controls shall be by the electrical contractor or by a factory-authorized agent of the Manufacturer of the system.
- 3. At least three weeks prior to any commissioning verification, notify the Engineer so that arrangement can be made for witnessing test, if deemed necessary. All pretesting shall have been tested satisfactorily prior to the Engineer's witnessed test.
- 4. Refer to the Lighting Control Sequence of Operation on the Drawings.

#### B. Occupancy sensors:

- 1. All occupancy sensors shall have a sensitivity appropriate for the space. Contractor shall be responsible for testing the sensitivity of the sensor in the space and adjusting as needed.
- 2. Where no direction is provided in a sequence of operation or by the owner set the occupancy sensor timeout to 15 minutes.

#### C. Daylight sensors:

- 1. Where no direction is provided in a sequence of operation or by the owner, the daylight sensor setpoint to dim the electric light should be at 150% of the maximum electric light output.

#### D. Scene controllers:

- 1. Where no scenes have been described in a sequence of operation or by the owner the contractor shall provide the following scenes as appropriate for the space:
  - a. Scene 1: All luminaires on at 100%
  - b. Scene 2: Luminaires near screen displays off, all other luminaires on at 75%.
  - c. Scene 3: All indirect luminaires off, all direct luminaires on at 100%.
  - d. Scene 4: All direct luminaires off, all indirect luminaires on at 100%.
  - e. Scene 5: All luminaires off.

## E. Time schedules:

1. All time schedules required shall be done through an astronomical time clock integral to the devices and equipment. The building location and date shall be programmed to ensure proper time schedule functions.
2. If no sequence of operations is provided program time schedules as follows:
  - a. Interior spaces: Per owner's direction, do not assume hours of operation.
  - b. Exterior spaces: on 30 minutes before sunset, and off 30 minutes after sunrise.

## F. Third party commissioning:

1. Refer to Specification Section 260800: Electrical Commissioning.
2. The purpose of third-party commissioning shall be to verify the system's functionality and parameters as detailed on the Drawings and specifications. The contractor and factory agent are still responsible for performing the startup and commissioning of the system.

## G. Contractor shall be responsible for all acceptance testing requirements related to the lighting control system as outlined in the California Energy Code Title 24 Part 6.

## 3.10 TRAINING

- A. Refer to Specification Section 260800: Electrical Commissioning.
- B. Factory authorized service representative shall conduct a 1-hour training session for Owner's Representatives upon completion and acceptance of system. Instruction shall include operation, programming, and maintenance of equipment.
- C. Any special commissioning / configuration tools required to program the lighting control system shall be provided to the district representative upon completion of training.
- D. Contractor shall schedule training with a minimum of 7 days advanced notice.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Locate transformers in dedicated electrical rooms wherever possible, refer to guidelines included in 260010 Basic Electrical Requirements. Do not install transformer on roof.

SECTION 26 22 13

DRY TYPE TRANSFORMERS

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work included: Labor, materials, and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
  - 1. Dry type ventilated transformers.
- B. Related Work: Consult all other Sections, determine the extent and character of related Work, and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.
  - 1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
  - 2. Division 03: Cast-in-place concrete. Equipment housekeeping pad.
  - 3. Division 09: Painting. Touch-up painted surfaces.

**1.02 REFERENCES**

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified.
  - 1. American National Standards Institute (ANSI):
    - ANSI C57;                      Pertaining to Power/Distribution Transformer.
  - 2. Underwriter's Laboratories, Inc. (UL):
    - UL 486E;                      Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors.
    - UL 1561;                      Dry-Type General Purpose and Power Transformers.
  - 3. National Electrical Manufacturers Association (NEMA):
    - NEMA ST 20;                      Dry Type Transformers.
    - NEMA TP-1;                      Guide for Determining Energy Efficiency for Distribution Transformers.
    - NEMA Premium;                      Guide for premium efficiency distribution transformers.
  - 4. Department of Energy (DOE):
    - DOE 78 FR 23335;                      Energy Conservation Standards for Distribution Transformers Rulemaking, 78 FR 23335 (April 18, 2013).
    - 10 CFR PART 431;                      Title 10 of the Code of Federal Regulations (CFR), Part 431, Subpart K – Distribution transformers with the DOE 2016 Efficiency Amendment.

**1.03 SUBMITTALS**

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
  - 1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
  - 2. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
  - 3. Shop Drawings: Include type and style, dimensions, insulation class, rated temperature rise, taps provided, voltage, kVA and impedance ratings and characteristics, loss data, efficiency at 25, 50, 75 and 100 percent rated load and sound level.
  - 4. Submit energy efficiency compliance documentation.
  - 5. Submit inrush current design limitation documentation.
  - 6. Furnish structural calculations for equipment anchorage as described in Section 260010: Basic Electrical Requirements.
  - 7. Submit Manufacturer's installation instructions.
  - 8. Final test results.
  - 9. Warranty.

#### 1.04 OPERATION AND MAINTENANCE MANUAL

- A. Supply operation and maintenance manuals in accordance with the requirements of Section 260010: Basic Electrical Requirements, to include the following:
  - 1. Detailed explanation of operation of the system.
  - 2. Instructions for routine maintenance.
  - 3. Telephone numbers for the authorized parts and service distributors.
  - 4. Include all service bulletins and torque Specifications for all terminations.
  - 5. Final testing reports.

#### 1.05 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused, and currently under production.
- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.
- C. Independent Testing Agency qualifications: Refer to Section 260010: Basic Electrical Requirements.

#### 1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery: Transformers shall not be delivered to the Project site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable. Equipment damaged during shipment shall be replaced and returned to Manufacturer at no cost to Owner. Components shall be properly packaged in factory-fabricated containers and mounted on shipping skids.



- B. Storage: Store in a clean, dry, ventilated space free from temperature extremes. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris and traffic. Provide heat where required to prevent condensation.
- C. Handling: Handle in accordance with Manufacturer's written instructions. Be careful to prevent internal component damage, breakage, denting and scoring. Damaged units shall not be installed. Replace damaged units and return equipment to Manufacturer.

1.07 WARRANTY

- A. Units and components offered under this Section shall be covered by a 1-year parts and labor warranty for malfunctions resulting from defects in materials and workmanship. Warranty shall begin upon acceptance by the Owner.

1.08 EXTRA MATERIAL

- A. Provide one spray can of matching finish paint for touching up damaged surfaces after installation.

**PART 2 - PRODUCTS**

2.01 MANUFACTURERS

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.
  - 1. Square D.
  - 2. ABB/ General Electric.
  - 3. Eaton.
  - 4. Siemens.

- B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

2.02 DRY TYPE TRANSFORMER - GENERAL

- A. Rating: Provide kVA rating, primary and secondary voltage, frequency, and phase as indicated on the Drawings. The designated rating is for continuous duty without the use of cooling fans unless specifically noted otherwise on the Drawings.
- B. Windings: Single and three phase dry type transformers shall be of the two-winding type.
- C. Taps: All dry type transformers rated 15 kVA and larger shall have two 2.5-percent full capacity taps above normal (FCAN) and four 2.5-percent full capacity taps below normal (FCBN) rated primary voltage.
- D. Noise attenuation:
  - 1. Isolate core and coil unit from the enclosure by means of vibration absorbing mounts that preclude metal-to-metal contact between the core-coil and the enclosure.
  - 2. Provide sound levels that do not exceed the following maximum levels in accordance with NEMA and ANSI standards:
    - a. Up to 9 kVA; 40 db
    - b. 10 to 50 kVA; 45 db
    - c. 51 to 150 kVA; 50 db

d. 151 to 300 kVA; 55 db

e. 301 to 500 kVA; 60 db

E. Impedance:

1. Transformer impedance shall conform to NEMA standards. Do not use low impedance type transformers unless the circuits and equipment affected by the larger short circuit currents through such transformers are increased in short circuit current ratings, as required, at no additional cost to the Owner.

2. The following impedance are used as our basis of design:

a. Single phase transformers:

1) Up to 15 kVA: 6.1Z

2) 16 to 25 kVA: 5.0Z

3) 26 to 37.5 kVA: 4.0Z

4) 38 to 50 kVA: 3.8Z

5) 76 to 100 kVA: 4.9Z

6) 101 to 167 kVA: 5.4Z

7) 168 to 333 kVA: 5.5Z

b. Three phase transformers:

1) 15 kVA: 6.4Z

2) 25 kVA: 5.8Z

3) 30 kVA: 5.2Z

4) 37.5 kVA: 5.5Z

5) 45 kVA: 5.0Z

6) 75 kVA: 4.7Z

7) 112.5 kVA: 5.1Z

8) 150 kVA: 5.3Z

9) 225 kVA: 5.7Z

10) 500 kVA: 5.7Z

F. Basic impulse level (BIL): 10 kV for transformers 600V and less.

G. Transformers shall have an efficiency compliant with the U.S. Department of Energy (DOE) final rule for the Distribution Transformers Energy Conservation Standard Rulemaking, 78 FR 23335 (April 18, 2013). Transformers built prior to January 1, 2016 will not be considered acceptable unless efficiency compliance documentation is submitted verifying transformer efficiency meets or exceeds the January 1, 2016 energy efficiency levels listed in DOE 78 FR 23335 (April 18, 2013).

H. Transformers shall be designed to limit inrush current to 12-times (12x) the base rated full load current or less.

- I. Grounding: Ground core and coil assembly to enclosure by means of a visible flexible copper strap.
- J. Enclosures:
  - 1. Material: Code gauge steel.
  - 2. Manufacturers nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.
  - 3. Type: Provide NEMA type as indicated on Drawings or specified herein, drip-proof, self-bracing enclosure designed to prevent accidental contact with electrically energized parts unless otherwise noted.
  - 4. Mounting: Transformers 75 kVA and less shall be suitable for wall, floor, frame, or trapeze mounting. Transformers larger than 75 kVA shall be suitable for floor mounting.
  - 5. Finish: Clean, degrease, zinc-phosphate, prime and finish paint steel parts with a baked-on synthetic enamel, ANSI 61 (light gray).
  - 6. Accessories: Provide accessories as indicated on the Drawings.
  - 7. Size: Dimensions and configurations shall conform to the spaces allocated on the Drawings.

## 2.03 DRY TYPE VENTILATED TRANSFORMERS

### A. General:

- 1. Indoor or outdoor, convection air-cooled, dry type transformers with NEMA Type 1 enclosure unless otherwise noted. Provide NEMA Type 3R Enclosure for all exterior mounted transformers or where indicated on Drawings.
- 2. Transformers shall have been tested to UL standards and constructed to NEMA standards.

### B. Insulation:

- 1. The average winding temperature rise for rated kVA as follows unless otherwise indicated:

| KVA RATING | RISE IN DEGREES |
|------------|-----------------|
| 16 - 500   | 150c            |

- 2. Case temperature shall not exceed 40-degrees centigrade rise above ambient at its warmest point.
- 3. Provide insulating materials that are in accordance with the latest addition of NEMA ST20 Standards for a 220-degree centigrade, UL component recognized insulation system for extended life.

### C. Core construction: High grade, non-aging, silicon steel, clamped with structural angles and bolted to the transformer enclosure on vibration isolating pads.

### D. Coil construction:

- 1. Continuous wound with copper wire, without splices except for taps.
- 2. Pressure type, primary, secondary and tap connections.
- 3. End fillers or tie downs for maximum strength.
- 4. Vacuum impregnated with non-hygroscopic, thermosetting varnish.

5. All connections shall be accessible from the front of the transformer to allow rear of transformer to be positioned within six inches of the adjacent wall.
6. Isolate core and coil from enclosure using vibration-absorbing mounts.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Contractor shall thoroughly examine Project site conditions for acceptance of transformer installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

#### **3.02 PREPARATION**

- A. Ensure all conduit stub-ups for bottom entry into transformer are in place and located as required per Shop Drawings.
- B. Where noted on the Drawings provide a 4-inch high concrete housekeeping pad beneath equipment. Coordinate actual sizes of equipment base with approved Shop Drawings and extend pad 4-inches in all directions beyond overall dimension of base. Provide reinforcing bars as required structurally within pad to ensure proper support of equipment.

#### **3.03 INSTALLATION**

- A. Install transformer in accordance with Manufacturer's written instructions, as indicated on the Drawings and as specified herein.
- B. Transformers shall be installed to provide adequate air circulation for the removal of the heat they produce, in accordance with Manufacturer recommendations.
- C. Transformers not specifically designed for wall mounting, shall be spaced a minimum of 6" from adjacent walls, ceiling, and equipment.
- D. Transformers shall be anchored and braced to withstand seismic forces as calculated per Section 260010: Basic Electrical Requirements.
- E. Loosen and/or remove all shipping bolts in accordance with Manufacturer's instructions.
- F. Install the transformers on the noise and vibration isolation pads designed to suppress the transformer noise from the building structure. Select and arrange the pads in accordance with the weight and mounting of the transformers. These pads are in addition to any internal vibration pads. Provide a neoprene sleeve over the portion of the bolt that passes through the transformer base or mounting bracket. Provide a rubber washer between the bolt head and the mounting channel. Use Kinetics Model KIP or equal.

#### **3.04 TERMINATIONS**

- A. Provide all transformers with lugs for both primary and secondary conductor sizes for conductors indicated on Drawing. Connect lug to termination point with appropriate size bolt, nut flat and Belleville washers.
- B. Provide high-pressure compression lugs, for primary and secondary phase and neutral terminations for transformers 45 kVA and larger. Utilize only the tool and dies designed for uses in installing the lugs provided.

- C. Use flexible conduit indoors in dry locations or liquid-tight flexible conduit in damp/wet locations, two-foot minimum in length, for primary and secondary connections to transformer case. Make connections to side panels of enclosure, except for floor mounted transformers fed from directly below enclosure.

### 3.05 GROUNDING

- A. Provide copper terminal bar for grounding and bonding the transformer in accordance with CEC Article 450.10. Bond the terminal bar to the enclosure and connect the following to the terminal bar:
  - 1. Primary feeder equipment grounding conductor.
  - 2. Secondary feeder supply side bonding conductor(s).
  - 3. Grounding electrode conductor.
  - 4. Main bond jumper to neutral (when present).

### 3.06 IDENTIFICATION

- A. Provide transformer nameplate as described in Section 260553: Electrical Identification.

### 3.07 FIELD QUALITY CONTROL

- A. Independent testing: Contractor shall arrange and pay for the services of an independent Testing Agency to perform all quality control electrical testing, calibration and inspection required herein. Independent Testing Agency shall meet the requirements as outlined in Section 260010: Basic Electrical Requirements. Testing Agencies objectives shall be to:
  - 1. Assure transformer installation conforms to specified requirements and operates within specified tolerances.
  - 2. Field test and inspect to ensure operation in accordance with Manufacturer's recommendations and Specifications.
  - 3. Prepare final test report including results, observations, failures, adjustments, and remedies.
  - 4. Apply label on transformer upon satisfactory completion of tests and results.
  - 5. Verify ratings and settings and make final adjustments.
- B. At least three weeks prior to any testing, notify the Engineer so that arrangement can be made for witnessing test, if deemed necessary. All pretesting shall have been tested satisfactorily prior to the Engineer's witnessed test.
- C. The Contractor shall supply a suitable and stable source of electrical power to each test site. The Testing Agency shall specify the specific power requirements.
- D. Prefunctional testing:
  - 1. Provide Testing Agency with Contract Documents and Manufacturer instructions for installation and testing.
  - 2. Visual and mechanical inspection:
    - a. Compare nameplate information and connections to Contract Documents.
    - b. Inspect for physical damage, defects alignment and fit.

- c. Check tightness of all control and power connections.
- d. Check that all covers, barriers, and doors are secure.
- e. Perform specific inspections and mechanical tests as recommended by Manufacturer.
- f. Verify seismic bracing is correct.
- g. Verify winding core, frame and enclosure grounding are correct.
- h. Verify tap connections are as specified.

3. Electrical tests:

- a. Perform insulation-resistance tests winding-to-winding and winding-to-ground with test voltage in accordance with Manufacturer's recommendation.
- b. Perform turn-ratio test on tap connections. Verify winding polarities are in accordance with nameplate.
- c. Verify correct secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.

4. Test values:

- a. Bolt-torque levels shall be in accordance with the Manufacturer's written instructions.
- b. Insulation-resistance test values at one minute should not be less than 500-megohms at 1000volt DC.
- c. Turn-ratio test results should not deviate more than 0.5% from either adjacent coils or calculated ratio.

- E. Contractor shall replace at no costs to the Owner all devices which are found defective or do not operate within factory specified tolerances.
- F. Contractor shall submit the Testing Agency's final report for review prior to Project closeout and final acceptance by the Owner. Test report shall indicate test dates, devices tested, results, observation, deficiencies, and remedies. Test report shall be included in the operation and maintenance manuals.

3.08 ADJUSTING

- A. Adjust primary taps so that secondary voltage is above and within 2-percent of rated voltage.

3.09 CLEANING

- A. Prior to energizing of transformer, the Contractor shall thoroughly clean the interior of enclosure of all construction debris, scrap wire, etc. using Manufacturer's approved methods and materials.
- B. Upon completion of Project prior to final acceptance the Contractor shall thoroughly clean both the interior and exterior of transformer per Manufacturers approved methods and materials. Remove paint splatters and other spots, dirt, and debris.
- C. Touch-up paint any marks, blemishes or other finish damage suffered during installation.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- At campus with existing main switchboard, the designer shall review the existing historical demand of the service per 220.87 to determine if a service upgrade is required. If the existing main switchboard is in excess of 35 years old, and the project scope requires a new connection to the switchboard, the gear should be replaced regardless of capacity to support the new project. If existing switchboard is between 25-35 years old, the designer shall assess the existing condition and project budget to determine if replacement is required.
- For a new campus, the electrical designer should consider locating the main switchboard in the main electrical room. Where space does not permit, an outdoor N3R switchboard should be installed in a

secured equipment enclosure; typically in the same equipment enclosure as the utility company transformer.

- In addition to providing a housekeeping pad, a concrete working surface must be provided in front of the switchboard, minimum 48" deep and as wide as the gear. Coordinate with the architect on a project-by-project basis to ensure that the working space in front of the switchboard is hardscaped.



## SECTION 26 24 13

## SWITCHBOARDS

**PART 1 - GENERAL****1.01 SUMMARY**

- A. Work included: Labor, materials, and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
  - 1. Main service switchboard.
  - 2. Distribution switchboards (800 amps and greater).
  - 3. Outdoor enclosure and accessories.
- B. Related Work: Consult all other Sections, determine the extent and character of related Work, and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.
  - 1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
  - 2. Division 03: Cast-in-place concrete. Equipment housekeeping pad.
  - 3. Division 09: Painting. Touch-up of painted surfaces.

**1.02 REFERENCES**

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:
  - 1. American National Standards Institute, Inc. (ANSI):
    - ANSI C12; Code for Electricity Metering.
  - 2. Underwriters Laboratories, Inc. (UL):
    - UL 486E; Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors.
    - UL 489; Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.
    - UL 869A; Service Equipment.
    - UL 891; Dead-Front Switchboards.
    - UL 943; Ground-Fault Circuit Interrupters.
    - UL 1053; Ground-Fault Sensing and Relaying Equipment.
  - 3. National Electrical Manufacturer Association (NEMA):
    - NEMA AB1; Molded Case Circuit Breakers.
    - NEMA PB 2; Deadfront Distribution Switchboards.

|              |                                                                                                                                                  |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| NEMA PB 2.1; | General Instruction for Proper Handling, Installation, Operation and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or less. |
| NEMA PB 2.2; | Application Guide Ground Fault Protective Devices for Equipment.                                                                                 |
| NEMA SG5;    | Power Switchgear Assemblies.                                                                                                                     |

### 1.03 SUBMITTALS

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
  - 1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
  - 2. Shop Drawings to include:
    - a. Front, plan, and side view elevations with overall dimensions.
    - b. Conduit entrance locations and requirements.
    - c. Nameplate legends; size and number of bus bars per phase, neutral and ground.
    - d. Switchboard instrument details and accessories.
    - e. Electrical characteristics including voltage, frame size and trip rating and withstand ratings.
  - 3. Outdoor weatherproof equipment enclosure and accessories.
  - 4. Submit Manufacturer's installation instructions.
  - 5. Complete Bill of Material listing all components.
  - 6. Final test results.
  - 7. Warranty.
- B. Dimensions and configurations of switchboards shall conform to the space allocated on the Drawings. The Contractor shall submit a revised layout if equipment furnished varies in size from that indicated on Drawings for the Engineer's approval.
- C. Service entrance switchboard utility metering sections shall be submitted to the local electrical utility company for approval prior to submission to the Engineer. A letter of acceptance from utility company shall be included in submittal package.

### 1.04 OPERATION AND MAINTENANCE MANUAL

- A. Supply operation and maintenance manuals in accordance with the requirements of Section 260010: Basic Electrical Requirements, to include the following:
  - 1. A detailed explanation of the operation of the system.
  - 2. Instructions for routine maintenance.
  - 3. Pictorial parts list and part numbers.

4. Pictorial and schematic Electrical Drawings of wiring systems, including operating and safety devices, control panels, instrumentation, and annunciators.
5. Telephone numbers for the authorized parts and service distributors.
6. Include all service bulletins and torque Specifications for all terminations.
7. Final testing report.

#### 1.05 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused, and currently under production.
- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.
- C. Independent Testing Agency qualifications: Refer to Section 260010: Basic Electrical Requirements.

#### 1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery: Switchboard components shall not be delivered to the Project site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable. Equipment damaged during shipment shall be replaced and returned to Manufacturer at no cost to Owner. Components shall be properly packaged in factory-fabricated containers and mounted on shipping skids.
- B. Storage: Store in a clean, dry, ventilated space free from temperature extremes. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris and traffic. Provide heat where required to prevent condensation.
- C. Handling: Handle in accordance with NEMA PB2.1 and Manufacturer's written instructions. Be careful to prevent internal component damage, breakage, denting and scoring. Damaged units shall not be installed. Replace damaged units and return equipment to Manufacturer.

#### 1.07 WARRANTY

- A. Units and components offered under this Section shall be covered by a 1-year parts and labor warranty for malfunctions resulting from defects in materials and workmanship. Warranty shall begin upon acceptance by the Owner.

#### 1.08 EXTRA MATERIAL

- A. Provide one spray can of matching finish paint for touching up damaged surfaces after installation.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.
  1. Square D.
  2. ABB/ General Electric.
  3. Eaton.

4. Siemens.

B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

2.02 SWITCHBOARDS - GENERAL

A. Enclosure:

1. Each switchboard shall consist of a dead front, completely metal enclosed self-supporting structure. Construction shall consist of vertical sections of the universal frame type bolted together and braced with self-tapping bolts. Sides, top and rear shall be covered with captive-bolt fastened steel plates having formed edges all around. Front plates shall be sectionalized and removable. All plates shall be fabricated from 12-gage steel and shall have die-formed edges all around. The switchboard frame shall be suitable for use as floor sills in indoor installations. Corners shall be reinforced with rigged gussets internal and external to the structural members.
2. Switchboards shall have depth as required to house all equipment contained within it. Switchboard shall be constructed so that the back and front of all sections align. Construction of the board shall allow maintenance of incoming line terminations, device connections and all bus bolted connections.
3. All devices shall be accessible and removable from the front unless rear access is indicated on the Drawings.
4. Provide necessary hardware to permit locking every overcurrent protective device handle in the "OFF" position.
5. Provide hinged access doors to all termination, meter, and relay compartments with knurled and slotted large head captive-bolts. The design shall allow access to compartments without tools and without removing any panels.
6. Furnish cable pull sections or top cable pull boxes where indicated on the Drawings complete with cable tie down supports. Where cable pull section or pull boxes contain utility service cables, provide utility acceptable sealing means.
7. Switchboard shall be suitable for use as service entrance equipment and be labeled in accordance with UL requirements.
8. Utility metering compartment section shall be fabricated to meet all utility company requirements. Where separate vertical section is required for utility metering, match and align with switchboard enclosure.

B. Bus assembly and terminations:

1. The switchboard bussing shall be highly conductive silver-plated copper with sufficient cross-sectional area to meet UL Standard 891 temperature rise requirements.
2. Bus arrangement shall be Phase A-B-C-N left-to-right, top-to-bottom and front-to-rear as viewed from the front. Horizontal and vertical bus ampere rating shall be uniform from end-to-end.
3. All bussing to and from an overcurrent protective device shall be rated to the frame sizing, not the trip rating.

4. Where "SPACE" is indicated in the switchboards, cross connectors and mounting hardware shall be installed to match the frame size ampere rating noted on the Electrical Drawings. All "SPACES" shall be ready for installation of overcurrent protective devices at a future time.
  5. Shipping splits and provisions for future bus extension shall be provided with necessary bus splices.
  6. Each switchboard shall contain a full length, bottom/front located copper ground bus that is securely connected to each vertical section. Ground bus shall be sized in accordance with UL 891, Table 25.1.
  7. Termination lugs: High compression circumference crimped type rated for use with aluminum/copper conductors.
  8. Switchboards shall be fully rated for a minimum of 65,000 AIC or as indicated on the Drawings.
  9. Neutral bus shall be 100-percent rated unless otherwise indicated on the Drawings.
  10. Main service switchboards:
    - a. Removable neutral link: Provide removable bolted bus section for the purpose of disconnecting the ground circuit conductor from the premises wiring at the supply side of the service in accordance with CEC article 230-75.
    - b. Main bonding jumper: Connection between the grounded circuit conductor and the equipment ground conductor at the supply side of the service. Size in accordance with CEC table 250-94 or 12-1/2% of the area of the largest phase conductor in accordance with CEC article 250-79(c).
- C. Switching and overcurrent protective devices:
1. Refer to Section 262816: Overcurrent Protective Devices.
  2. Main overcurrent protective device(s) shall be fixed mounted molded case circuit breaker with interrupting rating and frame and trip ratings as indicated on Drawings.
  3. Feeder overcurrent protective device(s) shall be fixed mounted molded case circuit breaker with frame and trip rating as indicated on Drawings.
  4. Devices interrupting rating shall match that of switchboard for which the device is installed.
  5. Series ratings of overcurrent protective devices is not acceptable unless specifically noted on the Drawings.
  6. Devices shall be manually operated unless shunt trip and/or electrically operated devices are indicated on Drawings.
- D. Ground fault protection:
1. General: A solid-state, zone-interlocked, ground fault protection system shall be provided integral on the main device(s) as indicated on Drawings. It shall consist of integral phase current sensors, appropriate solid-state relaying equipment to provide

the desired ground fault current sensitivity and time-current response characteristics. Provide neutral ground fault current transformer for four wire systems.

2. Device settings: Adjustable pickup current sensitivity for ground fault currents from 200 amperes to 1200 amperes shall be provided. A calibrated dial shall be provided for setting the current pickup point in the field. Time delay shall be adjustable from 0 to 60 cycles. Settings for individual relays shall be as directed by the short circuit/coordination study specified in Section 260060: Power System Study. A locking screw shall be provided to retain both adjustments at desired setting.
  3. All overcurrent devices shall be independently time coordinated irrespective of zone interlocking to allow the last downstream level of ground fault devices to be time coordinated, i.e. it shall NOT revert to the lowest time setting.
- E. Surge Protective Devices:
1. Refer to Section 264313: Surge Protective Devices.
- F. Instrumentation and controls:
1. Switchboards shall have a digital meter unit (DMU) as indicated on the Drawings. DMU shall be by the same manufacturer as the switchboard.
  2. Meter potential circuits shall be fused. Potential transformers if required for the monitoring devices shall be provided with fuses in the primary.
  3. Meter current circuits shall have shorting terminal blocks between the meter and the current transformers. Current transformers shall be ring type (one per phase) with ratio, thermal, and mechanical ratings coordinated with the application and protection.
  4. Instrument transformer accuracy per IEEE C57.13.6:
    - a. Current transformers must maintain 0.3% accuracy from 5% rated current through rating factor at rated burden.
    - b. Voltage transformers must maintain 0.15% accuracy from 90% to 110% of rated voltage.
  5. All internal devices (relays, transformers, etc.) shall be tagged as to rating and function with permanently fastened engraved nameplates.
  6. Control and signal circuits: Control devices, i.e.: contactors, relays, time clocks, etc. shall be mounted in a separate compartment that is fully barrier from the overcurrent protective device compartments. Control devices shall be accessible through a separate hinged cover panel.
  7. Relays: All relays shall be industrial control grade with a "ON" indicating neon light, hold down springs, minimum of 10amp rated contacts and a minimum of four form C contacts. Relays used for control power transfer shall have 20amp rated contacts. Do NOT use paralleled relays for relays with greater than 4-poles, use relays with the required number of poles. This is to prevent the situation where one relay fails, and half of the intended function is lost, which could be dangerous.
- G. Refer to Electrical Drawings for the following:

1. Mounting style; voltage; terminal lug size, location, and quantity; bus ampacity; interrupting capacity of bus and overcurrent protective devices, quantity, poles, and rating of overcurrent protective devices. Note that the AIC value noted on the Drawings for distribution equipment is the minimum rating of all components; values are in RMS symmetrical amps.
  2. If indicated on the Electrical Drawings, provide contactors, relays, time clocks, etc. mounted within switchboard.
- H. Miscellaneous requirements:
1. Circuit numbering: Starting at the top, odd numbered circuits in sequence down the left-hand side and even numbered circuits down the right-hand side.
  2. Nameplates: Engraved nameplates shall be provided for each device and all "SPACES" located in the switchboard. An engraved nameplate shall also be provided indicating the switchboard designation. See Section 260553: Electrical Identification for requirements.
  3. All control wires shall be labeled with wire markers and referenced to the control wiring diagrams. Provide colored wires with colored stripes to facilitate troubleshooting and locating both ends of wires. Do not use wires with all the same wire color. Use fork, crimp type terminations on all control wires.
  4. Provide a test block and plugs for voltage and current monitoring at each main switch. Provide engraved legend plates to indicate function of each test point.
  5. Vertically mounted mains shall have the operating handle in the up position when energized.
- I. Weatherproof outdoor enclosure and accessories:
1. Provide a NEMA 3R non-walk-in type weatherproof housing with hinged lockable access doors. Each section shall have a minimum of 13-inch deep vestibule. Provide a latch for each door to ensure adequate closing pressure to seal against harmful weather.
  2. The weatherproof housings shall be provided with lifting eyes.
- J. Finish:
1. Five step zinc phosphate pre-treatment, one coat of rust inhibiting dichromate primer and one coat of baked-on enamel finish, ANSI 61 (light gray).
  2. A seven-step spray wash electroplate primer with final baked-on enamel finish; ANSI 61 (light gray) is an acceptable finish alternative.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Contractor shall thoroughly examine Project site conditions for acceptance of switchboard installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

#### **3.02 PREPARATION**

- A. Ensure all conduit stub-ups for bottom entry into switchboard are in place and located as required per Shop Drawings.
- B. Whether noted on the Drawings or not, provide a 4-inch high concrete housekeeping pad beneath equipment. Coordinate actual sizes of equipment based on approved Shop Drawings and extend pad 4-inches in all directions beyond overall dimension of base. Provide reinforcing bars as required structurally within pad to ensure proper support of equipment. **In addition to housekeeping pad, add concrete working space min 48" depth.**

### 3.03 INSTALLATION

- A. Install switchboards in accordance with Manufacturer's written instructions, as indicated on the Drawings and as specified herein.
- B. Handling, storage, installation and energize of switchboards shall be carried out in accordance with latest edition of NEMA Publications PB 2.1.
- C. Freestanding switchboards shall be accurately aligned, leveled, and bolted in place on full-length channels securely fastened to concrete floor.
- D. Switchboards shall be anchored and braced to withstand seismic forces as calculated per Section 260010: Basic Electrical Requirements.
- E. Provide mounting hardware brackets, bus bar drilling and filler pieces for all unused spaces.
- F. "Train" interior wiring; bundle and clamp, using specified plastic wire wraps specified under Section 260519: Building Wire and Cable.
- G. Replace any panel pieces, doors or trims having dents, bends, warps, or poor fit that may impede ready access, security, or integrity.
- H. Conduits terminating in concentric, eccentric, or oversized knockouts at switchboards shall have ground bushings and bonding jumpers installed interconnecting all such conduits and the switchboards.
- I. Check and tighten all bolts and connections with a torque wrench using Manufacturer's recommended values.
- J. Visually inspect switchboards for rust and corrosion if signs of rust and corrosion are present, board shall be restored to new condition or replaced.
- K. In damp and wet locations mount switchboard with a minimum 1 inch of air space between enclosure and the wall or other supporting material.

### 3.04 FIELD QUALITY CONTROL

- A. Manufacturer's field service: Contractor shall arrange and pay for the services of a factory-authorized service representative to supervise the initial start-up, testing, and adjustment of the switchboard.
- B. Independent testing: Contractor shall arrange and pay for the services of an independent Testing Agency to perform all quality control electrical testing, calibration and inspection required herein. Independent Testing Agency shall meet the requirements as outlined in Section 260010: Basic Electrical Requirements. Testing Agencies objectives shall be to:
  - 1. Assure switchboard installation conforms to specified requirements and operates within specified tolerances.



2. Field test and inspect to ensure operation in accordance with Manufacturer's recommendations and Specifications.
  3. Prepare final test report including results, observations, failures, adjustments, and remedies.
  4. Apply label on switchboard upon satisfactory completion of tests and results.
  5. Verify ratings and settings and make final adjustments.
- C. At least three weeks prior to any testing, notify the Engineer so that arrangement can be made for witnessing test, if deemed necessary. All pretesting shall have been tested satisfactorily prior to the Engineer's witnessed test.
- D. The Contractor shall supply a suitable and stable source of electrical power to each test site. The Testing Agency shall specify the specific power requirements.
- E. Testing of overcurrent protective devices shall be done only after all devices are installed and prior to system being energized.
- F. Prefunctional testing:
1. Provide Testing Agency with Contract Documents and Manufacturer instructions for installation and testing.
  2. Visual and mechanical inspection:
    - a. Compare nameplate information and connections to Contract Documents.
    - b. Inspect for physical damage, defects alignment and fit.
    - c. Verify appropriate anchorage, required clearances and correct alignment.
    - d. Inspect doors, panels and sections for paint, dents, scratches, fit and missing hardware
    - e. Check tightness of all control and power connections.
    - f. Check that all covers, barriers, and doors are secure.
    - g. Verify correct barrier installation.
    - h. Verify that relays and overcurrent protective devices meet Drawing, power system study and specified requirements.
    - i. Perform mechanical operational tests in accordance with Manufacturer's instructions.
    - j. Exercise active components.
    - k. Inspect control power and instrument transformers.
    - l. Inspect insulators for evidence of physical damage or contaminated surfaces.
  - m. Ground-fault protection:
    - 1) Verify ground connection is made ahead of neutral disconnect link and on line side of any ground fault sensor.

- 2) Verify neutral sensors are connected with correct polarity on both primary and secondary.
  - 3) Verify all phase conductors and neutral pass through sensor in same direction for zero sequence systems.
  - 4) Verify grounding conductors do not pass through zero sequence sensors.
  - 5) Verify grounded conductor is solidly grounded.
  - 6) Verify correct operation of self-test panel.
  - 7) Set pickup and time-delay settings in accordance with Specifications. Record operation and test sequences as required by code.
3. Electrical tests:
- a. Perform resistance tests through bus joints with low-resistance ohmmeter. Joints that cannot be directly measured due to permanently installed insulation wrap shall be indirectly measured from closest accessible connection.
  - b. Perform insulation-resistance tests on each bus section, phase-to-phase, and phase-to-ground, at 1000volt DC for 60-seconds. Investigate resistance values less than 50-megohms.
  - c. Perform over-potential test on each bus section, each phase-to-ground with phases not under test grounded, in accordance with Manufacturer's published data. Test voltage shall be applied for 60-seconds.
  - d. Perform insulation-resistance tests at 1000volt DC for 60-seconds on control wiring. Do not perform this test on wiring connected to solid-state components.
  - e. Perform current injection tests on the entire current circuit in each section of switchgear.
    - 1) Perform current tests by primary injection, where possible, with magnitudes such that minimum of 1amp flows in secondary circuit.
    - 2) Where primary injection is impractical, utilize secondary injection with minimum current of 1amp.
    - 3) Test current at each device.
  - f. Perform tests on all instrument transformers in accordance with Manufacturer's written instructions.
  - g. Determine accuracy of meters and instruments per Manufacturer's instructions.
  - h. Perform the following tests on control power transformers:
    - 1) Perform insulation-resistance test. Perform measurements from winding-to-winding and each winding-to-ground. Test voltages shall be determined in accordance with Manufacturer's instructions.
    - 2) Perform secondary wiring integrity test. Disconnect transformer at secondary terminals and connect secondary wiring to correct secondary voltage. Confirm potential at all devices.

- 3) Verify correct secondary voltage by energizing primary winding with system voltage. Measure secondary voltage with secondary wiring disconnected.
  - i. Potential transformer circuits:
    - 1) Perform insulation-resistance tests. Perform measurements from winding-to-winding and each winding-to-ground. Test voltages shall be determined in accordance with Manufacturer's instructions.
    - 2) Perform secondary wiring integrity test. Disconnect transformer at secondary terminals and connect secondary wiring to correct secondary voltage.
    - 3) Verify secondary voltage by energizing primary winding with system voltage. Measure secondary voltage with secondary wiring disconnected.
  - j. Ground resistance:
    - 1) Measure system neutral-to-ground insulation-resistance with neutral disconnect link temporarily removed. Replace neutral disconnect link after test.
    - 2) Measure insulation-resistance of control wiring at 1000volt DC for 60-seconds. Refer to Manufacturer's instruction for devices with solid-state components
  - k. Ground fault protection system:
    - 1) Perform the following pickup tests using primary injection:
      - a) Verify relay does not operate at 90% of pickup setting.
      - b) Verify pickup is less than 125% of setting or 1200amps, whichever is smaller.
    - 2) Measure time delay of the relay at 150% or greater of pickup.
  - l. Test overcurrent protection devices per Section 262816: Overcurrent Protective Devices.
4. Test values:
- a. Bolt torque levels shall be in accordance with Manufacturer's requirements.
  - b. Compare bus connection resistances to values of similar connections.
  - c. Insulation-resistance values for bus, control wiring and control power transformers shall be in accordance with Manufacturer's published data. Values of insulation resistance less than Manufacturer's minimum levels should be investigated. Over-potential tests should not proceed until insulation-resistance levels are raised above minimum values.
  - d. Insulation shall withstand the over-potential test voltage applied.
  - e. Determine contact resistance in microhms. Resistance values shall not exceed high limit of normal range as indicated in Manufacturer's published data.
  - f. System neutral-to-ground insulation shall be a minimum of one megohm.
  - g. Ground fault protection systems relay timing shall be in accordance with Manufacturer's Specifications but must also be no longer than one second at 3000amps.

- G. In the event that the system fails to function properly during the testing as a result of inadequate pretesting or preparation, the Contractor shall bear all costs incurred by the necessity for retesting including test equipment, transportation, subsistence and the Engineer's hourly rate.
- H. Contractor shall replace at no costs to the Owner all devices which are found defective or do not operate within factory specified tolerances.
- I. Contractor shall submit the Testing Agency's final report for review prior to Project closeout and final acceptance by the Owner. Test report shall indicate test dates, devices tested, results, observation, deficiencies, and remedies. Test report shall be included in the operation and maintenance manuals.

### 3.05 CLEANING

- A. Prior to energizing of switchboard, the Contractor shall thoroughly clean the interior of enclosure of all construction debris, scrap wire, etc. using Manufacturer's approved methods and materials.
- B. Upon completion of Project prior to final acceptance the Contractor shall thoroughly clean both the interior and exterior of switchboard per Manufacturers approved methods and materials. Remove paint splatters and other spots, dirt, and debris.
- C. Touch-up paint any marks, blemishes or other finish damage suffered during installation.

### 3.06 TRAINING

- A. Factory authorized service representative shall conduct a 4-hour training seminar for Owner's Representatives upon completion and acceptance of system. Instructions shall include safe operation, maintenance, and testing of equipment with both classroom training and hands-on instruction.
- B. Contractor shall schedule training with a minimum of 7-days advance notice.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 2025-02-07 – Designer direction only; distribution panelboards and branch circuit panelboard are to be provided with 25% spare capacity and 25% spare breakers or breaker space.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Locate panelboards in dedicated electrical rooms wherever possible, refer to guidelines included in 26 00 10 Basic Electrical Requirements. Remote panels may be installed flush-mounted in kitchen area (where interface with fire suppression system is required), science labs (flush-mounted, where coordinated with the Architect or lab consultant), or in MDF room (where dedicated to equipment located in the MDF room), or where otherwise approved by the architect and a district representative.

- Provide new panelboards with minimum of 25% spare capacity, both calculated demand load (in amps) and combined spare breakers and/or breaker space. Branch circuit panelboards should include spare 20A/1-pole breakers in lieu of spaces.

## SECTION 26 24 16

## PANELBOARDS

**PART 1 - GENERAL****1.01 SUMMARY**

- A. Work included: Labor, materials, and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
  - 1. Branch circuit panelboards.
  - 2. Distribution panelboards (400amps to 800amps).
- B. Related Work: Consult all other Sections, determine the extent and character of related Work, and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.

**1.02 REFERENCES**

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified.
  - 1. National Electrical Manufacturers Association (NEMA):
    - NEMA AB 1;                      Molded Case Circuit Breakers.
    - NEMA PB 1;                      Panelboards.
    - NEMA PB 1.1;                      General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
  - 2. Underwriters Laboratories, Inc. (UL):
    - UL 67;                              Panelboards.
    - UL 486E;                              Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors.
    - UL 489;                              Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.
    - UL 870;                              Wireways, Auxiliary Gutters and Associated Fittings.

**1.03 SUBMITTALS**

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
  - 1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards
  - 2. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.

3. Shop Drawings: Include elevations, cabinet dimensions, gutter sizes, layout of contactors, relays, time clocks, lug sizes, bussing diagrams; make, location and capacity of installed equipment; mounting style; finish and panelboard nameplate inscription.
  4. Furnish structural calculations for equipment anchorage as described in Section 26 00 10: Basic Electrical Requirements.
  5. Submit Manufacturer's installation instructions.
  6. Complete bill of material listing all components.
  7. Warranty.
- B. Dimensions and configurations of panelboards shall conform to the spaces allocated on the Drawings for their installation. The Contractor shall include with the submittal a layout of the electrical room if it differs from construction documents for review and approval by the Engineer prior to release of order.

#### 1.04 OPERATION AND MAINTENANCE MANUAL

- A. Supply operation and maintenance manuals in accordance with the requirements of Section 260010: Basic Electrical Requirements, to include the following:
1. A detailed explanation of the operation of the system.
  2. Instructions for routine maintenance.
  3. Pictorial parts list and parts number.
  4. Telephone numbers for authorized parts and service distributors.
  5. Final testing reports.

#### 1.05 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused, and currently under production.
- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.

#### 1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery: Panelboard components shall not be delivered to the Project site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable. Equipment damaged during shipment shall be replaced and returned to Manufacturer at no cost to Owner.
- B. Storage: Store in a clean, dry, ventilated space free from temperature extremes. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris and traffic. Provide heat where required to prevent condensation.
- C. Handling: Handle in accordance with NEMA PB1.1 and Manufacturer's written instructions. Be careful to prevent internal component damage, breakage, denting and scoring. Damaged units shall not be installed. Replace damaged units and return equipment to Manufacturer.

#### 1.07 WARRANTY



- A. Units and components offered under this Section shall be covered by a 1-year parts and labor warranty for malfunctions resulting from defects in materials and workmanship. Warranty shall begin upon acceptance by the Owner.

#### 1.08 EXTRA MATERIAL

- A. Turn over two (2) sets of panelboard keys to the Owner at completion of Project. All panelboards shall be keyed alike.
- B. Provide one spray can of matching finish paint for touching up damaged surfaces after installation.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.
  - 1. Square D.
  - 2. ABB/ General Electric.
  - 3. Eaton.
  - 4. Siemens.
- B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

#### 2.02 PANELBOARDS - GENERAL

- A. Enclosure:
  - 1. Cabinets shall be NEMA Type 1 enclosure, door, and trim of code gauge galvanized steel. Provide NEMA Type 3R enclosures for exterior mounted panelboard.
  - 2. Panelboard covers shall be door-in-door construction such that inner door exposes the overcurrent protective devices and the outer door exposes the complete panelboard interior (i.e. branch circuit conductors, lugs, neutral and ground bus, overcurrent protective devices, etc.). Outer door shall have full-length piano hinge and inner door shall have two-point hinges.
  - 3. Provide combination spring catch and lock on inside edge of the inner door trims with flush fitting joint between door and trim. Locks on all panelboards shall be keyed alike. Doors 36 inches and over in height shall be provided with three-point catch and lock. Provide quarter-turn captive bolts on the outer door.
- B. Bus assembly and terminations:
  - 1. Bus shall be bolted copper with taps arranged for distributed phase connections to branch circuit devices
  - 2. Cross connectors shall be copper, drilled and tapped for bolt-on device connections, arranged for double row placement of device and designed to permit removal or addition of overcurrent protection devices without disturbing adjacent devices or removing main bus connections.
  - 3. Neutral bus shall be 100 percent rated of phase bus bars and shall have lugs for each outgoing branch circuit or feeder requiring a neutral connection unless otherwise noted.
  - 4. Ground bus shall be full size with lugs for each outgoing branch circuit and feeder.

5. Refer to panelboard schedules on Drawings for bus rating. Bus rating shall match or be greater than main device or main lug rating.
  6. As a minimum, bus bars shall be rated 10,000 AIC for 120/208volt panelboards and 14,000 AIC for 277/480volt panelboards. Unless otherwise noted.
  7. Provide full sized bussing in all sections of multi-section panelboards.
  8. Termination Lugs: Rated for use with aluminum/copper conductors.
  9. All "SPACES" shall be ready for installation of future overcurrent protective device.
- C. Miscellaneous requirements:
1. Circuit numbering: Starting at the top, indicate odd numbered circuits in sequence down the left-hand side and even numbered circuits down the right-hand side. Multi-section panelboards shall have continuous consecutive circuit numbers. Provide metal embossed circuit identification of panelboards.
  2. Directories: A 6" x 8" minimum size circuit directory frame and card with clear plastic covering shall be provided inside the inner panelboard door to reflect conditions at completion of Work. Directory shall be typewritten denoting loads served by room number or area for each circuit.
  3. Nameplates: Provide engraved nameplate for each panelboard. See Section 260533: Electrical Identification for requirements.
- D. Refer to Panelboard Schedules for the following:
1. Mounting style; service voltage; terminal lug size, location, and quantity; bus ampacity; interrupting capacity of bus and breakers; quantity, poles and rating of overcurrent protective devices.
- E. Overcurrent protective devices:
1. Refer to Section 26 28 16: Overcurrent Protection Devices.
  2. Overcurrent protective devices shall be molded case circuit breakers.
  3. Main devices shall be hard bus connected to the panelboard bus bars.
  4. In all cases, panelboards fed directly from a transformer shall have a main overcurrent protective device. If not indicated on the Drawings or Panelboard Schedules, provide this device sized to provide the full capacity of the transformer rating.
  5. Main devices shall be vertically mounted and shall have their operating handle in the up position when energized. Main devices that are mounted in the same manner as the branch devices are NOT acceptable, i.e. main devices shall be individually mounted at the top or bottom of the phase bus bars.
  6. Panelboards overcurrent protective devices layout shall conform to the layout indicated on the panelboard schedules.
  7. Provide identified handle ties for single pole circuit breakers that share a neutral conductor.
- F. Surge Protective Devices:
1. Refer to Section 264313: Surge Protective Devices.

- G. Finish: Five step zinc phosphate pre-treatment, one coat of rust inhibiting dichromate primer and one coat of baked-on enamel finish, ANSI 61 (light gray).

#### 2.03 DISTRIBUTION PANELBOARDS

- A. Enclosures shall be sized as required and shall meet the space restriction allocated on Drawings. Panelboard shall comply with NEMA PB 1.
- B. Provide necessary hardware to permit locking every overcurrent protective device handle in the "OFF" position.
- C. Where "SPACE" is indicated on panelboard schedules or Drawings, install cross connectors and mounting hardware to match the frame size ampere rated noted.

#### 2.04 BRANCH CIRCUIT PANELBOARDS

- A. Enclosure shall be 20" wide x 5-3/4" deep, surface or flush mounted and shall comply with NEMA PB 1.
- B. Flush panelboards mounted adjacent to each other shall be same physical size.
- C. Where "SPACE" is indicated on panelboard schedules or Drawings, install minimum 100amp branch circuit cross connectors and mounting hardware. For future device spaces larger than 100amps, cross connectors shall match the frame size ampere rated noted.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Contractor shall thoroughly examine Project site conditions for acceptance of panelboard installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.
- B. Where panelboards are shown to be flush mounted in walls, the contractor shall insure that 6" deep studs are employed in wall construction to accommodate the 5-3/4" deep panelboard enclosure.

#### 3.02 INSTALLATION

- A. Install panelboards in accordance with Manufacturer's written instructions, as indicated on the Drawings and as specified herein.
- B. Set panels plumb and symmetrical with building lines in conformance with PB1.1. Furnish and install all construction channel bolts, angles, etc., required to mount the equipment furnished under this Section.
- C. Mounting height shall be 6 feet.
- D. Panelboards shall be anchored and braced to withstand seismic forces as calculated per Section 260010: Basic Electrical Requirements.
- E. Provide mounting hardware brackets, busbar drillings and filler pieces for all unused spaces.
- F. "Train" interior wiring; bundle and clamp, using specified plastic wire wraps specified under Section 260519: Building Wire and Cable.
- G. Replace panel pieces, doors or trim exhibiting dents, bends, warps, or poor fit that may impede ready access, security, or integrity.

- H. Conduits terminating in concentric, eccentric, or oversized knockouts at panelboards shall have ground bushings and bonding jumpers installed interconnecting all such conduits and the panelboard.
- I. Check and tighten all bolts and connections with a torque wrench using Manufacturer's recommended values.
- J. Provide four 3/4" spare conduits stubbed-out of flush mounted panelboards to nearest accessible ceiling space.
- K. Visually inspect panelboard for rust and corrosion. If signs of rust and corrosion are present, restore or replace panelboard to new condition.
- L. In damp and wet locations, mount panelboards with a minimum one inch of air space between cabinet and the wall or other support material.
- M. Provide close up plugs in all unused openings in the cabinet.
- N. Field install handle ties on single pole circuit breakers that share a neutral conductor.
- O. Circuit breakers feeding "Fire Alarm Control Panel(s)" shall be red in color.

### 3.03 FIELD QUALITY CONTROLS

- A. Independent testing: Contractor shall arrange and pay for the services of an independent Testing Agency to perform all quality control electrical testing, calibration and inspection required herein. Testing Agencies objectives shall be to:
  - 1. Assure panelboard installation conforms to specified requirements and operates within specified tolerances.
  - 2. Field test and inspect to ensure operation in accordance with Manufacturer's recommendations and Specifications.
  - 3. Prepare final test report including results, observations, failures, adjustments, and remedies.
  - 4. Apply label on panelboards upon satisfactory completion of tests and results.
  - 5. Verify ratings and settings and make final adjustments.
- B. At least three weeks prior to any testing, notify the Engineer so that arrangement can be made for witnessing test, if deemed necessary. All pretesting shall have been tested satisfactorily prior to the Engineer's witnessed test.
- C. The Contractor shall supply a suitable and stable source of electrical power to each test site. The Testing Agency shall specify the specific power requirements.
- D. Testing of overcurrent protective devices shall be done only after all devices are installed and system is energized.
- E. Prefunctional testing:
  - 1. Provide Testing Agency with Contract Documents and Manufacturer instructions for installation and testing.
  - 2. Visual and mechanical inspection:
    - a. Inspect for physical damage, defects alignment and fit.

- b. Perform mechanical operational tests in accordance with Manufacturer's instructions.
  - c. Compare nameplate information and connections to Contract Documents.
  - d. Check tightness of all power connections.
  - e. Check that all covers, barriers, and doors are secure.
3. Electrical tests:
- a. Insulation resistance: 1000volt DC tests for one minute on all 600volt and lower rated equipment, components, buses, feeder and branch circuits and control circuits. Test phase-to-phase and phase-to-ground circuits showing less than 10-megohms resistance to ground shall be repaired or replaced.
  - b. Circuit continuity: All feeders shall be tested for continuity. All neutrals shall be tested for improper grounds.
  - c. Ground resistance: Test resistance to ground of system and equipment ground connection.
  - d. Test overcurrent protection devices per Section 262816: Overcurrent Protective Devices.
- F. In the event that the system fails to function properly during the testing as a result of inadequate pretesting or preparation. The Contractor shall bear all costs incurred by the necessity for retesting including test equipment, transportation, subsistence, and the Engineer's hourly rate.
- G. Contractor shall replace at no costs to the Owner all devices which are found defective or do not operate within factory specified tolerances.
- H. Contractor shall submit the Testing Agency's final report for review prior to Project closeout and final acceptance by the Owner. Test report shall indicate test dates, devices tested, results, observation, deficiencies, and remedies. Test report shall be included in the operation and maintenance manuals.

#### 3.04 CLEANING

- A. Prior to energizing of panelboards, the Contractor shall thoroughly clean the interior of enclosure of all construction debris, scrap wire, etc. using Manufacturer's approved methods and materials.
- B. Upon completion of Project prior to final acceptance the Contractor shall thoroughly clean both the interior and exterior of panelboards per Manufacturers approved methods and materials. Remove paint splatters and other spots, dirt, and debris.
- C. Touch-up paint any marks, blemishes or other finish damage suffered during installation.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2025-01-31 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

-

## SECTION 26 26 53

## ELECTRIC VEHICLE CHARGING EQUIPMENT

**PART 1 - GENERAL****1.01 SUMMARY**

- A. Work included: Labor, materials, and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
  - 1. Level 2 Electric Vehicle Charger.
- B. Related Work: Consult all other Sections, determine the extent and character of related Work, and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.

**1.02 REFERENCES**

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated on specified:
  - 1. California Green Building Standards Code (CALGreen)
  - 2. SAE International:
    - SAE J1772; Electric Vehicle and Plug in Hybrid Electric Vehicle Conductive Charge Coupler.
  - 3. Underwriters Laboratories, Inc. (UL):
    - UL 2231-1; Standard for Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits; Part 1: General Requirements.
    - UL 2231-2; Standard for Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits: Particular Requirements for Protection Devices for Use in Charging Systems.
    - UL 2594; Standard for Electric Vehicle Supply Equipment.

**1.03 SYSTEM DESCRIPTION**

- A. Provide Electric Vehicle Supply Equipment (EVSE) and Level 2 Electric Vehicle Chargers per SCUSD standards and current CALGreen requirements as shown on the plans, with the following features:
  - 1. Provides up to 32A Charging to all J1772 compatible electric vehicles.
  - 2. OpConnect cloud-based software platform.
  - 3. Cellular communication.
  - 4. Pedestal mount, single or dual configuration as noted on the plans.

**1.04 DEFINITIONS**

- A. Electric Vehicle (EV): An automotive-type vehicle for on-road use, such as passenger automobiles, buses, trucks, vans, neighborhood electric vehicles, electric motorcycles and the like, primarily powered by an electric motor that draws current from a rechargeable storage battery, fuel cell, photovoltaic array or other source of electric current. Plug-in hybrid electric vehicles (PHEV) are considered electric vehicles. For purposes of the California Electrical Code, off-road, self-propelled

electric vehicles, such as industrial trucks, hoists, lifts, transports, golf carts, airline ground support equipment, tractors, boats and the like, are not included.

- B. EV Cable: The off-board cable containing the conductor(s) to connect the EV power controller to the EV that provides both power and communications during energy transfer.
- C. EV Capable Space: A vehicle space with electrical panel space and load capacity to support a branch circuit and necessary raceways, both underground and/or surface mounted, to support EV charging. Electrical wiring need not be pulled through raceway (conduit) until charging station is installed.
- D. Electric Vehicle (EV) Charger: Off-board charging equipment used to charge an electric vehicle.
- E. Electric Vehicle Charging Space (EV Space): A space intended for future installation of EV charging equipment and charging of electric vehicles.
- F. Electric Vehicle Charging Station (EVCS): One or more electric vehicle charging spaces served by EVSE or receptacle(s).
- G. EV Connector: A conductive device that, when electrically coupled to an EV inlet, establishes an electrical connection to the EV for the purpose of power transfer and information exchange. This device is part of the EV coupler.
- H. EV Coupler: A mating EV inlet and connector set.
- I. EV Inlet: The device in the vehicle into which the EV connector is inserted, and a conductive connection is made for the transfer of power and communication. This device is part of the EV coupler.
- J. Electric Vehicle (EV) Ready Space: A vehicle space which is provided with a branch circuit; any necessary raceways, both underground and/or surface mounted; to accommodate EV charging, terminating in a receptacle or a charger.
- K. Electric Vehicle Supply Equipment (EVSE): The conductors, including the ungrounded, grounded and equipment grounding conductors and the electric vehicle connectors, attachment plugs, personnel protection system, and all other fittings, devices, power outlets or apparatus installed specifically for the purpose of transferring energy between the premises wiring and the electric vehicle.

#### 1.05 SUBMITTALS

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
  - 1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
  - 2. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
  - 3. Shop Drawings to include:
    - a. Front, plan and side view elevations with overall dimensions.
    - b. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
    - c. Detail fabrication and assembly of mounting assemblies for EV charging equipment.



- d. Include diagrams for power, signal, and control wiring.
  - e. Include verification of wireless communications service at each location of EV charging equipment, if applicable.
  - f. Hardware and software description shall be provided in detail for all communications hardware, software, including devices and gathering data to be transmitted over the network, and master display unit.
  - g. Dimensions and configurations of integrated distribution assembly shall conform to the space allocated on the Drawings. The Contractor shall submit a revised layout if equipment furnished varies in size from that indicated on Drawings for the Engineer's approval.
- 4. Submit Manufacturer's installation instructions.
  - 5. Complete Bill of Material listing all components.
  - 6. Warranty.

#### 1.06 OPERATION AND MAINTENANCE MANUAL

- A. Supply operation and maintenance manuals in accordance with the requirements of Section 260010: Basic Electrical Requirements, to include the following:
  - 1. A detailed explanation of the operation of the system.
  - 2. Instructions for routine maintenance.
  - 3. Pictorial parts list and part numbers.
  - 4. Pictorial and schematic Electrical Drawings of wiring systems, including operating and safety devices.
  - 5. Software and Firmware Operational Documentation:
    - a. Online training and help documentation.
    - b. Station activation sticker.
  - 6. Telephone numbers for the authorized parts and service distributors.
  - 7. Include all service bulletins and torque Specifications for all terminations.
  - 8. Final testing report.

#### 1.07 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused, and currently under production.
- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.

#### 1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery: Integrated distribution assembly components shall not be delivered to the Project site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable. Equipment damaged during shipment shall be replaced and returned to Manufacturer at no cost to Owner. Components shall be properly packaged in factory-fabricated containers and mounted on shipping skids.

- B. Storage: Store in a clean, dry, ventilated space free from temperature extremes. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris and traffic. Provide heat where required to prevent condensation.
- C. Handling: Handle in accordance with NEMA PB2.1 and Manufacturer's written instructions. Be careful to prevent internal component damage, breakage, denting and scoring. Damaged units shall not be installed. Replace damaged units and return equipment to Manufacturer.

#### 1.09 WARRANTY

- A. Units and components offered under this Section shall be covered by a 3-year parts and labor warranty for malfunctions resulting from defects in materials and workmanship. Warranty shall begin upon acceptance by the Owner.

#### 1.10 SYSTEM START-UP

- A. Upon completion of installation, a factory trained dealer service representative shall perform initial start-up of the system, including any required system programming. Sufficient time shall be allowed to properly checkout the system and perform required adjustments before the Owner's witnessed test shall begin.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Provide the following product with all features specified herein and indicated on the Drawings.
  - 1. Clipper Creek HCS-40XR, "ruggedized" with OpConnect cloud network and cellular communications, and credit card reader.

#### 2.02 EV CHARGING EQUIPMENT DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Electrical Specifications:
  - 1. Charging power: 32A
  - 2. Input voltage/input voltage range: 208/240 VAC (L-L), single-phase/185 VAC - 264 VAC.
  - 3. Input voltage frequency: 50/60 Hz
  - 4. Overcurrent protection: Dedicated 40a 2-pole breaker.
  - 5. Input cable type: Pre-wired with (L1, L2, Gnd) 10AWG service whip
  - 6. Input cable: Hardwired, 3'-0"
  - 7. Maximum output current/output power: 32 A continuous/7.68 kW
  - 8. Output cable/cable length: Pre-wired with impact and crush resistant, lockable SAE J1772/18' connector.
- C. Mechanical Data:
  - 1. Enclosure dimensions (L x W x D): 19.7" x 8.9" x 5.3" (500 mm x 226 mm x 135 mm)
  - 2. Weight: 13.5 lbs. (6.1 kg)

3. Enclosure mounting: Pedestal mounted, dual or single configuration as indicated on the plans.
- D. Environmental specifications:
1. Environment/enclosure rating: Fully sealed, indoor and outdoor rated/NEMA Type 4X – watertight and corrosion resistant rubber over-molded EV connector.
  2. Operating/storage temperature: -22°F to 122°F (-30°C to 50°C)/-40°F to 176°F (-40°C to 80°C)
- E. Compliance specifications:
1. Codes and standard: NEC Article 625.22, SAE J1772, ENERGY STAR®, UL, ETL, cETLus
  2. Safety compliance: UL 2594, UL 2251, UL 2231-1, UL 2231-2, UL 1998, UL 991 C22.2 No. 280-13, CSA C22.2 No. 282, CSA C22.2 No. 281.1, CSA C22.2 No. 281.2, CSA C22.2 No. 0.8
  3. EMC compliance: FCC Part 15 Class B
  4. Short-circuit protection: 5000 RMS Symmetrical Amps at 240 VAC
  5. Open safety ground detection: Features a continuous earth ground monitor to ensure consistent connection to good earth ground
  6. Ground fault detection: Ground fault protection integral, CCID 20 mA, auto reset
  7. Auto-reclosure: System will automatically resume standard operation after minor power fault has cleared
- F. Features
1. 4 LED indicators: Amber LED: Power, Green LED: Charging, 1st Red LED: Power fault, 2nd Red LED: Charging fault
  2. Cable management: Provide with retractable output cable.
- G. Network Specifications:
1. Smart Phone (iOS and Android) mobile application for drivers.
  2. Integration with utility customer management system.
  3. Station owner can have chargers from multiple manufacturers at one site and manage under one platform.
  4. Email and text notifications when charging complete (to drivers).
  5. Round robin reservation system with notifications to next driver in the queue.
  6. Station owner dashboard:
    - a. View real-time charging station status.
    - b. View and download usage and revenue reports.
    - c. Schedule automatic e-mail delivery of usage and revenue reports.
    - d. View open maintenance and support tickets (e-mail service tickets).
  7. Flexible access control:
    - a. Restrict access to authorized users only (e.g. employees only).

- b. Charge different usage rates for different users (e.g. employees charge for free).
  - c. Station owner can set own rates and update any time with web portal.
  - d. Time-of-day rates with weekday vs weekend rates.
  - e. Time span rates (e.g. cost increase after a certain period of time to increase station turnover).
  - f. Support for credit cards, OpConnect card, Smartphone app.
8. Portal administration functions:
- a. Multiple Access Levels (Company Admin, User, Maintenance, etc.).
  - b. Data views and ability to control chargers (set rate plans, restrict usage, etc.).
9. Load Management:
- a. Load sharing on a single circuit breaker or entire load source.
  - b. Minimum load per charger: 8A for HCS-40.
- H. Credit Card Reader:
- 1. Provide with optional ID TECH VP6300 3-in-1 credit card reader.
  - 2. Support for Magstripe (MSR), contact EMV, and contactless card reading using NFC and RFID.
  - 3. High-contrast LCD display.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for EV charging equipment electrical conduit to verify actual locations of conduit connections before equipment installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.02 INSTALLATION**

- A. Comply with NECA 1 and NECA 413.
- B. Concrete Base Mounting:
  - 1. Install EV charging equipment on pad/base as shown on the drawings.
- C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- D. Wiring Method: Install cables in underground raceways.
- E. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- F. Secure covers to enclosure.

#### **3.03 CONNECTIONS**

- A. Connect wiring according to Section 260519, Building Wire and Cable.
- B. Comply with grounding requirements in Section 260526, Grounding and Bonding.
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

#### 3.04 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553, Electrical Identification.

#### 3.05 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections with the assistance of a factory-authorized service representative.
- C. Tests and Inspections:
  - 1. For each unit of EV charging equipment, perform the following tests and inspections:
    - a. Unit self-test.
    - b. Operation test with EV.
    - c. Network communications test.
- D. EV charging equipment will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

#### 3.06 STARTUP SERVICE

- A. Engage a factory-authorized service representative to Perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.

#### 3.07 ONGOING MANAGEMENT SERVICES

- A. Include first year of management within the contract proposal.
- B. Provide yearly costs and service per year for services beyond the first year.

#### 3.08 CLEANING

- A. Upon completion of Project prior to final acceptance the Contractor shall thoroughly clean both the interior and exterior of enclosure of all construction debris, scrap wire, paint splatters, dirt, etc.

#### 3.09 TRAINING

- A. Factory authorized service representative shall conduct an 4-hour training seminar for Owner's Representatives upon completion and acceptance of system. Instructions shall include operation, maintenance, and testing of equipment with both classroom training and hands-on instruction

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- For power & signal applications, utilize a multi-channel raceway with devices flush mounted in face of raceway; Legrand 5400 or 5500 series or equal. For power only applications, metal raceway is required, use Legrand/Wiremold 500 or 700 series as required. Single-channel, non-metallic raceways are only acceptable for low voltage systems.

## SECTION 26 27 19

## SURFACE RACEWAYS

**PART 1 - GENERAL****1.01 SUMMARY**

1. Work included: Labor, materials, and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
  - a. Surface metal raceways.
  - b. Surface nonmetallic raceways.
  - c. Multi-outlet assemblies.
- B. Related Work: Consult all other Sections, determine the extent and character of related Work, and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.

**1.02 REFERENCES**

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified.
  1. Federal Specifications (FS):  
FS W-C-582;                      Conduit, Raceway, Metal and Fitting; Surface.
  2. Underwriters Laboratories, Inc. (UL):  
UL 5;                                  Standard for Surface Metal Raceways and Fittings.  
UL 5A                                Nonmetallic Surface Raceways and Fittings.  
UL 870;                              Wireways, Auxiliary Gutters and Associated Fittings.

**1.03 SUBMITTALS**

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
  1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
  2. Clearly mark on each data sheet the specific item(s) being submitted and proposed application.
  3. Submit Manufacturer's installation: Provide written instructions for raceway products special installation techniques.
  4. Complete bill of material listing all components.

**1.04 QUALITY ASSURANCE**

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused, and currently under production.
- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.

**PART 2 - PRODUCTS****2.01 MANUFACTURERS**

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.
  - 1. Surface metal raceways and multi-outlet assemblies:
    - a. Wiremold (Legrand)
  - 2. Surface nonmetallic raceways and multi-outlet assemblies:
    - a. Wiremold (Legrand)
- B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

**2.02 SURFACE METAL RACEWAYS**

- A. Assembly: Single or Double compartment raceway shall be complete to include bases, covers, end plates, compartment divider, fittings and connections as required. Raceways shall be UL labeled.
- B. Construction: Raceway base, cover, compartment divider and end plates shall be constructed of cold rolled steel with 0.094" minimum wall thickness. or of extruded aluminum of No. 6063-T5 aluminum alloy extrusion. Corner extrusions shall be identical to linear extrusions.
- C. Size: Raceway size and length shall be as indicated on Drawings.
- D. Fittings: Boxes, extension rings, couplings, elbows, and connectors shall be designed for use with raceway system.
- E. Finish: To be determined by the Architect.
- F. Application: Utilize for power-only applications.
  - 1. Legrand/Wiremold 500 or 700 series, or equal, as required.

**2.03 SURFACE NONMETALLIC RACEWAYS**

- A. Assembly: Single, double, or triple compartment raceway shall be complete to include bases, covers, end plates, compartment divider, fittings and connections as required. Raceways shall be UL labeled. Double and triple compartment raceway shall have individual covers for each channel to allow access to one compartment at a time.
- B. Construction: Raceway base, cover, compartment divider and end plates shall be of non-metallic construction.
- C. Size: Raceway size and length shall be as indicated on Drawings.
- D. Fittings: Boxes, extension rings, couplings, elbows and connectors shall be designed for use with raceway system.
- E. Finish: To be determined by the Architect.
- F. Application:
  - 1. Multi-channel nonmetallic raceway system: Utilize for applications where both power and low voltage systems (telecommunications, A/V) are required.
    - a. Legrand/Wiremold 5500 or equal.



2. Single channel, non-metallic raceway shall not be used for power applications; acceptable for use only for low voltage systems.

#### 2.04 MULTI-OUTLET ASSEMBLIES

- A. Assembly: Single or Double compartment raceway shall be factory pre-assembled, pre-cut and complete, including bases, covers, end plates, compartment dividers, wiring, receptacles, fittings and connections as required. Raceway shall be U.L. labeled.
- B. Construction: Raceway base, cover, compartment divider and end plates shall be constructed of cold rolled steel with 0.094" minimum wall thickness.
- C. Size: Raceway size and length shall be as indicated on Drawings.
- D. Receptacles: Convenience receptacles mounted in cover shall be NEMA 5-20R in accordance with Specification Section 262726: Wiring Devices. Space receptacles on center as indicated on Drawings.
- E. Coverplates: Device coverplates shall be of same material and finish as the raceway.
- F. Wiring: Receptacle circuits shall be pre-wired, or field wired with minimum #12 AWG conductors throughout entire length of section. 12" pigtails shall be provided for field connections. Pigtails shall be properly tagged with circuit identification in the field. No tap splicing.
- G. Wire retention clips: Shall be installed in sufficient numbers to securely hold all wire lengths in place.
- H. Grounding: Ground continuity shall be maintained to receptacles throughout the entire length of raceway by means of a separate, insulated, code sized ground conductor.
- I. Fittings: Boxes, extension rings, couplings, elbows and connectors shall be designed for use with raceway system.
- J. Finish: To be determined by the Architect.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Contractor shall thoroughly examine Project site conditions for acceptance of surface raceway installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

#### 3.02 SURFACE METAL RACEWAY AND MULTI-OUTLET ASSEMBLY

- A. Installation:
  1. Install raceway in accordance with Manufacturer's written instructions, as indicated on Drawings and as specified herein.
  2. Contractor shall coordinate raceway lengths with building walls, counter, and actual field conditions.
  3. Raceways mounted on walls above benches and counters shall align exactly with each end of bench or counter.

4. Use flat-head screws to fasten channel to surfaces, at heights indicated on Drawings, per Manufacturer's instructions. Mount plumb and level. Channel must be mechanically fastened; use of double-sided tape or other methods of attachment are not acceptable.
  5. Installed complete with all necessary corner connectors, 'T' connectors, feed connectors, compartment dividers and any other hardware required to provide a complete system as described in the Drawings.
  6. Provide fittings to feed the raceway from the back.
- B. Branch circuiting: Provide connection to pre-wired or field wired assembly as indicated on Drawings. Install circuit identification tags on pigtails. Receptacles shall be identified with panel and circuit I.D. above each outlet with gray dymo label.
- C. Grounding: Ground continuity shall be maintained throughout entire raceway length per CEC.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 2025-01-31 – Modified list of acceptable floorbox manufacturers, clarified requirements for while-in-use device covers.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Use standard receptacles and switches in lieu of "Decora" style.
- Where controlled receptacles are required by code, designer is to ensure that unswitched power is provided at the same location as switched power; at duplex receptacle, provide a split-wired controlled receptacle. At double-duplex receptacles, provide one standard, and one split-wired controlled receptacle. In addition to providing specially marked devices for this application, ensure that device plate is labeled with type-on-tape indicating that receptacle is controlled.
- Use only tamper-proof receptacles.



SECTION 26 27 26

WIRING DEVICES

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work included: Labor, materials, and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
  - 1. Wall switches.
  - 2. Occupancy/vacancy sensors, including wallbox and ceiling mounted.
  - 3. Time switches.
  - 4. Receptacles.
  - 5. Floor mounted service boxes.
  - 6. Coverplates.
- B. Related Work: Consult all other Sections, determine the extent and character of related Work, and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.
  - 1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
  - 2. Division 03: Cast-in-place concrete.

**1.02 REFERENCES**

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified.
  - 1. National Electrical Manufacturer's Association (NEMA):
    - NEMA WD-1;                      General-Purpose Wiring Devices.
    - NEMA WD-2;                      Semiconductor Dimmers for Incandescent Lamps.
    - NEMA WD-5;                      Specific-Purpose Wiring Devices.
    - NEMA SSL 7A;                      Phase-Cut Dimming for Solid State Lighting
  - 2. Underwriter's Laboratories (UL):
    - UL 20                              General-Use Snap Switches.
    - UL 231;                              Power Outlets.
    - UL 310;                              Electrical Quick-Connect Terminals.
    - UL 498;                              Attachment Plugs and Receptacles.
    - UL 514A;                              Metallic Outlet Boxes.

|          |                                                |
|----------|------------------------------------------------|
| UL 514D; | Cover Plates for Flush-Mounted Wiring Devices. |
| UL 943;  | Ground-Fault Circuit-Interrupters.             |
| UL 1681; | Wiring Device Configurations.                  |

### 1.03 SUBMITTALS

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
  - 1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
  - 2. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
  - 3. Provide color finishes for Architect to select from.
  - 4. Submit Manufacturer's installation instructions.
- B. Where inscribed device coverplates are noted on the Drawings or in the Specifications, conform to the requirements of Section 260553: Electrical Identification.

### 1.04 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused, and currently under production.
- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.

### 1.05 WARRANTY

- A. Occupancy sensors offered under this Section shall be covered by a 1-year parts and labor warranty for malfunctions resulting from defects in materials and workmanship. Warranty shall begin upon acceptance by the Owner.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.
  - 1. Switches, receptacles and coverplates:
    - a. Pass & Seymour.
    - b. Hubbell.
    - c. Leviton.
  - 2. Occupancy/vacancy sensors switches, time switches:
    - a. SensorSwitch, Inc.
    - b. Wattstopper
    - c. Cooper Controls "Greengate"

- d. Leviton
    - e. Hubbell Building Automation, Inc.
  - 3. Floor mounted service boxes:
    - a. Legrand
    - b. FSR, Inc.
  - B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.
- 2.02 WALL SWITCHES
- A. Standards: Provide general-purpose 120/277volt AC switches that conform to NEMA WD-1 Specifications.
  - B. Color: Device color shall be as selected by the Architect, unless otherwise noted.
  - C. Wall switches:
    - 1. Provide twenty amperes, 120/277volt, Specification grade, toggle handle, quick-make slow-break, quiet type snap switch with silver cadmium alloy contacts, binding head terminal screws, back and side wired with totally enclosed case.
    - 2. Single-pole, single-throw switches: Hubbell #1221 series, Pass & Seymour #20AC1 series or Leviton #1221 series.
    - 3. Three-way switches: Hubbell #1223 series, Pass & Seymour #20AC3 series or Leviton #1223 series.
- 2.03 OCCUPANCY/VACANCY SENSOR SWITCHES
- A. Occupancy sensors: automatic on, automatic off.
  - B. Vacancy sensors: manual on, automatic off.
  - C. General:
    - 1. Occupancy sensors shall comply with the latest edition of the California Building Energy Efficiency Standards, California Building Code, Part 6 and be certified by The California Energy Commission. All sensors shall be listed in the most current directory of Certified Occupancy Sensing Devices or be on file with the CEC.
    - 2. Sensors shall be dual-technology type infrared/ultrasonic or infrared/microphonic or as specified herein.
    - 3. Neutral connection required. Sensors that rely on ground leakage current for operation shall not be provided.
    - 4. All sensors shall have an adjustable time delay off setting and a sensitivity adjustment.
    - 5. Ceiling mounted sensors shall operate be line voltage or low voltage with separate control unit. Control unit shall contain power supply and relays for switching loads.
    - 6. Units shall be furnished with area coverage to suit application. No allowance shall be given for providing sensors improperly sized for the square footage of the controlled area.
  - D. Color: Device color shall be as selected by Architect, unless otherwise noted.

- E. Wallbox mounted single level control sensors:
  - 1. Sensor shall provide minimum coverage of 900-square feet.
  - 2. Time delay adjustment from 30-seconds to 20-minutes. Set initial time-out setting at 4-minutes, unless otherwise specified. Set sensitivity adjustment at maximum.
  - 3. Load capacity of 0 to 1800watts at connected voltage.
  - 4. For use in small utility closets and similar areas where dual level switching is not indicated.
- F. Wallbox mounted dual level control sensors:
  - 1. Sensor shall provide dual level switching capability and minimum coverage of 1000-square feet.
  - 2. Operation shall be manual (in two levels) "ON" and manual (in two levels) or automatic (full) "OFF".
  - 3. Time delay adjustment from 30-seconds to 20-minutes. Set initial time-out setting at 20-minutes, unless otherwise specified. Set sensitivity adjustment at maximum.
  - 4. Load capacity of 50 to 1000watts at connected voltages.
  - 5. Integral photocell. Provide with ambient light control adjustment.
  - 6. For use in offices and similar areas where dual level switching is indicated.
- G. Wallbox mounted combination sensor and dimmer:
  - 1. Sensor shall provide 0-10volt dimming capability for LED loads.
  - 2. Sensor shall provide minimum coverage of 20-feet for clear line-of-sight applications.
  - 3. Infrared only or dual-technology sensor.
  - 4. Time delay adjustment from 3-minutes to 20-minutes. Set initial time-out setting at 15-minutes, unless otherwise specified. Set sensitivity adjustment at maximum.
  - 5. For use in private offices and similar areas where dimming is indicated.
- H. Ceiling or wall mounted single-directional sensors:
  - 1. Sensor shall provide minimum coverage of 900-square feet.
  - 2. Operation shall be automatic "ON" and automatic "OFF". Provide with a manual override switch.
  - 3. Time delay adjustment from 30-seconds to 20-minutes. Set initial time-out setting at 10-minutes. Set sensitivity adjustment at maximum.
  - 4. Load capacity of 20amps per power or slave pack at connected voltage.
  - 5. Power pack, if required, consisting of Class 2, 24volt output transformer and relay in single housing, capable of powering up 2 sensors and mounted inside standard 4-inch square box.
  - 6. For use in small office, classroom, and similar areas.
- I. Ceiling mounted omnidirectional sensors:
  - 1. Sensor shall provide minimum omnidirectional coverage of 1000-square feet.



2. Operation shall be automatic "ON" and automatic "OFF". Provide with a manual override switch.
3. Time delay adjustment from 30-seconds to 20-minutes. Set initial time-out setting at 10-minutes. Set sensitivity adjustment at maximum.
4. Load capacity of 20amps per power or slave pack at connected voltage.
5. Power pack, if required, consisting of Class 2, 24volt output transformer and relay in single housing, capable of powering up to 2 sensors and mounted inside standard 4-inch square box.
6. For use in large storage rooms and similar areas.

#### 2.04 TIME SWITCHES

- A. Wallbox mounted, line voltage type.
- B. Shall be compatible with all LED lighting loads, electronic ballasts, motor loads, and inductive loads. Triac and other harmonic generating devices shall not be allowed.
- C. Shall have no minimum load requirement and shall be capable of controlling up to 800watts.
- D. Shall allow manual override of the preset time-out period.
- E. Time switch shall be capable of operating as an "ON/OFF" switch.
- F. Digital time switch:
  1. Shall have the option for a beep warning that shall sound every 5-seconds once the time switch countdown reaches one minute.
  2. Shall have an electroluminescent backlit Liquid Crystal Display that shows the timer's countdown.
  3. Maximum setting of 30-minutes for server aisles and 10-minutes for closets.
- G. Analog time switch:
  1. Spring wound rotary style.
  2. Maximum setting of 30-minutes for server aisles and 10-minutes for closets.
- H. Astronomical time switch:
  1. Includes integral programming function for precise Time Zone, Longitude, and Latitude input/
  2. Weekly schedule format.
  3. Minimum 5 programmable schedules.

#### 2.05 RECEPTACLES

- A. Standards:
  1. Provide general purpose 20amp, 125/250volt AC receptacles that conform to NEMA WD-1 Specifications. Specialty receptacles shall conform to NEMA WD-5 Specifications as applicable.
  2. Provide NEMA 5-20R, industrial (heavy-duty) specification grade as noted herein, 20amp, 125volt AC, 2-pole, 3-wire grounding type receptacles.
  3. Receptacles shall be the standard conventional style device.

4. Receptacles shall be tamper-resistant to meet the requirements of CEC Article 406.12.
- B. Color:
1. Device color shall be as selected by the Architect, unless otherwise noted.
  2. Devices connected to an emergency circuit shall be red.
- C. General purpose single outlets:
1. Provide self-grounding back and side wired with binding head staked terminal screw.
  2. Use Hubbell #5361 series, Pass & Seymour #5361 series Leviton #5361 series.
- D. General purpose duplex receptacles:
1. Provide self-grounding, back and side wired with binding head staked terminal screws and break-off strip for two-circuit wiring.
  2. Use Hubbell #5362 series, Pass & Seymour #5362 series or Leviton #5362 series.
- E. Ground fault circuit interrupting (GFCI) receptacles:
1. Provide 20amp, 125volt AC, receptacles consisting of NEMA 5-20R duplex device with integral solid state sensing and signaling circuitry capable of detecting and interrupting a maximum 5-milli-amp line-to-ground fault current in approximately 1/40th of a second.
  2. Provide visual device with trip indication, manual reset, and test mechanisms and with point of use and multi-outlet protection.
  3. Provide self-test and monitor feature with visual indicators on device face representing power status, trip condition, ground fault condition and end of life status.
  4. Provide weather resistant devices at all damp and wet locations.
  5. Use Pass & Seymour #2097TR series, Hubbell GFTRST20 series, Leviton #S7899 series, for Specification grade GFCI receptacles.
  6. Use Pass & Seymour #2097TRWR series, Hubbell GFTWRST20 series, Leviton #WT899 series for weather resistant GFCI receptacles.
- F. Controlled Receptacles:
1. Provide 20amp, 125volt AC, receptacles consisting of NEMA 5-20R duplex device permanently marked with universal symbol for controlled receptacle, and the word "CONTROLLED".
  2. Controlled duplex receptacles shall include split circuit hot tab for one controlled outlet, and one uncontrolled.
  3. Controlled double duplex receptacle shall consist of one uncontrolled general-purpose duplex receptacle, and one controlled duplex receptacle.
  4. For half controlled receptacle with split-circuit hot tab, use Pass & Seymour #5362CH, Hubbell BR20C1, or Leviton 5362-1P.
  5. For dual controlled receptacle, use Pass & Seymour #5362CD, Hubbell BR20C2, or Leviton 5362-2P.
- G. USB Charger Type Duplex Receptacles

1. Provide 20amp, 125volt AC, tamper-resistant specification grade receptacles consisting of NEMA 5-20R duplex device with two 5volt DC USB Type A charging ports; compatible with USB 2.0 and 3.0 devices, and capable of charging two devices simultaneously while still using receptacles.
  2. Comply with USB battery charging spec USB BC1.2
  3. Minimum 3.1 amps total charging capacity.
  4. Use Pass & Seymour TR5362USB series, Hubbell USB20X2 series, Leviton #T5832 series, for USB charger type duplex receptacles.
- H. Special purpose receptacles: Provide Specification grade devices with the NEMA configuration, voltage and current rating, number of poles and ground provisions as noted on the Drawings.

## 2.06 FLOOR MOUNTED SERVICE BOXES

### A. Multi-service recessed floor box:

1. Combination power and communication cable service floor box with flush cover and recessed compartment for access to service device(s). Box shall be for installation concrete floors.
2. Box shall be constructed of formed steel with provisions for adjustments before and after pour. Access hatch shall be steel and provided with carpet trim and insert. Make allowances for floor finishes if other than carpet. Furnish with specified receptacle(s) and accessories called for on Drawings.
3. Use Legrand Evolution Series or FSR FL series.

### B. Poke-through floor fitting:

1. Flush style fire rated poke-through device for installation in a 2" or 3" cured hole through a concrete floor. Provide with finish ring, receptacle, cable access, box, etc. or any other accessories to facilitate the installation indicated on Drawings.
2. Use Legrand Evolution Series or FSR Smart Fit series.

## 2.07 COVERPLATES

### A. General:

1. Provide all coverplates with rounded edges and corners, smooth and free of grooves, embossing or other embellishment.
2. Provide mounting screws to match the plate finish.
3. Provide gang type coverplates where two or more devices are installed at one location. Individual gangable coverplates are not acceptable.
4. Provide plates of one design, standard conventional designer decora style, throughout the Project unless otherwise specified.

### B. Color: Coverplate color shall be ivory white black gray as specified by the Architect, unless otherwise noted.

### C. Plastic coverplates:

1. Provide smooth, high impact, self-extinguishing thermoplastic coverplates and 0.100 inches thick with rounded edges and corners.

2. Provide openings to accommodate the devices indicated on the Drawings and in the Specifications.
- D. Metal coverplates:
  1. Provide smooth, type 430 stainless steel coverplates, 0.035" thick with rounded edges and corners.
  2. Provide openings to accommodate the devices indicated on the Drawings and in the Specifications.
  3. Provide removable plastic film to protect coverplates during installation. Remove film at time of final acceptance.
- E. Weatherproof coverplates:
  1. Provide NEMA 3R die-cast aluminum, extra-duty weatherproof in-use coverplate for exterior GFCI receptacles per CEC Article 406.9(B)(1), CEC Article 26-702 compliant, with 1/8" neoprene gasket, lockable hasp, 2.75" deep.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Contractor shall thoroughly examine Project site conditions for acceptance of wiring device installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

#### **3.02 PREPARATION**

- A. Coordinate device heights in vending, kitchen and utility areas with benches and counters.
- B. Coordinate switch mounting location with Architectural details. Unless otherwise noted, locate switches on latch side of door.

#### **3.03 INSTALLATION**

- A. Install wiring devices in accordance with Manufacturer's written instructions, as indicated on the Drawings and as specified herein.
- B. Install devices with the vertical centerline plumb and with all edges of the device flush against the adjacent wall surfaces.
- C. Mount switches at 42 inches to center above finished floor unless otherwise noted.
- D. Mount receptacles vertically with the centerline 18-inches above finished floor and with grounding slot at bottom.
- E. Mount receptacles vertically/horizontally when mounting above counters, mount with grounding slot to the left.
- F. Mount GFCI receptacles in the following locations, whether indicated as GFCI type or not on the drawings:
  1. In bathrooms.
  2. Where receptacles are installed within 6'0" from edge of sinks.

3. In kitchens above counters.
4. On rooftops.
5. Outdoors.
6. Where serving vending machines.
7. Where serving electric drinking fountains.
- G. Derate ganged dimmer switches as instructed by Manufacturer. Do not use common neutrals in dimmer circuits.
- H. Install red receptacles where connected to an emergency circuit.
- I. Provide coverplates for all outlet boxes, switches, receptacles, etc.
- J. Install blank coverplates on all outlet boxes in which no device is required or installed.
- K. Provide coverplates that completely cover wall opening and seat against wall.
- L. Provide stainless steel coverplates for all devices in kitchen/food service equipment areas.

### 3.04 OCCUPANCY/VACANCY WALLBOX SENSORS

- A. All occupancy/vacancy sensors shall have a sensitivity appropriate for the space. Contractor shall be responsible for testing the sensitivity of the sensor in the space and adjusting as needed.
- B. Where no direction is provided in a sequence of operation or by the owner set the occupancy sensor timeout to values as indicated in Part 2 above.
- C. Install wall mounted devices with the vertical centerline plumb and alleges of device flush against adjacent wall surfaces. Mount devices at 42-inches to center above finished floor unless otherwise noted.

### 3.05 FLOOR MOUNTED SERVICE BOXES

- A. Installation:
  1. Install floor boxes to be level or within 1/16" below screed line.
  2. Make conduit connections and anchor box to sub-flooring.
  3. Core drill hole in floor (core sized based on Manufacturer's installation instructions) for insert of poke-through device.
  4. Make conduit connection to poke-through box from floor below.
- B. Coordination: Contractor shall mark the location of all floor boxes with paint prior to installation or core drilling for review and approval by Architect.

### 3.06 FIELD QUALITY CONTROL

- A. Electrical testing:
  1. Test proper polarity of all receptacles.
  2. Test ground continuity of all wiring devices.
  3. Test ground fault interrupting device operation.

B. Visual and mechanical inspection:

1. Check proper operation of all switches.
2. Check indicating lights on all SPD receptacles.
3. Visually inspect and replace damaged or defective devices.

3.07 CLEANING

- A. Clean interior of all boxes from dirt and paint prior to installation of devices.
- B. Clean wiring devices and coverplates from dirt and paint over spray.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

## SECTION 26 27 36

## ENERGY INFORMATION SYSTEM

**PART 1 - GENERAL****1.01 SUMMARY**

- A. Work included: Labor, materials, and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
  - 1. Power monitoring equipment.
  - 2. Web-based power monitoring communication system.
  - 3. Data acquisition server "Gateway."
  - 4. Miscellaneous monitoring systems.
- B. Related Work: Consult all other Sections, determine the extent and character of related Work, and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.

**1.02 REFERENCES**

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:
  - 1. American National Standards Institute, Inc. (ANSI)/Institute of Electrical and Electronics Engineers (IEEE):  
ANSI/IEEE 802.3;            Ethernet Standard.
  - 2. American National Standards Institute, Inc. (ANSI):  
ANSI C12.20;                For Electricity Meters – 0.2 and 0.5 Accuracy Classes.  
ANSI C37.90.1;             Surge Withstand Capability (SWC) Test.
  - 3. Federal Communications Commission (FCC) Regulations:  
FCC Part 15;                Subpart B for Unintentional Radiators that Generate Radio Frequency Emissions. Class A for Digital Devices that Market use for Commercial applications.
  - 4. Underwriters Laboratories, Inc. (UL):  
UL 61010A-1;                General Safety Requirements for Electrical Equipment intended for Laboratory Use.

**1.03 SUBMITTALS**

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
  - 1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
  - 2. Describe product operation, equipment and dimensions and indicate features of each component.



3. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
  4. Shop Drawings to include:
    - a. Front, plan, and side view elevations with overall dimensions.
    - b. Wiring diagrams showing all components and the connections between the components.
  5. Furnish structural calculations for equipment anchorage as described in Section 260010: Basic Electrical Requirements.
  6. Submit Manufacturer's installation instructions.
  7. Complete bill of material listing all components.
  8. Warranty.
- B. Hardware and software description shall be provided in detail for all communications hardware, software, including sensor devices and gathering data to be transmitted over the network, and master display unit. This description will include a list of all the communicating devices to be connected to the network.
- C. Typical software screen displays shall be provided in printout form and/or on disk.

#### 1.04 OPERATION AND MAINTENANCE MANUAL

- A. Supply operation and maintenance manuals in accordance with the requirements of Section 260010: Basic Electrical Requirements, to include the following:
1. A detailed explanation of the operation of the system.
  2. Instructions for routine maintenance.
  3. Parts list and part numbers.
  4. Pictorial and schematic Electrical Drawings of wiring systems, including operating, hardware, flat screens, instrumentation, and annunciators.
  5. Telephone numbers for authorized parts and service distributors.
  6. Final testing reports.

#### 1.05 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused, and currently under production.
- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.

#### 1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery: Energy information system shall not be delivered to the Project site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable. Equipment damaged during shipment shall be replaced and returned to Manufacturer at no cost to Owner.

- B. Storage: Store in a clean, dry, ventilated space free from temperature extremes. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris and traffic. Provide heat where required to prevent condensation.
- C. Handling: Handle in accordance with Manufacturer's written instructions. Be careful to prevent internal component damage, breakage, denting and scoring. Damaged units shall not be installed. Replace damaged units and return equipment to Manufacturer.

#### 1.07 WARRANTY

- A. Units, components and programming offered under this Section shall be covered by a 1-year parts and labor warranty for malfunctions resulting from defects in materials and workmanship. Warranty shall begin upon acceptance by the Owner.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.
  - 1. Power monitoring equipment:
    - a. Schneider/ Square D
    - b. Eaton:
    - c. Siemens
  - 2. Web-based power monitoring communication system:
    - a. Schneider/ Square D
    - b. Eaton
    - c. Siemens
  - 3. Data acquisition server gateway:
    - a. Obvius A8812-1 "AcquiSuite" Data Acquisition Server
- B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

#### 2.02 MICORPROCESSOR-BASED POWER MONITORING EQUIPMENT

- A. Integrated multi-point metering/switchboard construction:
  - 1. Combines switchboard design with multi-point metering (MPM) equipment to provide a complete factory installed metering switchboard consisting of distribution switchboard with overcurrent protection devices, meter module(s) and current sensors, factory installed and wired to meters.
  - 2. The MPM shall monitor 60 single-pole loads, 30 two pole loads or 20 three-pole loads or any combination thereof by use of current sensors.
  - 3. All connections to the MPM shall be through removable plugs.
  - 4. The MPM shall be capable of accepting input from current sensors by connecting with factory installed plug connectors.

5. The MPM shall be capable of automatically sensing the current rating of the current sensor.
6. The MPM shall provide a mechanism for detecting tampering with the current sensors. Tamper detection shall be accessible remotely by the headend computer.
7. The MPM shall be available in one of three voltage ratings:
  - a. 120/208volt AC
  - b. 277/480volt AC
  - c. 347/600volt AC
8. The MPM shall calculate power and energy consumption in accordance with ANSI C12.20 metering specification and stored in non-volatile memory for forwarding to an intelligent system.
9. The MPM shall store power in kW and energy in kWh for each metering point.
10. The MPM shall store energy profile information for each metering point in non-volatile memory. The profile time-period shall be adjustable from 1 to 60-minutes. The MPM shall be able to save a minimum of 365-days of energy profile data for all 60-meter points on a 15-minutes basis.
11. The MPM shall be suitable for mounting within a panelboard or switchboard utilizing a dedicated mounting bracket. The MPM shall have all connections oriented towards the wiring gutters of the panelboard or switchboard in which it is mounted. The MPM may also be mounted in a separate enclosure.
12. The MPM shall have LEDs that can be easily viewed when the unit is installed to aid in the installation and operation of the device with the following functionality as a minimum:
  - a. Each current input shall have an LED that shall flash in proportion to the amount of power flowing in the measures circuit.
  - b. An indication LED that flashes to indicate when the MPM is functioning properly.
  - c. A transmit LED that indicates when the MPM is transmitting data on the communication network.
  - d. A receive LED that indicates when the MPM is receiving data on the communication network.
13. The MPM shall have rotary address switches that are easily accessible and set the unit address on the communication network.
14. The local device network shall be factory interconnected utilizing two Modbus RTU ports. The communication speed at the device level shall be a minimum of 9,600-baud. Devices shall communicate at their maximum baud rate regardless of the number of devices on the network.
15. MPM shall be networkable such that a single modem can be utilized to read multiple meters.
16. Current sensors shall be provided with a toroidal winding over solid core. The winding shall be mounted over the circuit to be monitored by inserting the load conductor through a hole in the center of the current transformers. The current in the load conductor shall be made available to an electronic monitoring device through a four-conductor cable and terminated to a removable plug on the current sensor. The current sensor shall have two LEDs, one red for indicating loss of connection and one blue for verification to connected load. The current sensors shall be

suitable for use with circuits rated 125amp through 400amp. Extension cables, with a length of 8 and 16-feet and factory installed connectors shall be available for installations where the standard cable is too short for proper installation. The current sensors shall have 600volt rated cable insulation and shall be UL listed with the MPM.

## 2.03 WEB-BASED POWER MONITORING COMMUNICATION SYSTEM

- A. General: Furnish and install a complete web-based power monitoring communications system (PMCS) as detailed on the drawings and as described herein. The PMCS shall include all remote devices for metering, monitoring, control and protection, a network time server, all Ethernet communications gateways and gateway interfaces, intercommunication wiring, and ancillary equipment.
- B. Web-based PMCS:
  - 1. The PMCS shall provide a web browser-based monitoring and management system for all communicating devices in the power system.
  - 2. The PMCS shall communicate to all devices over an industry standard Ethernet communication backbone. For devices that cannot communicate directly on Ethernet, a gateway complying with the requirements of this specification can be provided.
  - 3. The PMCS shall provide a real time, web-based system to allow the user to easily view the key operational characteristics of the system. These features of the system shall not require any custom screen development or configuration to provide the following functions:
    - a. The PMCS shall provide the ability to view the current value of all operational variables available from all supported devices connected to the Ethernet network without the need for any additional system software.
    - b. The PMCS shall not require specific knowledge of a device to be able to display information from that device. Instead, the software shall have the ability to query the device for its operational capabilities and automatically set up web-based pages to display the information. No custom screen development shall be required to display data from any device able to connect to the system:
      - 1) The software shall support the ability to automatically establish a connection to any device added to a gateway without the user doing any configuration in the software.
    - c. The PMCS shall automatically build a one-line network hierarchy for all connected devices so the user can easily view them and display the corresponding data, status for those devices.
  - 4. The PMCS shall provide the ability trend one or more variables (volts, amps, kW, kWh, etc.) from one or more devices on a web-based trend graph. The trend viewer shall support the following features:
    - a. Web accessible trending tool.
    - b. Option to display all variables on a single chart.
    - c. Support for Min and Max value generation and graphing.
    - d. Ability to select trend date ranges from a calendar.
    - e. Ability to save the selected trend data to a CSV file using the web interface
  - 5. The PMCS shall provide an energy graph on the home page and shall include:

- a. Ability to show either demand or usage.
  - b. Ability to show the peak value for selected time periods and load factor.
  - c. Compare energy usage across devices.
  - d. Display peak periods for each device.
  - e. Ability to display line, bar, stacked bar, and cumulative usage for each selected period.
  - f. Move cursor to view energy values at any given time.
  - g. Calendar based date and time selection.
6. The PMCS shall support displaying of the waveform data collected by the power monitoring devices that can capture waveforms. The graphic format will display the data in an oscilligraphic format and in a Fourier Amplitude Spectrum graph.
  7. The PMCS shall provide time stamped sequential order of events for trips, analog alarms, motor start profiles, and operator actions based on the information received from the actual devices.
  8. The PMCS shall have the ability to manage alarm and event conditions detected by the devices. Alarm management shall include:
    - a. Ability to acknowledge alarms via the web interface.
    - b. Ability to flag priority alarms.
    - c. Ability to export alarms.
    - d. Ability to sort and analyze alarms by time, device, or priority.
  9. The PMCS shall provide web-based navigation system to easily:
    - a. Drill down” in the one-line hierarchy.
    - b. Upload any .jpeg or, png file as a one-line background.
  10. The PMCS shall be easy to operate and manage and shall include:
    - a. Ability to have a favorite’s list of devices.
    - b. Ability to add and remove devices from the favorites list.
    - c. Ability to see devices current status and key parameters at a glance.
    - d. Ability to navigate to main software views with a single mouse click.
  11. The PMCS shall be scalable such that the system can be expanded without requiring the user to reconfigure a new system.
  12. The PMCS shall be sized to support the number of devices shown on the drawings, plus the capacity to accommodate 10% additional devices.
  13. The PMCS shall not restrict the number of simultaneous users except based on the computing resources provided to support the system.
  14. The PMCS shall allow users to be granted privileges based on their user ID and password, to perform various functions in the system. The software shall support, at a minimum 2 levels of access with one supporting Read only access and the other provide full Administration access.

15. The PMCS shall provide onboard embedded memory that is not external to the system or resident on a separate computer.

C. Web-Enabled PMCS Hardware Components:

1. All web enabled devices in the PMCS shall provide any authorized user on the customer's network access to the critical data listed below with the user requiring only a supported Internet browser on their own computer.
  - a. Meter Screen providing:
    - 1) Volts: L-L and L-N, and average.
    - 2) Frequency.
    - 3) Current and average phase A, B, and C, N and G.
  - b. Power Screen providing:
    - 1) Energy.
    - 2) Demand.
    - 3) Power Factor.
  - c. Quality Screen providing:
    - 1) Total Harmonic Distortion (THD) of volts and current.
  - d. Events screen providing:
    - 1) Latest events.
    - 2) Enabled Triggers.
    - 3) Historical Events.
2. The web-enabled power monitoring hardware shall support multiple protocols over Ethernet to ensure the system can easily be integrated into the PCMS software system as well as existing systems. These protocols shall include:
  - a. Modbus TCP/IP.
  - b. BACnet/IP.
  - c. SNMP.
  - d. HTTP.
  - e. SMTP.
  - f. NTP.
  - g. File System for exporting .CSV trend files.
3. The web enabled power monitoring hardware shall provide support for configuration of all web enabled meters and gateways directly via the web pages on the device.
  - a. To support the configuration of legacy devices on the device networks connected to the gateway, the gateway shall support a "pass through mode" to allow the legacy configuration software to connect from any computer on the users network to the device via the gateway.

4. All web enabled power monitoring hardware that is connected directly to Ethernet shall support the ability to synchronize their time clock using Network Time Protocol (NTP). The purpose for this support is to ensure all device clocks are accurate so that event sequences can be adequately analyzed.
  - a. For devices that support clock synchronization and are on the device networks connected to the gateways, they shall support the ability to sync their clock to the clock in the gateway.
5. Ethernet Switches:
  - a. A single web access point: 4 or 6-port Ethernet switch shall be provided in the equipment to allow a single access point for the user and the ability to connect more than one network device directly on the customer's Ethernet Local Area Network (LAN).
  - b. Ethernet switch shall support standard copper RJ45 connectors and/or 100BaseFX Fiber-Optic via ST connectors.

## 2.04 DATA ACQUISITION SERVER GATEWAY

### A. General:

1. The data acquisition server allows users to connect and secure data from virtually any meter type and convert the raw meter output into usable information. This information can be integrated with almost any level of software system or database, from an enterprise software suite to a simple Excel spreadsheet.
2. The data acquisition server is scalable for energy monitoring applications, including the ability to access and configure devices through any web browser.
3. The data acquisition server employs "plug & play" technology, and automatically detects and configures downstream Modbus devices in seconds. Data from downstream devices are time stamped and stored in non-volatile memory at user-selected intervals. The data can be stored or uploaded to a destination of user's choice through a number of different formats. Data can also be accessed through any web browser via integrated modem or Ethernet connection.
4. Using the built-in modem or Ethernet port, data is sent via either the network or phone lines to the online server system. From the Online website, you can view past data, plot charts, and export data.
5. User can push/pull data into energy kiosk or dashboard, custom software applications, or any web interface.

### B. Equipment description:

1. The data acquisition server unit shall be a standalone, wall-mounted device powered by a 120volt AC plug-in transformer with 24volt DC output.
2. The unit shall accept up to 32 Modbus device inputs on the RS485 serial input terminals. The unit shall provide automatic recognition and configuration for Modbus power meters as well as other Modbus devices.
3. The unit shall provide user interface via standard web browser using an integrated Ethernet RJ45 jack.
4. Unit shall provide alarm setpoints for all measured values including the option for either high/low or warning/alarm.

5. Unit shall be capable of using LAN connections (static IP or DHCP), telephone modem or cell modem (GSM) for data upload.
6. Unit shall provide data in standard delimited text form (.txt). There shall be an option for retrieving data using XML. Data uploads shall be either push or pull at the option of the user, on user-selected intervals.
7. Store all recorded variables in non-volatile memory.
8. The unit shall function as a gateway device, using Modbus TCP to retrieve specific data from connected devices as required.
9. Performance characteristics:
  - a. Main processor: ARM 9
  - b. I/O Co-processor: ARM 7
  - c. Operating system: Linux 2.6
  - d. Flash ROM: 16MB NOR Flash (expandable with USB memory device)
  - e. Memory: 32MB RAM
  - f. LED: 8x pulse input, 4 modem activity, Modbus TX/RX, power status
  - g. Console: 2x 16 LCD character, two buttons
  - h. LAN: 10/100, Auto crossover detection
  - i. Modem (phone): V.34bis, 33,600bps
  - j. Modem (cellular): GSM/GPRS Class 10, 85kbps
  - k. Protocols: Modbus/RTU, Modbus/TCP, TCP/IP, PPP, HTTP/HTML, FTP, SNMP, SMTP, XML
  - l. Power supply: 24volt DC, transformer included
  - m. Power requirement: 120volt AC
  - n. Serial port: RS485 Modbus
  - o. USB port: USB memory expansion port
  - p. Interval recording: User selectable 1 to 60-minutes. Default of 15-minute interval
  - q. Outputs: 2x, Dry contact 30volt DC, 150mA max
  - r. The unit shall accept up to 8 inputs directly. Each input shall be capable of being configured for the following:
    - 1) 0-10volts: Min/Max/Ave/Instantaneous
    - 2) 4-20mA: Min/Max/Ave/Instantaneous
    - 3) Pulse: Consumption, rate.
    - 4) Resistance: Min/Max/Ave/Instantaneous
    - 5) Runtime: Runtime, status

## 2.05 MISCELLANEOUS MONITORING SYSTEMS



- A. The meters that follow are all to be furnished under another Division of Work but require connection under this Division to the energy information system network. Coordinate the exact location of these meters with HVAC, plumbing and landscape irrigation contractors prior to commencing installation.
- B. Meters provided by others shall have a Modbus TCP/IP protocol to be supported on the energy information system network. The exception being the water flow meters and the natural gas flow meters, which shall be the pulse output type meters with dry contacts. The data acquisition server can support direct connections with both the Modbus meters and the pulse output meters.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Contractor shall thoroughly examine Project site conditions for acceptance of metering equipment installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

#### **3.02 INSTALLATION**

- A. Install energy information system components in accordance with Manufacturer's written instructions, as indicated on the Drawings and as specified herein.
- B. Tighten electrical connectors and terminals; including screws and bolts, in accordance with equipment Manufacturers published instructions.
- C. Coordinate the software installation after all hardware has been completely installed, connected, and activated.

#### **3.03 PROGRAMMING**

- A. The contractor shall insure the on-site programming of the system by a manufacturer's representative, as well as to assist in the system startup. On-site services shall include:
  - 1. Setting all the addresses of all devices in the equipment.
  - 2. Verifying and troubleshooting the integrity of the data.
  - 3. Assisting the Owner in correcting any data line problems.
  - 4. Coordinating any possible warranty problems.
  - 5. Configure the software to match the field devices.

#### **3.04 FIELD QUALITY CONTROL**

- A. Independent testing: Contractor shall arrange and pay for the services of an independent Testing Agency to perform all quality control electrical testing, calibration and inspection required herein. Testing Agencies objectives shall be to:
  - 1. Assure energy information system equipment installation conforms to specified requirements and operates within specified tolerances.
  - 2. Field test and inspect to insure operation in accordance with Manufacturer's recommendations and Specifications.
  - 3. Prepare final test report including results, observations, failures, adjustments, and remedies.
  - 4. Verify settings and make final adjustments.

- B. At least three weeks prior to any testing, notify the Engineer so that arrangement can be made for witnessing test, if deemed necessary. All pretesting shall have been tested satisfactorily prior to the Engineer's witnessed test.
- C. The Contractor shall supply a suitable and stable source of electrical power to each test site. The Testing Agency shall specify the specific power requirements.
- D. Testing of energy information system equipment shall be done only after all devices are installed and system is energized.
- E. Prefunctional testing:
  - 1. Provide Testing Agency with Contract Documents and Manufacturer instructions for installation and testing.
  - 2. Visual and mechanical inspection:
    - a. Inspect for physical damage, defects alignment and fit.
    - b. Verify the meters are functional by scrolling through monitoring options.
    - c. Compare nameplate information and connections to Contract Documents.
    - d. Check tightness of all control and power connections.
    - e. Check that all covers, barriers, and doors are secure.
  - 3. Electrical tests:
    - a. Provide a portable meter that was calibrated prior to test, on the same day as test, and with an accuracy equivalent to that of the meters being tested.
    - b. Confirm values of each meter in the system by hooking up portable meter to feeder being monitored. Ensure that there is a minimum of 5% load on feeder at time of test, based on the overcurrent protection size.
    - c. Calibrate meters as required based on reading from portable meter.
- F. Contractor shall replace at no costs to the Owner all devices which are found defective or do not operate within factory specified tolerances.
- G. Contractor shall submit the Testing Agency's final report for review prior to Project closeout and final acceptance by the Owner. Test report shall indicate test dates, devices tested, results, observation, deficiencies, and remedies. Test report shall be included in the operation and maintenance manuals.

### 3.05 CLEANING

- A. Upon completion of Project prior to final acceptance the Contractor shall thoroughly clean energy information system equipment per Manufacturer's approved methods and materials.

### 3.06 TRAINING

- A. Factory authorized service representative shall conduct a 4-hour training seminar for Owner's Representatives upon completion and acceptance of system. Instructions shall include operation, maintenance, and testing of equipment with both classroom training and hands-on instruction.
- B. Contractor shall schedule training with a minimum of 7-days advance notice.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Attic stock for fuses, one set for every set installed.

## SECTION 26 28 16

## OVERCURRENT PROTECTIVE DEVICES

**PART 1 - GENERAL****1.01 SUMMARY**

- A. Work included: Labor, materials, and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
  - 1. Fuses.
  - 2. Molded case circuit breakers.
- B. Related Work: Consult all other Sections, determine the extent and character of related Work, and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.

**1.02 REFERENCES**

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:
  - 1. Underwriters Laboratories, Inc. (UL):
    - UL 248(1-16); Low-Voltage Fuses.
    - UL 489; Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.
    - UL 512; Fuseholders.
  - 2. National Electrical Manufacturer Association (NEMA):
    - NEMA AB 1; Molded Case Circuit Breakers.

**1.03 SUBMITTALS**

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
  - 1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
  - 2. Describe product operation, equipment and dimensions and indicate features of each component.
  - 3. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
  - 4. Provide factory certification of trip characteristics for each type and rating of circuit breaker.
  - 5. Provide current let-through and melting time information for each type and rating of fuses.
  - 6. Confirmation in writing of compliance with Arc Energy Reduction per CEC Articles 240.67 and 240.87.

7. Submit Manufacturer's installation instructions.
8. Complete bill of material listing all components.
9. Warranty.

#### 1.04 OPERATION AND MAINTENANCE MANUAL

- A. Supply operation and maintenance manuals in accordance with the requirements of Section 260010: Basic Electrical Requirements, to include the following:
  1. A detailed explanation of the operation of the system.
  2. Instructions for routine maintenance.
  3. Parts list and part numbers.
  4. Telephone numbers for authorized parts and service distributors.
  5. Final testing reports.

#### 1.05 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused and currently under production.
- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.

#### 1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery: Overcurrent Protective Device components shall not be delivered to the Project site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable. Equipment damaged during shipment shall be replaced and returned to Manufacturer at no cost to Owner.
- B. Storage: Store in a clean, dry, ventilated space free from temperature extremes. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris and traffic. Provide heat where required to prevent condensation.
- C. Handling: Handle in accordance with Manufacturer's written instructions. Be careful to prevent internal component damage, breakage, denting and scoring. Damaged units shall not be installed. Replace damaged units and return equipment to Manufacturer.

#### 1.07 WARRANTY

- A. Units and components offered under this Section shall be covered by a 1-year parts and labor warranty for malfunctions resulting from defects in materials and workmanship. Warranty shall begin upon acceptance by the Owner.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.
  1. Fuses:
    - a. Bussmann Division, Cooper Industries.

b. Gould Shawmut Co.

2. Circuit breakers:

a. Square D.

b. ABB/ General Electric.

c. Eaton.

d. Siemens.

B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

2.02 GENERAL

A. Overcurrent protective devices shall satisfy all CEC mandated selective coordination requirements (e.g. CEC Articles 517, 620, 645, 695, 700, 701, 708).

B. Fuses rated 1200 amps or higher shall satisfy CEC Article 240.67 requirements.

C. Circuit breakers rated (or can be adjusted) 1200amps or higher shall satisfy CEC Article 240.87 requirements.

2.03 FUSES

A. General: All power fuses shall be time-delay, high interrupting (300K AIC), current limiting type, unless otherwise noted on the Drawings. All fuses shall be the product of a single Manufacturer and shall be selectively coordinated when applied in 2:1 ratio. Types of fuses shall be as follows:

1. 0 to 600amps: UL Class J, dual element, time delay type fuse with separate overload and short-circuit elements. The fuse shall hold 500% of rated current for a minimum of 10-seconds.

B. Control and instrument fuses shall be suitable for installing in blocks or fuseholders. Exact type and rating shall be as recommended by the Manufacturer of the equipment being protected.

2.04 MOLDED CASE CIRCUIT BREAKERS

A. Branch and feeder circuit breakers shall be molded case, bolt on and trip indicating.

B. Where stationary molded case circuit breakers are indicated on the Drawings to be current limiting type, they shall be current limiting as defined by UL 489 and shall not employ any fusible elements.

C. Circuit breakers shall have interrupting capacity not less than that indicated on the Drawings or if not indicated, not less than 14,000 RMS symmetrical amps for 480volt systems and 10,000 RMS symmetrical amps for 208volt systems.

D. Covers shall be sealed on non-interchangeable breakers and trip unit covers shall be sealed on interchangeable trip breakers to prevent tampering. Circuit breaker ratings shall be clearly visible after installation or engraved nameplates shall be provided stating the rating. All ferrous parts shall be plated to minimize corrosion.

E. Circuit breakers shall be toggle, quick-make and quick-break operating mechanisms with trip-free feature to prevent contacts being held closed against overcurrent conditions in the circuit. Trip position of the breakers shall be clearly indicated by operating handles moving to a center position.

F. Provide identified handle ties for single pole circuit breakers that share a neutral conductor.

- G. Multipole breakers shall have a single handle to open and close all contacts simultaneously in both manual operation and under automatic tripping. Interpole barriers shall be provided inside the breaker to prevent any phase-to-phase flashover. Each pole of the breaker shall have means for Arc extinguishing.
- H. All terminals shall be dual rated for aluminum or copper wire.
- I. Circuit breakers with frame ratings 100amps and smaller shall be ambient temperature compensated, thermal magnetic type unless otherwise noted. Breakers shall be of full size, 1" per pole type. Panels with more than one branch breaker larger than 100amps shall be installed in distribution type panels.
- J. Circuit breakers with frame ratings above 100amps through 400amps shall have solid state electronic trips with true RMS reading through the 13th harmonic with 1% accuracy, interchangeable trip via front accessible current plug, adjustable instantaneous and short time be rated as indicated on Drawings at the voltage indicated.
- K. Circuit breakers with frame ratings above 400amps through 2500amps shall have microprocessor-based RMS sensing trip units with the following characteristics:
  - 1. Interchangeable current rating plug or an adjustable trip setting to match the trip rating as indicated on Drawings.
  - 2. Adjustable long-time pick-up setting. Minimum of five settings from 50% to 100%.
  - 3. Adjustable long-time delay setting. Minimum of three delay bands.
  - 4. Adjustable short time pick-up setting. Minimum of five settings from 200% to 800%.
  - 5. Adjustable short-time delay setting. Minimum of three delay bands with I2t IN and OUT curves.
  - 6. Adjustable instantaneous pick-up setting. Minimum of five settings from 200% to 1000%. Where the instantaneous feature is omitted on the Drawings, the trip unit shall have an instantaneous override feature.
  - 7. Zone selective interlocking (ZSI) for short-time delay and ground-fault delay trip functions, if indicated on the drawings.
  - 8. LED status indication to show "health" of trip unit.
  - 9. Three-phase ammeter, if indicated on the drawings.
  - 10. Trip indication targets on overload, ground fault and short circuit, if indicated on the drawings.
- L. Accessories: Provide accessories as noted on the Drawings, i.e. shunt-trip, auxiliary contacts, undervoltage trip, alarm switch, etc.
- M. Spaces in the boards shall be able to accept any combination of 1, 2 or 3-pole circuit breakers as indicated. Provide all necessary bus, device supports, and mounting hardware sized for frame, not trip rating.
- N. Series rated breakers are not acceptable unless specifically noted on the Drawings.
- O. Breaker shall be rated to operate in an ambient temperature of 40-degrees C and at 100% of their frame ampere rating on a continuous basis, if indicated on the drawings.
- P. For circuit breakers rated or can be adjusted to 1200amps (or higher), provide zone selective interlocking (ZSI) with downstream protective devices, if indicated on the drawings. If ZSI is not



indicated on the drawings, provide a key interlock maintenance mode switch and blue LED indicating lamp in the same section, which shall allow an operator to manually enable temporary protective device maintenance settings to reduce the arc flash energy level. Key shall be held captive when maintenance mode signal is disabled and removable when maintenance mode signal is enabled. Maintenance mode switch positions shall be labeled "Enabled" and "Disabled". Blue indicating lamp shall be push-to-test type.

- Q. Refer to the Drawings for breakers requiring ground fault protection. See Section 262413: Switchboards for requirements of ground fault protection system.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Contractor shall thoroughly examine Project site conditions for acceptance of overcurrent protective device installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

#### **3.02 INSTALLATION**

- A. Install overcurrent protective devices in accordance with Manufacturer's written instructions, as indicated on the Drawings and as specified herein.
- B. Tighten electrical connectors and terminals; including screws and bolts, in accordance with equipment Manufacturers published torque-tightening values for equipment connectors. Where Manufacturers torque requirements are not indicated tighten connectors and terminals to comply with tightening torque specified in UL Standard 486A.
- C. Install overcurrent protective devices and accessories in accordance with Manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements. All devices shall be installed in accordance with applicable CEC and NEMA standards for installation.
- D. Circuit breakers serving "Fire Alarm Control Panel(s)" shall be red in color.

#### **3.03 ATTIC STOCK**

- A. Provide 1 set of spare fuses for every set installed.

#### **3.04 FIELD QUALITY CONTROL**

- A. Independent testing: Contractor shall arrange and pay for the services of an independent Testing Agency to perform all quality control electrical testing, calibration and inspection required herein. Testing Agencies objectives shall be to:
1. Assure overcurrent protective device installation conforms to specified requirements and operates within specified tolerances.
  2. Field test and inspect to ensure operation in accordance with Manufacturer's recommendations and Specifications.
  3. Prepare final test report including results, observations, failures, adjustments, and remedies.
  4. Verify ratings and settings and make final adjustments.

- B. At least three weeks prior to any testing, notify the Engineer so that arrangement can be made for witnessing test, if deemed necessary. All pretesting shall have been tested satisfactorily prior to the Engineer's witnessed test.
- C. The Contractor shall supply a suitable and stable source of electrical power to each test site. The Testing Agency shall specify the specific power requirements.
- D. Testing of overcurrent protective devices shall be done only after all devices are installed and prior to system being energized.
- E. Prefunctional testing:
  - 1. Provide Testing Agency with Contract Documents and Manufacturer instructions for installation and testing.
  - 2. Visual and mechanical inspection:
    - a. Inspect for physical damage, defects alignment and fit.
    - b. Perform mechanical operational tests in accordance with Manufacturer's instructions.
    - c. Compare nameplate information and connections to Contract Documents.
    - d. Check tightness of all control and power connections.
    - e. Check that all covers, barriers, and doors are secure.
  - 3. Electrical tests:
    - a. Circuit continuity: All feeders shall be tested for continuity. All neutrals shall be tested for improper grounds.
    - b. Test all circuit breakers with frame size 225amps and larger in each panelboard, distribution board, switchboard, etc. unless otherwise noted via primary current injection testing. Testing shall verify the following:
      - 1) Determine that circuit breaker will trip under overcurrent conditions, with tripping time in conformance with NEMA AB 1 requirements.
      - 2) Circuit breaker pickup and delay measurements are within the manufacturers published tolerances for long time, short time, instantaneous, and ground fault.
      - 3) For circuit breakers rated or can be adjusted to 1200amps (or higher), confirm ZSI protection is acceptable or the maintenance mode switch is operational (enabled and disabled) with reduced pickup and delay measurements when enabled.
- F. Contractor shall replace at no costs to the Owner all devices which are found defective or do not operate within factory specified tolerances.
- G. Contractor shall submit the Testing Agency's final report for review prior to Project closeout and final acceptance by the Owner. Test report shall indicate test dates, devices tested, results, observation, deficiencies, and remedies. Test report shall be included in the operation and maintenance manuals.

### 3.05 ADJUSTING

- A. Adjust circuit breaker trip settings based on recommendations of Section 260060: Power System Study.

- B. Adjust circuit breaker trip settings for coordination with other overcurrent protective devices in system.
- C. Adjust circuit breaker trip settings for adequate protection from overcurrent and fault currents.

### 3.06 CLEANING

- A. Upon completion of Project prior to final acceptance the Contractor shall thoroughly clean overcurrent protective devices per Manufacturer's approved methods and materials. Remove paint splatters and other spots, dirt, and debris.

### 3.07 TRAINING

- A. Factory authorized service representative shall conduct a 4-hour training seminar for Owner's Representatives upon completion and acceptance of system. Instructions shall include safe operation, maintenance, and testing of equipment with both classroom training and hands-on instruction.
- B. Contractor shall schedule training with a minimum of 7-days advance notice.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Take into account working clearance requirements for all disconnect switches.

## SECTION 26 28 19

## DISCONNECT SWITCHES

**PART 1 - GENERAL****1.01 SUMMARY**

- A. Work included: Labor, materials, and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
  - 1. Disconnect Switches.
- B. Related Work: Consult all other Sections, determine the extent and character of related Work, and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.

**1.02 REFERENCES**

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated on specified:
  - 1. National Electrical Manufacturer Association (NEMA):
    - NEMA KS 1;                      Enclosed Switches.
  - 2. Underwriters Laboratories, Inc. (UL):
    - UL 512;                              Fuseholders.

**1.03 SUBMITTALS**

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
  - 1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
  - 2. As a minimum the following characteristics shall be indicated:
    - a. NEMA types.
    - b. Current rating.
    - c. Number of poles.
    - d. Fuse provisions.
    - e. Enclosure dimensions.
    - f. Voltage.
    - g. Horsepower rating (if applicable).
    - h. Short circuit rating.
  - 3. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
  - 4. Submit Manufacturer's installation instructions.

**1.04 QUALITY ASSURANCE**

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused, and currently under production.
- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.
  - 1. Square D.
  - 2. ABB/ General Electric.
  - 3. Eaton.
  - 4. Siemens.
- B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

### **2.02 DISCONNECT SWITCHES**

- A. Description: Provide NEMA heavy-duty type switches with dead front construction and padlock provisions for up to three locks in the "OFF" position.
- B. Switch interior: Provide switch with switchblades that are fully visible in the "OFF" position when the door is open. Provide UL listed lugs for copper conductors, lugs to be front removable. Provide plated current carrying part.
- C. Switch mechanism: Provide switches with a quick-make, quick-break, position indicating, operating handle and mechanism and a dual cover interlock to prevent unauthorized opening of the switch door in the "ON" position or closing of the switch mechanism with the door open. Furnish an electrical interlock to de-energize control wiring when the disconnect switch is opened.
- D. Enclosures: Provide switches with hinged cover in NEMA 1 general purpose, sheet steel enclosure for dry locations and NEMA 3R weatherproof galvanized enclosures for exterior, damp, or wet locations, unless otherwise noted on the Drawings. Provide an enclosure treated with a rust-inhibiting phosphate primer and finished in gray baked enamel.
- E. Ratings: Provide switches that are horsepower rated for 240 VAC or 600volt AC as required for the circuit involved and that meet "I-SQUARED-T" requirements. Fusible switches to have provisions for the types of fuses specified in Section 262816: Overcurrent Protective Devices. UL listed short circuit rating, when equipped with fuses to be 200,000amps RMS symmetrical. Furnish with provisions for RK-1 fuses for switches up to 600amps. 800amp switches and larger to have provisions for Class L fuses.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Contractor shall thoroughly examine Project site conditions for acceptance of disconnects switch installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

### **3.02 PREPARATION**

- A. Coordinate locations of switches and equipment in the field to provide code required clearances in front of switches and to ensure that switches are insight of the controller as described in CEC Article 430.

### 3.03 INSTALLATION

- A. Install disconnect switches where indicated on the Drawings.
- B. Install fuses in fusible disconnect switches.
- C. Include construction channel and mounting hardware as required to support disconnect switch.

### 3.04 IDENTIFICATION

- A. Provide engraved, machine screw retained type 'NP' nameplate on each disconnect switch. See Section 260553: Electrical Identification.

### 3.05 CLEANING

- A. Upon completion of Project prior to final acceptance the Contractor shall thoroughly clean both the interior and exterior of enclosure of all construction debris, scrap wire, paint splatters, dirt, etc.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 2025-01-31 – Miscellaneous modifications to reflect current PV system standards and DSA requirements.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Photovoltaic systems shall be designed to meet the requirements of DSA IR 16-8.



## SECTION 26 31 00

## PHOTOVOLTAIC POWER SYSTEMS

**PART 1 - GENERAL****1.01 SUMMARY**

- A. Work included: Labor, materials, and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
  - 1. PV Inverter(s).
  - 2. PV modules or panels.
  - 3. Rapid shutdown devices.
  - 4. Disconnect switches.
  - 5. Combiner and junction boxes.
  - 6. Monitoring.
  - 7. Conduit and wire.
  - 8. Utility metering/monitoring equipment.
  - 9. Start-up and field quality control.
- B. Related Work: Consult all other Sections, determine the extent and character of related Work, and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.

**1.02 REFERENCES**

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:
  - 1. Institute of Electrical and Electronic Engineers (IEEE):
    - IEEE 587;                      Category B for Surge Withstand ability (ANSI C62.41).
    - IEEE 1547;                    Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces
  - 2. California Building Standards Code:
    - CEC;                          California Electrical Code
    - CBC;                          California Building Code
    - CFC;                          California Fire Code (Section 1204 Solar Photovoltaic Power Systems)
  - 3. Underwriters Laboratories, Inc. (UL):
    - UL 1703;                      Standard for Flat-Plate Photovoltaic Modules and Panels.
    - UL 1741;                      Standard for Inverters, Converters and Controllers for Use in Independent Power Systems

UL 1741 SB;                   Advanced Inverter Testing and Certification Program

UL 2703;                    Standard for Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Grounds Lugs for Use with Flat-Plate Photovoltaic Modules and Panels

4. UL 61730           Photovoltaic (PV) Module Safety QualificationCalifornia Energy Commission:  
Title 24, Part 6, JA11 Standard for system sizing, interconnection, and performance monitoring.  
PV Module List  
Grid Support Solar Inverter List
5. SMUD Electric Service Requirements:  
Commercial Distributed Generation with Optional Energy Storage Systems, Engineering Specifications T015

### 1.03 DEFINITIONS

- A. PV power system: Photovoltaic power source consisting of input and output feeders, PV inverter(s), PV modules or panels, DC disconnect(s), combiner and junction boxes, remote monitoring panels, data acquisition systems, and associated accessories.

### 1.04 SUBMITTALS

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
  1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
  2. Describe system operation, equipment and indicate features of each component.
  3. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
  4. Shop Drawings to include:
    - a. Completely dimensioned plan view (1/4-inch scale) of all PV modules or panels and associated equipment with dimensioned locations of all incoming conduits. Indicate clearance requirements and interconnection cable requirements. Include feeder tags for all interconnections and feeder cables indicated on the equipment layout plan.
  5. One line power diagram: Complete interconnection schematic wiring diagrams indicating all major power components, including the current draw on each feeder and wiring requirements and conductor terminal identification for the following items:
    - 1) PV inverter(s).
    - 2) Disconnect switch(es).
    - 3) AC Panelboards / Switchboards.
    - 4) Rapid Shutdown Devices.
    - 5) PV modules.
    - 6) Combiner and junction boxes.

- 7) Conduit and wire specifications.
- 8) Overcurrent protection device ratings.
- 9) Utility-required metering / monitoring equipment.
- 10) Data acquisition system(s).
- b. Grounding diagram: Complete interconnection schematic wiring diagram showing all major ground connections and wiring requirements for the following:
  - 1) Modules.
  - 2) Racking equipment.
  - 3) PV mounting structures.
  - 4) PV inverter(s).
  - 5) Disconnect Switches.
  - 6) AC Panelboards / Switchboards.
  - 7) Equipment grounding and bonding.
  - 8) Grounding electrode system.
  - 9) Equipment bonding jumpers.
6. Furnish structural calculations for equipment and mounting structure anchorage as described in Section 260010: Basic Electrical Requirements. Provide weights, dimensions, and center of gravity for structural calculations.
7. Furnish structural engineering drawings and calculations for PV module racking, attachment, and anchorage to building or structure. Structural drawings and calculations shall be stamped by a licensed structural engineer. Structures requiring calculations shall include, but is not limited to:
  - a. Carports and canopies.
  - b. Rooftop racking equipment.
  - c. Ground mounted PV arrays.
8. Submit Manufacturer's installation instructions.
9. Complete Bill of Materials listing all components; include equipment height, width, depth, and weight.
10. Warranty.
- B. Dimensions and configurations of PV components shall conform to the space allocated on the Drawings. The Contractor shall submit a revised layout if the equipment furnished varies in size from that indicated on Drawings for Engineer's approval.
- C. Manufacturer's qualifications: Furnish satisfactory proof of required experience specified herein for Manufacturer of each product.
- D. Installer's qualifications: Furnish satisfactory proof of required experience specified herein for system installer.

- E. Copies of the completed and submitted rebate and incentive program documents.

1.05 OPERATION AND MAINTENANCE MANUAL

- A. Supply operation and maintenance manuals in accordance with the requirements of Section 260010: Basic Electrical Requirements, to include the following:
  - 1. A detailed explanation of the operation of the system.
  - 2. Instructions for routine maintenance.
  - 3. Pictorial parts list and part numbers.
  - 4. Schematic wiring diagrams.
  - 5. Telephone numbers for the authorized parts and service distributor.
  - 6. Include all service bulletins.
  - 7. Final testing reports.

1.06 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused, and currently under production.
- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.
- C. Manufacturer qualifications: Firms regularly engaged in the manufacturing of PV power systems of types and sizes required for this Project and whose products have been in satisfactory use in similar service for not less than 5-years.
- D. The unit shall be factory assembled and tested by the PV power system provider or by a firm holding a contract as the authorized distributor of the equipment and shipped to the Project site by his authorized dealer having a parts facility within 100-miles of the Project. Upon request, the Contractor shall furnish to the Engineer a notarized letter of certification stating that in fact the bidder meets the requirements of this paragraph.
- E. Installer's qualifications: Firms with a minimum of 5-years of successful installation experience with Projects utilizing PV power systems similar to that of this Project.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Shipment: The equipment specified herein shall be delivered via an air-suspension van, complete and ready for installation, to the Owner's Project site. The Contractor shall be given at least two weeks notification of intent to ship and vendor shall not ship without written approval by the Engineer.
- B. Preparation for shipment:
  - 1. Protective coatings:
    - a. PV inverter and other similar self-contained or enclosed components shall be shop primed and finished. Surfaces that will be inaccessible after assembly shall be painted or otherwise protected before assembly by a method that provides protection for the life of the equipment.

- b. After final factory tests and acceptance, prior to packing, crating or shipment, all machined and/or polished and other ferrous and non-ferrous surfaces that are not to be painted shall be coated with rust preventive compounds according to the best judgment and experience of the Manufacturer.
  - c. Primers for steel and iron surfaces shall be suitable for the service and operating temperatures to be encountered during the life of the equipment.
  - d. All exterior parts of equipment shall receive factory paint in the Manufacturer's standard colors.
2. Packing: All material and equipment shall be protected to ensure cleanliness during shipment, storage, and erection.
- a. All equipment shall be adequately packed to prevent damage from handling, weather, shock, vibration, and corrosion during shipment.
  - b. All boxes, crates and shipments shall be identified with equipment numbers, tag numbers, mark numbers or other identification.
  - c. All boards, panels, racks, and equipment shall be prepared for shipment with provisions for lifting and/or skidding. All lifting points shall be clearly marked.
  - d. Each shipping unit shall be braced adequately and rigidly both internally and externally to prevent damage during transit or in the process of erection.
  - e. All original shipping stops, bolts, ties, shunts, and other such hardware shall be reinstalled in all instruments and devices and vendor shall provide any other necessary protection required to prevent damage during shipment.
  - f. When assemblies are supplied that require disassembly for installation or are shipped disassembled, each piece of the subassembly so affected shall be uniquely identified to its assembly position.
  - g. Manufacturer shall identify all equipment and components with metal or heavy linen tags substantially wired to the object and bearing the appropriate designation or tag number.
  - h. All loose peripheral equipment shall be boxed, crated, or otherwise completely enclosed and protected during storage, handling, and shipment. Each item of equipment shall be clearly marked. All equipment shall be protected from possible rough handling or vibration during transit.
- C. Delivery: PV power system components shall not be delivered to the Project site until Contractor is ready for installation and construction is complete in area. Equipment damaged during shipping shall be replaced and returned to Manufacturer at no cost to Owner.
- D. Storage: Storage on Project site is not acceptable.
- E. Handling: Handle in accordance with Manufacturer's written instructions. Be careful to prevent internal component damage, breakage, denting and scoring. Damaged units shall not be installed. Replace damaged units and return equipment to Manufacturer.

#### 1.08 UTILITY INTERCONNECTION REQUIREMENTS

A.

- B. The PV power system provider shall be responsible for acquiring the utility interconnection approval permit. This includes acquiring all forms, documents, permit applications, associated fees and attending any required meetings with the utility.
- C. The PV power system provider shall comply with all utility interconnection requirements. Additional requirements deemed necessary by the utility that were not included by the PV inverter Manufacturer will be provided by the PV power system provider at no cost to Owner.
- D. The Engineer shall be copied on all forms, documents, applications, permits and correspondence between the PV power system provider and utility.

#### 1.09 REBATE AND INCENTIVE PROGRAMS

- A. The PV power system provider shall be responsible for acquiring, completing, and submitting information to qualify and reserve funds from rebate and incentive programs offered by state and federal programs in the Owner's name.
- B. The PV power system provider shall coordinate all inspections and perform all follow-up Work deemed necessary in order for the Owner to receive the rebate or incentive compensation.
- C. The Engineer shall be copied on all forms, documents, applications, permits and associated correspondence.

#### 1.10 WARRANTY

- A. Units and components offered under this Section shall be covered by a 15-year parts and labor warranty for malfunctions resulting from defects in materials and workmanship. Warranty shall begin upon acceptance by the Owner. The exception to this shall be the PV modules or panels which shall be covered by a 25-years parts and labor warranty.
- B. The PV power system Supplier shall promptly correct any deficiencies in the materials and workmanship, which occur during the parts and labor warrantee to the satisfaction of the Engineer at no additional cost to the Owner.
- C. PV modules or panels shall be warrantee to be free from defective materials and workmanship. The PV power system Supplier shall repair or replace, at their option, without charge to the Owner, any PV module or panel that fails as a result of defective workmanship or materials within 5 years from the date of Engineer's acceptance of the completed installation.
- D. In addition, PV power system Supplier agrees to replace or repair at their option, on a pro-rated basis after the 5-year parts and labor warranty, any PV module or panel that fails for the full 25-years warranty period.
- E. Warranty discharge limitations shall be specified and shall be consistent with these Specifications.

#### 1.11 SYSTEM START-UP

- A. Upon completion of installation, a factory trained dealer service representative shall perform initial start-up of the PV power system. Sufficient time shall be allowed to properly check the system out and perform required minor adjustments before the Engineer's witnessed test shall begin.

#### 1.12 MAINTENANCE

- A. Maintenance services:
  - 1. For a period of 1 year following acceptance the equipment Supplier shall have a person(s) familiar with this Project attend 4 meetings with the Owner's Representative to review system

performance, operation, and any system problems. That person shall provide a written summary of the items discussed in each meeting and a schedule of when the system problems will be corrected. The report is due within 7 working days after each meeting.

2. Provide a 2-year Manufacturer's maintenance contract of the full PV power system. The 2-year period shall begin from the date of acceptance on a total no-charge basis. During this period, Manufacturer's maintenance staff shall visit the installation not less than 2-times for routine inspection and preventive maintenance. The maintenance visits shall be scheduled at 6-month intervals and shall be coordinated with the Owner and performed at times selected by the Owner. A written report of each maintenance visit shall be submitted to the Owner within 10-days. The vendor shall submit a preventative maintenance schedule outlining in detail the following:
  - a. Time and duration when services are to be performed.
  - b. Work to be performed. Minimum Work per visit shall include voltage and current readings on all PV modules or panels.
  - c. Shutdowns required for service.
  - d. Company or Contractor support services required.
3. Manufacturer of PV power system shall have service and maintenance personnel solely in employ of and trained by Manufacturer in the maintenance, field testing, repair, and adjustment of the type system to be provided.
  - a. Service and maintenance personnel to be used for on-site testing and placing system in operation to have minimum of 2-years of experience with system to be provided.
  - b. Service and maintenance personnel shall be capable of responding to requests for emergency on-site service calls within 24 hours from initial call during normal working hours (8 a.m. to 5 p.m. Monday, through Friday) and within 48 hours during off hours (holidays, weekends, evenings after 5 p.m.).

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.
  1. PV inverters: Refer to the latest California Energy Commission List for Approved Grid Support Inverters.
  2. PV modules or panels: Refer to the latest California Energy Commission List for PV Modules.
- B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

### **2.02 GENERAL**

- A. The PV power system shall consist of the following:
  1. PV inverter(s).
  2. Utility interconnection protection.
  3. Rapid shutdown devices.

4. System metering, system status indicators and system alarm annunciation circuitry.
  5. PV modules or panels.
  6. Accessories as specified herein.
- B. Installation and wiring methods shall conform to the requirements set forth in the CEC Articles 690 and 705.
- C. Logic and control connections shall be routed away from any power runs.

## 2.03 RATINGS

- A. The PV system kW rating (in AC and DC STC) shall be as indicated on the Drawings. Each PV system shall consist of the quantity of PV inverters and PV modules as indicated on the Drawings.
- B. Available short circuit current RMS symmetrical at the input to the system is 65,000amps at 480volt AC, therefore all non-automatic breakers exposed to this current (inputs and bypass) shall be adequately rated to withstand the short circuit in the closed mode and all automatic circuit breakers exposed to this current shall be adequately rated to interrupt it. All switchgear bussing shall be braced to withstand the specified short circuit current.

## 2.04 PV INVERTER CHARACTERISTICS

- A. The PV inverter shall be UL 1741-SA Listed.
- B. The PV inverter shall be listed on the latest California Energy Commission List for Approved Grid Support Inverters.
- C. DC Input:
1. Maximum Open Circuit Voltage: 1000 volt DC (minimum)
  2. Surge withstand rating: Per IEEE 587/ANSI C62.41, category B standards.
  3. Integrated DC disconnect, 1000 VDC (minimum) load-break rated.
  4. Ground Fault protection (detection and isolation) in accordance with CEC Article 690.41(B).
  5. Listed arc fault circuit interrupter in accordance with CEC Article 690.11.
- D. AC Output:
1. Rating: Refer to drawings.
  2. Voltage: 480volt AC, plus or minus 10%, 3-phase, plus ground.
  3. Frequency: 60 Hz., plus or minus 0.5 Hz.
  4. Minimum Efficiency: 96%.
  5. Capable of producing reactive power to operate between a power factor of 0.9 lagging to 0.9 leading (as adjusted on the inverter equipment).
  6. Surge withstand rating: Per IEEE 587/ANSI C62.41, Category B Standards.
- E. Noise level: Noise generated by the PV inverter(s) under any condition of normal operation shall not exceed the allowable sound pressure level of 75dBa (75/150 CPS octave band) measured at five feet from the nearest surface of the cabinet using a sound level measuring device equivalent to a General Radio type 1551B. If noise generated by the PV inverter(s) exceeds this value, the



Manufacturer shall install, at his own expense, additional acoustical treatment on the walls and ceiling of the PV inverter equipment room to reduce the noise level to acceptable values.

- F. Environmental conditions: The PV inverter shall be capable of withstanding any combination of the following external environmental conditions without mechanical or electrical damage or degradation of operating characteristics.
1. Operating ambient temperature: 0-degrees C to 40-degrees C.
  2. Non-operating and storage ambient temperature: -10-degrees C to 40-degrees C.
  3. Relative humidity: 5% to 95% non-condensing for all temperatures in the temperature range stated above.
  4. Altitude to 4000-feet above means sea level without derating.

## 2.05 CONTROLS

- A. The following system level control functions shall be provided:
1. Start/ Stop switch to enable or disable the PV inverter. Located on the front panel.
  2. Maximum power tracking circuitry to achieve maximum power output.
  3. Automatic start-up when sufficient DC voltage is present for a specified time.
  4. Automatic turn-off when insufficient DC voltage is present for a specified time.
  5. Lamp test/reset pushbutton.
  6. Audible alarm test/reset pushbutton.
  7. Audible alarm silence button.

## 2.06 RAPID SHUTDOWN DEVICES

- A. General:
1. Module level device capable of reducing shock hazard for emergency responders. Device shall be listed for providing rapid shutdown protection and meet the requirements of CEC Article 690.12.

## 2.07 PV MODULES OR PANELS

- A. General:
1. PV panels shall be UL 1703 or UL 61730-1 and UL61730-2 Listed.
  2. Each panel shall have bypass diodes for shadow tolerance.
  3. Each module shall be effectively bonded to the racking structure via UL 2703 listed racking assembly or UL 2703 listed bonding devices.
  4. Fire performance Type as listed per UL 1703 / UL 61730-1 and UL61730-2 . Module shall achieve a fire resistance Class B rating when paired with a PV racking system.
  5. PV modules shall withstand winds up to 140mph without damage to the modules or roofing structure.
  6. PV modules shall be connected strings, and the quantity of modules per string shall be selected to ensure that the maximum string voltage never exceeds 1000 volts DC under any conditions.

## B. PV Modules:

1. Installation method shall be per manufacturer's instructions or approved methods.
2. The PV module or panel shall have a minimum efficiency rating of at least 16.5%.

## 2.08 DISCONNECT SWITCHES

- A. Wall mounted local AC disconnect with utility lockable, visible blade type switch.
- B. See section 262819 "Disconnect Switches" for additional requirements.

## 2.09 COMBINER AND JUNCTION BOXES

- A. Combiner and junction boxes used to terminate and fuse PV arrays with other PV arrays shall be UL 1741 Listed.
- B. Blocking diodes shall be incorporated with each PV array circuit to prevent back feeding.
- C. Each PV array circuit shall be fused.
- D. Enclosures shall be wall mounted, NEMA 3R and rated for 1000volt DC.
- E. Enclosure shall have chassis ground.

## 2.10 MONITORING

- A. A Data Acquisition and Monitoring System (DAS) shall be provided as shown on Drawings. DAS shall include, but not be limited to, the measurement, calculation, display, and reporting of the following items:
  1. PV production in 15-min reporting intervals.
  2. Energy consumption in 15-min reporting intervals.
  3. Weather data in 15-min reporting intervals
  4. System electrical functions (instantaneous and accumulated power output (kW and kWh), AC and DC system voltage and amperage, inverter fault status, and peak value tracking with associated time stamps).
  5. DAS shall be capable of outputting data in the Western Renewable Energy Generation Information System (WREGIS) format sufficient for registering Renewable Energy Credits (RECs) from each system.
  6. Service to access data reported by DAS.
  7. DAS shall allow customer or customer's third-party designee to programmatically access, view and download data through a web-based and mobile device Application Program Interface ("API") at no cost to customer or customer's third-party designee. This data shall, at a minimum, include the following data in accordance with Title 24 Part 6 Joint Appendix JA11.5.
    - a. Nominal kW rating of the PV system.
    - b. Number of PV modules and the nominal Watt rating of each module.
    - c. Hourly (or 15-minute interval), daily, monthly, and annual kWh production in numeric and graphic formats.
    - d. Running total of daily kWh production.

- e. Daily kW peak power production.
- f. Current kW production of the entire PV system.
- B. The DAS unit shall be a standalone, wall-mounted device powered by a 120 volt AC plug-in transformer with 24 volt DC output.
- C. The unit shall provide user interface via standard web browser using an integrated Ethernet RJ45 jack.
- D. Unit shall be capable of using LAN connections (static IP or DHCP), telephone modem or cell modem (GSM) for data upload.
- E. Store all recorded variables in non-volatile memory.
- F. Separate consumption and production meters shall be provided as shown on Drawings. Consumption meters shall include a web-enabled interface and 15-min reporting intervals to be synced with PV meter production intervals.
- G. A weather station shall be provided as shown on plans. The station shall provide at a minimum: solar irradiation (coplanar and horizontal), ambient temperature, wind speed and any other data relevant to weather correction of solar PV system performance.

#### 2.11 CONSTRUCTION AND INTERWIRING

- A. The PV inverter shall be constructed in NEMA Type 3R outdoor enclosure, unless otherwise noted on the drawings.
- B. Parts placement: The PV inverter shall be designed to permit ready access to modules and assemblies. Parts, test points and terminals shall be placed so that they are accessible for circuit checking, adjustment, and maintenance without the removal of any adjacent module or assembly.

#### 2.12 SOURCE QUALITY CONTROL

- A. Verification of performance:
  - 1. All PV equipment, including inverters, modules or panels, DAS, combiner boxes, etc., shall be inspected and tested in the Manufacturer's plant to demonstrate achievement of the system's power objectives and for full compliance with the requirements of the Contract Documents.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Contractor shall thoroughly examine Project site conditions for acceptance of PV power system installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

#### 3.02 INSTALLATION

- A. Install PV power system in accordance with Manufacturer's written instructions, as indicated on the Drawings and as specified herein.
- B. Installation, circuit requirements, disconnecting means, wiring methods, grounding and bonding, markings, signage, and interconnections shall conform to the requirements set forth in the NFPA 70 (California Electric Code - 2019) Article 690.

- C. All equipment shall be anchored and braced to withstand seismic forces as calculated per Section 260010: Basic Electrical Requirements

### 3.03 WIRE MANAGEMENT

- A. Feeders and branch circuits for direct-current (DC) systems shall be type PV wire or USE-2/RHW-2 copper conductors rated minimum 1000V and shall be sunlight resistant.
- B. All DC string wiring methods must meet or exceed current industry standards for wire management, strain relief and fastening.
- C. All DC string wire management shall use stainless steel or galvanized steel cable clips, Heyco or similar. UV rated cable ties shall be used minimally and only in locations where the use of cable clips is impossible.
- D. Wiring shall not be routed over sharp edges of structural members, equipment, or modules.
- E. Wiring shall be routed under the modules of the array wherever possible to avoid direct exposure to the sun or elements.
- F. Wiring shall be secured under the array to prevent excessive slack resulting in wire motion, and to minimize visibility of inter-module and home run wiring to the public.
- G. Excess slack in the wire shall be secured such that it is in the module channel or secured to the junction box of the module. Factory-installed wire leads for modules can be wrapped around the junction box of the module.
- H. Where exposed, wires, cables and conductors shall be managed in a neat and orderly manner. Where exposed to environmental conditions e.g. sunlight, rain, wind etc. and visible from below, wires shall be fastened in a uniform and discrete fashion.
- I. Strain relief and drip loops shall be utilized at all entrances to and from conduit bodies, junction boxes, weather heads, switchgear, inverters and panelboards etc. Conductors shall be strapped with strain relief as not to stress panel leads, optimizer leads, home runs or mechanically crimped connections within the array. Sufficient slack shall be provided at both ends of cables to allow service and re-termination, and to prevent thermal expansion and contraction from stressing connections.

### 3.04 PV SYSTEM GROUNDING AND BONDING

- A. Perform all PV system grounding and bonding in accordance with Part V of CEC Article 690.
- B. The PV system shall include ground fault protection (including both detection and isolation) for DC circuits in accordance with CEC Article 690.41(B).
- C. Provide connection to an equipment grounding conductor for all exposed non-current-carrying metal parts of PV module frames, electrical equipment, and conductor enclosures of PV systems in accordance with CEC Articles 250.134 or 250.236. Equipment Ground Conductors shall be sized in accordance with CEC Article 250.122.
- D. Metallic support structures shall have identified bonding jumpers connected between separate metallic sections or shall be identified for equipment bonding and shall be connected to the equipment grounding conductor, per CEC Article 690.43(B).

- E. Equipment ground conductors for the PV array and support structure shall be contained within the same raceway or cable as the PV system conductors, whose circuits leave the vicinity of the PV array per CEC Article 690.43(C).
- F. Equipment grounding conductors for PV systems supported by buildings or structures shall be connected to grounding electrode systems in accordance with CEC Article 690.47(A) and Part III of Article 250.

### 3.05 PV MODULE MOUNTING AND GROUNDING DEVICES

- A. Contractor shall follow the design for mounting and grounding PV modules to the racking structure. Any changes to the design must be approved by the owner. If the contractor would like to propose an alternate method, the proposed method shall utilize either of the following:
  - 1. UL 2703 listed module mounting and grounding clamps and devices.
  - 2. Direct bolting of the module to the racking structure and UL listed PV module grounding devices.
- B. Where PV module clamps are allowed, the clamps must be approved for this purpose by their manufacturer as part of a UL 2703 listed assembly. Clamps shall be listed for PV module grounding to racking substrate, and their installation shall comply with the clamp installation manual and the PV module installation manual.
- C. For canopy installations, if PV modules are direct bolted to the canopy steel structural purlins, mounting bolt size and specification must be written and detailed in the canopy structural drawings. Mounting bolt size must comply with the PV module installation manual and be compatible with the module mounting hole diameter.
- D. Washer-type PV module grounding devices shall be listed for grounding PV modules to racking substrate and shall be installed according to the manufacturer's installation manual with appropriate bolt size and clearance hole size.
- E. All PV modules shall be bonded to the racking structure with listed PV module grounding devices and equipment grounding conductors. An equipment grounding conductor shall ground the PV array to the PV inverter ground bar. In addition, the PV array must connect to the building's grounding electrode system, in compliance with CEC Article 690.47(A).
- F. Where PV modules and steel racking systems are grounded and bonded, contact between dissimilar metals such as copper and galvanized steel shall be avoided. Where contact cannot be avoided, outdoor-rated deox or conductive joint compound shall be applied between the interfacing metal surfaces.

### 3.06 RAPID SHUTDOWN DEVICES

- A. Initiation of Rapid Shutdown shall be indicated by one of the following devices in the PV system, as required per CEC Article 690.12:
  - 1. Service disconnecting means.
  - 2. PV system disconnect.
  - 3. Readily accessible switch, plainly indicating "on" and "off" positions.
- B. Controlled conductors within 1ft of the array shall be limited to not more than 80 volts within 30 seconds of rapid shutdown initiation.

- C. Conductors more than 1ft away from the array shall be limited to not more than 30 volts within 30 seconds of rapid shutdown initiation.

### 3.07 MONITORING

- A. Contractor shall load monitoring software (as applicable) on Owner provided computers and train Owner in operation and maintenance of software or cloud-based systems and related monitoring functions.

### 3.08 REQUIRED PLACARDS

- A. Refer to CEC Articles 690 and 705 and CFC Section 1204 for requirements.
- B. All placards shall be machine generated phenolic type with red background and white lettering, affixed to equipment with stainless steel screws or with permanent adhesive where set screws are not feasible. Minimum lettering size to be 1/4" unless otherwise noted or required for legibility.
- C. Provide a placard clearly visible at each main service panel to identify the locations of all sources of power, as noted on drawings.
- D. Provide a placard on all disconnects, as noted on drawings.
- E. Provide a placard on the Main PV System Disconnect (adjacent to each main service panel), as noted on drawings.
- F. Provide a placard on each PV System Inverter, as noted on drawings.
- G. Provide placards as required by local utility company.

### 3.09 STARTUP AND FIELD QUALITY CONTROL

- A. Manufacturer's field service: Contractor shall arrange and pay for the services of a factory-authorized service representative to supervise the initial start-up, pretesting, and adjustment of the PV power system.
- B. Independent testing: Contractor shall arrange and pay for the services of an independent Testing Agency to perform all quality control electrical testing, calibration and inspection required herein. Testing Agencies objectives shall be to:
  - 1. Assure PV power system installation conforms to specified requirements and operates within specified tolerances.
  - 2. Field test and inspect to ensure operation in accordance with Manufacturer's recommendations and Specifications.
  - 3. Prepare final test report including results, observations, failures, adjustments, and remedies.
  - 4. Apply label on PV power system upon satisfactory completion of tests and results.
  - 5. Verify ratings and settings and make final adjustments.
- C. Engineer witnessed testing: Allow a period of 8-hours per PV power system for Engineer review and final check.
- D. At least three weeks prior to any testing notify the Engineer so that arrangements can be made for witnessing tests, if deemed necessary. All pretesting shall have been tested satisfactorily prior to the Engineer's witnessed test.

- E. The Contractor shall supply a suitable and stable source of electrical power to each test site. The Testing Agency shall specify the specific power requirements.
- F. Testing of overcurrent protective devices shall be done only after all devices are installed and prior to system being energized.
- G. Prefunctional testing:
  - 1. Provide Testing Agency with Contract Documents and Manufacturer instructions for installation and testing.
  - 2. Visual and mechanical inspection:
    - a. Inspect for physical damage, defects alignment and fit.
    - b. Perform mechanical operational tests in accordance with Manufacturer's instructions.
    - c. Compare nameplate information and connections to Contract Documents.
    - d. Check tightness of all control and power connections.
    - e. Check that all covers, barriers, and doors are secure.
    - f. Verify interlock operation.
  - 3. Pretesting:
    - a. Upon completing system installation, align and adjust the system and perform complete pretesting to determine conformance with the requirements of the Contract Documents. Correct any deficiencies observed in the pretesting. Replace all malfunctioning or damaged items and retest until satisfactory results are achieved.
    - b. Insulation resistance tests of all buses, components, and control circuits.
    - c. Continuity tests of circuits.
    - d. Provide Testing Agency with Contract Documents and Manufacturer's instructions for installation and testing.
  - 4. PV module or panel certification: Prior to the load testing of the PV modules or panels and in the presence of the Engineer, each installation shall be certified in writing by the PV module or panel Manufacturer.
    - a. As part of the certification process, the module or panel open circuit voltage shall be taken for each PV module or panel and recorded.
    - b. DC voltage and current readings shall be taken at the junction or combiner boxes for each PV array and recorded.
    - c. Torque shall be checked on ALL bolted connections.
    - d. PV modules or panels shall be completely cleaned.
- H. Functional performance testing:
  - 1. Contractor shall provide all tools, labor, and load bank to perform the performance tests on the PV power system listed below.
  - 2. Test and cycle all alarm and annunciation circuits to verify proper operation.

3. Test and verify all interlocks and shutdowns (including rapid shutdown).
4. Furnish all meters and recording equipment required to fully document the tests and the performance of the system and prepare typewritten reports of all tests. Review and sign all test reports attesting to their accuracy as required by the Engineer.
5. The Contractor shall provide the following equipment and services:
  - a. Load bank cables.
  - b. Load bank(s).
6. The Contractor shall provide the following equipment and services:
  - a. Field labor to start emergency generator and provide assistance during the on-site testing.
  - b. Retain the services of Testing Agency for infrared scanning during load bank testing.
7. With PV power system operating with the utility at full power load (utilizing a load bank as the load) and in the presence of the Engineer perform and document the following tests:
  - a. PV power system: DC input voltage, current and power
  - b. PV power system and PV inverter: AC output voltage, current, power, power factor and THD with harmonic spectrum graph showing individual harmonic components.
  - c. Efficiency: Calculate the PV power system efficiency and PV inverter efficiency. (Efficiency shall be defined as the AC RMS Output Power/ DC Input Power.)
  - d. Remove utility source and measure response time for PV power system to shutdown.
8. The operation of the equipment installation does not constitute an acceptance of the Work by the Owner. The final acceptance is to be made after the equipment has been adjusted and has demonstrated to the Engineer's satisfaction that it fulfills the requirements of the Plans and Specifications and Supplier has furnished all required certificates in accordance with testing procedures indicated.
9. Should it be found that the equipment or any portion thereof, furnished under this Section, fails to comply with the Specifications forming part thereof, with respect or regard to the quality amount or value of materials, appliances or labor used in the Work, it shall be rejected and replaced. All Work disturbed by changes necessitated in consequence of said defects or imperfections shall be restored to the original condition.
10. Contractor shall replace at no cost to the Owner all devices which are found defective or do not operate within factory specified tolerances.
- I. In the event that the system fails to function properly during the testing as a result of inadequate pretesting or preparation, the Contractor shall bear all costs incurred by the necessity for retesting including test equipment, transportation, subsistence and Engineer's hourly rate.
- J. Contractor shall submit the Testing Agency's final report for review prior to Project closeout and final acceptance by the Owner. Test report shall indicate test dates, devices tested, results, observations, deficiencies, and remedies. Include a copy of the test report in the Owner's operation and maintenance manuals.

### 3.10 TRAINING



- A. Provisions shall be made for an on-site 2-day training program, one of the days shall be concurrent with the field-testing program. The training shall include, but not be limited to, a theoretical presentation of the PV power system and a thorough explanation and training in general operating procedures including system level troubleshooting, and access & use of the web-based monitoring software. The classes shall be for 3 to 6 students at the discretion of the Owner.
- B. The Contractor shall furnish all materials, books, and other aids for each student at no charge to Owner.
- C. Contractor shall schedule training with a minimum of 7-days advance notice.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- For a typical project, provide integral surge protective devices at the main electrical service, and at 120/208V branch circuit panelboards that service classrooms, office space, etc. Integral SPD furnished with gear and by the same manufacturer is preferable to separately installed SPDs.
- For every SPD installed, provide 1 SPD for attic stock.

## SECTION 26 43 13

## SURGE PROTECTIVE DEVICES (SPD)

**PART 1 - GENERAL****1.01 SUMMARY**

- A. Work included: Labor, materials, and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
  - 1. Surge protective devices (SPD).
- B. Related Work: Consult all other Sections, determine the extent and character of related Work, and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.

**1.02 REFERENCES**

- A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified.
  - 1. American National Standards Institute, Inc. (ANSI)/Institute of Electrical and Electronics Engineers (IEEE):
    - ANSI/IEEE C62.1;           Standard for Surge Arresters for Alternating Current Power Circuits.
    - ANSI/IEEE C62.11;       Standard for Metal-Oxide Surge Arrestors for AC Power Circuits.
    - ANSI/IEEE C62.41.1;     Guide on the Surges Environment in Low-Voltage (1000V and Less) AC Power Circuits.
    - ANSI/IEEE C62.41.2;     Recommended Practices on Characterization of Surges in Low-Voltage (1000V and Less) AC Power Circuits.
    - ANSI/IEEE C62.45;       Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000V and Less) AC Power Circuits.
  - 2. Underwriters Laboratory, Inc. (UL):
    - UL 50;                   Cabinets and Boxes.
    - UL 1283                 Electromagnetic Interference Filters. [Type 2 only]
    - UL 1449;                Surge Protective Devices, 4th Edition.
  - 3. National Electrical Manufacturers Association (NEMA):
    - NEMA PB 1.1;           General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

**1.03 SYSTEM DESCRIPTION**

- A. Provide surge protective device (SPD) equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection shall be integrated into electrical distribution equipment such as switchboards, and panelboards.
- B. SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable UL standard (ANSI/UL 1449 4th Edition).
- C. SPD units shall be furnished in two Types. Type 1 and Type 2 as outlined below:

1. Type 1: Permanently connected SPDs installed on the line or load side of main disconnect device(s), at main switchboard. This type closely relates to the devices previously referred to as secondary surge arrestors. These Type 1 SPDs should be specially suited to conduct the high energy impulses from lightning strikes.
2. Type 2: Permanently connected SPD installed on the load side of the service panel main disconnect device(s). This type most closely relates to devices that were previously classified as Transient Voltage Surge Suppression (TVSS). These Type 2 SPDs are especially suited for distribution boards and panelboard applications.

#### 1.04 SUBMITTALS

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
  1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
  2. Describe system operation, equipment and dimensions and indicate features of each component.
  3. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
  4. Shop Drawings: Include elevations, cabinet dimensions, complete component listing and layout within cabinet, amperage ratings and capacities, system characteristics and wiring diagrams.
  5. Submit Manufacturer's installation instructions.
  6. Complete bill of material listing all components.
  7. Warranty.

#### 1.05 OPERATION AND MAINTENANCE MANUAL

- A. Supply operation and maintenance manuals in accordance with the requirements of Section 260010: Basic Electrical Requirements, to include the following.
  1. A detailed explanation of the operation of the system.
  2. Instruments for routine maintenance.
  3. Pictorial parts list and parts number.
  4. Telephone numbers for authorized parts and service distributors.

#### 1.06 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused, and currently under production.
- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.

#### 1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery: SPD components shall not be delivered to the Project site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable. Equipment damaged during shipment shall be replaced and returned to Manufacturer at no cost to Owner.

- B. Storage: Store in a clean, dry, ventilated space free from temperature extremes. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris and traffic. Provide heat where required to prevent condensation.
- C. Handling: Handle in accordance with the Manufacturer's written instructions. Be careful to prevent internal component damage, breakage, denting and scoring. Damaged units shall not be installed. Replace damaged units and return equipment to Manufacturer.

#### 1.08 WARRANTY

- A. Units and components offered under this Section shall be covered by a 5-year parts and labor warranty for malfunctions resulting from defects in materials and workmanship. Warranty shall begin upon acceptance by the Owner.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.
  - 1. Schneider Electric/ Square D.
  - 2. ABB/ General Electric.
  - 3. Eaton.
  - 4. Siemens.
- B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

#### 2.02 GENERAL

- A. All Specification noted herein apply to the switchboard, and panelboard units, unless otherwise noted.
- B. The SPD system utilizes diversion modules to suppress and divert transient voltage and surge currents. The system is designed to provide protection for sensitive electronic devices against the effects of surges, transients, and electrical line noise.
- C. Environmental requirements:
  - 1. Operating temperature: -40-degree C to 60-degree C.
  - 2. Relative humidity: 0% to 95%.
  - 3. Operating altitude: 0 to 12,000-feet.
  - 4. Audible noise: Less than 35-dB.
- D. Electrical requirements:
  - 1. Unit operating voltage: The SPD system voltage shall be as indicated on the Drawings.
  - 2. Maximum continuous operating voltage "MCOV": The MVOC shall not be less than 125% of the nominal system operating voltage.
  - 3. The suppression system shall incorporate thermally protected metal-oxide varistors "MOVs" as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other

components that may crowbar the system voltage leading to system upset or create any environmental hazards.

4. Protection modes: The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

| PROTECTION MODES TABLE |     |     |     |     |
|------------------------|-----|-----|-----|-----|
| Configuration          | L-N | L-G | L-L | N-G |
| WYE                    | ●   | ●   | ●   | ●   |
| Delta                  | N/A | ●   | ●   | N/A |
| Single Split Phase     | ●   | ●   | ●   | ●   |
| High Leg Delta         | ●   | ●   | ●   | ●   |

5. Nominal discharge current (In): All SPDs applied to the distribution system shall have a 20kA In rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an in less than 20kA shall be rejected.
6. Voltage protection rating (VPR): The maximum ANSI/UL 1449 4th Edition VPR for the device shall not exceed the following:

| VOLTAGE PROTECTION RATING TABLE |       |       |       |       |
|---------------------------------|-------|-------|-------|-------|
| System Voltage                  | L-N   | L-G   | L-L   | N-G   |
| 120/208                         | 700V  | 700V  | 1200V | 700V  |
| 277/480                         | 1200V | 1200V | 2000V | 1200V |
| 346/600                         | 1500V | 1500V | 3000V | 1500V |

E. SPD design:

- The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
- The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV.
- Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50-dB from 10kHz to 100MHz using the MIL-STD-220A insertion loss test method.
- No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.
- SPD shall provide the following integral monitoring options:
  - Each unit shall have a green/red solid-state indicator light that reports the status of the protection on each phase:
    - For WYE configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. WYE configured units shall also

- contain an additional green/red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode.
- 2) For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.
  - 3) The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators shall indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights shall continue to indicate the status of the protection on all other phases and protection modes.
- b. The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.
  - c. The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.
  - d. Surge counter:
    - 1) The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location.
    - 2) The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of 50amps  $\pm$  20amps occurs.
    - 3) A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2-seconds in order to clear the surge count total.
    - 4) The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.
6. The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.
  7. All the SPD's components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.
  8. Safety requirements:
    - a. The SPD shall minimize potential arc flash hazards by containing no user serviceable or replaceable parts and shall be maintenance free. SPDs requiring any maintenance of any

sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

- b. SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.

## 2.03 SYSTEM APPLICATION

- A. The SPD applications covered under this section include switchboards panelboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.
- B. The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

| MINIMUM SURGE CURRENT CAPACITY TABLE |                                                                    |           |          |
|--------------------------------------|--------------------------------------------------------------------|-----------|----------|
| Category                             | Application                                                        | Per Phase | Per Mode |
| C                                    | Service Entrance Locations (Switchboards)                          | 250kA     | 125kA    |
| B                                    | High Exposure Roof Top Locations<br>(Switchboards and Panelboards) | 160kA     | 80kA     |
| A                                    | Branch Locations (Panelboards)                                     | 120kA     | 60kA     |

- C. All SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

## 2.04 PANELBOARDS

- A. The SPD application covered under this section includes lighting and outlet panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category A or B environments.
- B. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.
- C. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.
- D. The panelboard shall be capable of re-energizing upon removal of the SPD.
- E. The SPD shall be interfaced to the panelboard via a direct bus bar connection.
- F. The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.
- G. The SPD shall be of the same manufacturer as the panelboard.
- H. The complete panelboard including the SPD shall be UL67 listed.

## 2.05 SWITCHBOARDS

- A. The SPD application covered under this section is for switchboard locations. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.
- B. The SPD shall be of the same manufacturer as the switchboard.



- C. The SPD shall be factory installed inside the switchboard at the assembly point by the original equipment manufacturer.
- D. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.
- E. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
- F. The SPD shall be integral to switchboard as a factory standardized design.
- G. All monitoring and diagnostic features shall be visible from the front of the equipment.

## 2.06 ENCLOSURES

- A. All enclosed equipment shall have NEMA 1 general purpose enclosures, unless otherwise noted. Provide enclosures suitable for locations as indicated on the drawings and as described below:
  - 1. NEMA 1: Constructed of a polymer (units integrated within electrical assemblies), intended for indoor use to provide a degree of protection to personal access to hazardous parts and provide a degree of protection against the ingress of solid foreign objects (falling dirt).
  - 2. NEMA 4: Constructed of steel, intended for either indoor or outdoor use, to provide a degree of protection from the following:
    - a. Against access to hazardous parts.
    - b. Of equipment inside the enclosure against ingress of solid foreign objects (dirt and windblown dust).
    - c. With respect to the harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water).

## 2.07 SOURCE QUALITY CONTROL

- A. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.

# PART 3 - EXECUTION

## 3.01 EXAMINATION

- A. Contractor shall thoroughly examine Project site conditions for acceptance of SPD installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

## 3.02 INSTALLATION

- A. Install SPD in accordance with Manufacturer's written instructions, as indicated on the Drawings and as specified herein.
- B. As a minimum, provide SPDs on all service entrance switchboards, 120/208volt distribution switchboards and 120/208volt panelboards in compliance with CEC Article(s) 285, 620, 645, 670, 695, and 700.
- C. Conductors from the power source to the SPD shall be minimum #4 AWG copper in switchboards and #8 AWG copper in panelboards (when not direct bus connected). Conductors shall be routed

without sharp bends and straight and short as possible. The absolute maximum of 7'-0" long for units in switchboards and 1'-0" long for units in panelboards.

- D. Conductors originating from direct bus bar connections shall be individually wrapped with electric tape in half-lapped increments for added protection of the un-protected conductors. Tie-wrap the conductors away from the bus bars without any sharp bends. All holes that the conductors pass through shall be grommets.
- E. Cabinets shall be anchored and braced to withstand seismic forces as calculated per Section 260010: Basic Electrical Requirements.

### 3.03 ATTIC STOCK

- A. For every SPD installed in panelboard or switchboard, a replacement SPD shall be provided for attic stock.

### 3.04 FIELD QUALITY CONTROL

- A. Prefunctional testing:
  - 1. Visual and mechanical inspection:
    - a. Inspect for physical damage, defects, alignment, and fit.
    - b. Compare nameplate information and connections to Contract Documents.
    - c. Check tightness of all control and power connections.
    - d. Prior to energization, verify source neutral is bonded to ground per CEC Articles 250.24(B), 250.28 and 250.30.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Attic Stock: Designer should include provisions for additional parts for luminaires that are used extensively on any project. This will vary by project.
  - Power packs, motion sensors
- Luminaires should be selected based on architectural aesthetic, performance and efficacy, ease of maintenance, durability, visual comfort/glare control, and project budget. Specific manufacturers and models noted below are provided for consideration only and are not standards.

| Space | Allowed<br>LPD | Design<br>LPD | Target<br>Light<br>Level | Fixture Description |
|-------|----------------|---------------|--------------------------|---------------------|
|       |                |               |                          |                     |

|                                         |                   |      |                 |                                                                                                           |
|-----------------------------------------|-------------------|------|-----------------|-----------------------------------------------------------------------------------------------------------|
| Classrooms, clg<10'                     | 0.7               | 0.5  | 35              | Recessed LED 2x4 troffers (Lithonia BLT, Finelite HPR, Metalux Accord, etc.)                              |
| Classrooms, clg>10'                     | 0.7               | 0.5  | 35              | Linear suspended LED Ind/Direct (70%/30%) (Peerless Bruno, Finelite S16LED, etc.)                         |
| Office / Reception                      | 0.7               | 0.5  | 30              | Recessed architectural LED troffers                                                                       |
| Break Room, Work Rooms                  | 0.7               | 0.5  | 30              | Recessed architectural LED troffers                                                                       |
| Gymnasium                               | 1.5               | .8   | 50              | High-bay LED Gym Lights (Lithonia JCBL, Kenall EPLB, etc.)                                                |
| Library                                 | 0.8               | 0.6  | 35              | Pendant linear LED                                                                                        |
| Kitchen                                 | 0.95              | 0.7  | 50 <sup>a</sup> | LED troffers with smooth lens for easy wipe-down.                                                         |
| Multi-User Restrooms                    | 0.6               | 0.4  | 10-15           | Surface linear LED over vanity, surface LED downlights                                                    |
| Custodial, Storage Rooms, Support Space | 0.6               | 0.5  | 10              | LED utility lights (Lithonia CLX, Metalux SLSTP, Williams 75R, etc.)                                      |
| Exterior Landings                       | 0.03 <sup>b</sup> | 0.02 | 5               | Surface LED downlights (Lightolier Slim Surface), full cut-off LED wallpacks w/sensor (Lithonia D-Series) |
| Parking Lot                             | 0.025             | 0.02 | 1               | Full cut-off LED Area Lights w/sensor (Lithonia D-Series, Gardco Pureform)                                |

SECTION 26 50 00

LIGHTING

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Work included: Labor, materials, and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:
  - 1. Interior luminaires (lighting fixtures.)
  - 2. Exterior luminaires.
  - 3. Light-emitting diode (LED) assemblies.
  - 4. Drivers and transformers.
  - 5. Optical components; including diffusers, refractors, reflectors, and louvers.
  - 6. Poles and brackets.
  - 7. Unit battery equipment.
- B. Related Work: Consult all other Sections, determine the extent and character of related Work, and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.
  - 1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
  - 2. Division 03: Concrete; for cast-in place bases for lighting poles and bollards.
  - 3. Division 05: Metals; for fittings, brackets, backing supports, rods, etc. as required for support and bracing of luminaires.
  - 4. Division 09: Finishes; for ceilings, wall assemblies, acoustical treatment, and field painting of luminaires.

**1.02 REFERENCES**

- A. Comply with the latest edition of the following applicable Specifications and Standards except as otherwise indicated or specified:
  - 1. American National Standards Institute (ANSI):
    - ANSI/IEC 60529; American National Standard for Degrees of Protection Provided by Enclosures (IP Code)
    - C137.0 Lighting System Terms and Definitions.
    - C137.1 0-10V Dimming Interface for LED Drivers and Controls
  - 2. Underwriters Laboratories, Inc. (UL):
    - UL 66; Fixture Wire.
    - UL 102.3; Standard Method of Fire Test of Light Diffusers and Lenses.
    - UL 844; Luminaires for Use in Hazardous (Classified) Locations.
    - UL 924; Emergency Lighting and Power Equipment.

|            |                                                                                |
|------------|--------------------------------------------------------------------------------|
| UL924a;    | Auxiliary Power Supplies (for generator-backed systems.)                       |
| UL 1574;   | Track Lighting Systems.                                                        |
| UL 1598;   | Luminaires.                                                                    |
| UL 1598C;  | Light-Emitting Diode Retrofit Luminaire Conversion Kits.                       |
| UL 1838;   | Low Voltage Landscape Lighting Systems.                                        |
| UL 1993;   | Self-Ballasted Lamps and Lamp Adapters.                                        |
| UL 2007A;  | Shatter Containment of Lamps for Use in Regulated Food Establishments.         |
| UL 2108;   | Low Voltage Lighting Systems.                                                  |
| UL 2592;   | Low Voltage LED Wire.                                                          |
| UL 5085-3; | Low Voltage Transformers: Class 2.                                             |
| UL 8750;   | Light Emitting Diode (LED) Equipment for Use in Lighting Products.             |
| UL 8753;   | Field-Replaceable Light Emitting Diode (LED) Light Engines.                    |
| UL 8754;   | Holders, Bases, and Connectors for Solid-State (LED) Light Engines and Arrays. |

3. National Electrical Manufacturers Associations (NEMA):

|        |                                                                              |
|--------|------------------------------------------------------------------------------|
| SSL-1; | Electronic Drivers for LED Devices, Arrays or Systems.                       |
| SSL-4; | Retrofit Lamps—Minimum Performance Requirements.                             |
| 77;    | Temporal Light Artifacts: Test Methods and Guidance for Acceptance Criteria. |
| LE-4;  | Recessed Luminaires, Ceiling Compatibility                                   |
| 100;   | Wire Insulation Colors for Lighting Systems                                  |

4. Illuminating Engineering Society of North America (IESNA):

|               |                                                                                            |
|---------------|--------------------------------------------------------------------------------------------|
| TM-15;        | Luminaire Classification System for Outdoor Luminaires.                                    |
| TM-21;        | Projecting Long Term Lumen Maintenance of LED Light Sources.                               |
| TM-30;        | Method for Evaluating Light Source Color Rendition.                                        |
| TM-30-Annex E | Recommendations for Specifying Light Source Color Rendition                                |
| LM-79;        | Electrical and Photometric Measurements of Solid-State Lighting Products.                  |
| LM-80;        | Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules.         |
| LM-84;        | Measuring Luminous Flux and Color Maintenance of LED Lamps, Light Engines, and Luminaires. |
| LM-86;        | Measuring Luminous Flux and Color Maintenance of Remote Phosphor Components                |

5. Restriction of Hazardous Substances (RoHS):

RoHS 3;

Directive 2015/863 - Cat 5. Lighting: lamps, luminaires, light bulbs.

1.03 SYSTEM DESCRIPTION

- A. Provide and install a fully functional and operating lighting system as indicated, complete with light engines, lamps, wiring, and securely attached to support system to meet all seismic code requirements.
- B. Where catalog number and narrative or pictorial descriptions are provided, the written description shall take precedence and prevail.

1.04 SUBSTITUTIONS

- A. Refer to Section 260010: Basic Electrical Requirements for specific Equipment requirements.
- B. Items specified under this Section and Luminaire Schedule are subject to the requirements, with the following qualifications:
  - 1. Items solely specified by Manufacturer name and catalog number, without qualifiers: Provide as specified – No Substitutions.
  - 2. Items specified by multiple Manufacturers, without qualifiers: Provide any listed manufacturer – No Substitutions.
  - 3. Items specified by sole or multiple Manufacturers, followed by “Or Approved Equal” or “Or Approved Equivalent”: Conform to substitution requirements outlined for Equipment.
  - 4. Items specified by sole or multiple Manufacturers, followed by “Or Equal” or “Or Equivalent”: Products that meet the salient requirements are acceptable to provide.
    - a. Equivalency is at the sole judgement of the Architect and Engineer.
    - b. Should a submitted, unspecified product fail to meet the requirements of Equivalency, provide specified products at no additional cost to the Owner.
- C. Equivalency shall be determined by review of the following luminaire characteristics where applicable. Lack of pertinent data on any characteristic shall constitute justification for rejection of the submittal or substitution.
  - 1. Performance:
    - a. Distribution.
    - b. Utilization.
    - c. Luminance distribution (Average brightness / maximum brightness.)
    - d. Spacing to mounting height ratio.
    - e. Overall luminaire efficiency.
  - 2. Construction:
    - a. Engineering.
    - b. Workmanship.
    - c. Rigidity.
    - d. Permanence of materials and finishes.
  - 3. Installation Ease:

- a. Captive parts and captive hardware.
- b. Provision for leveling.
- c. Through-wiring ease.
- 4. Maintenance:
  - a. Ease of relamping / replacement of LED array.
  - b. Ease of replacement of driver/ballast and lamp sockets.
- 5. Appearance:
  - a. Architectural integration.
  - b. Light tightness.
  - c. Styling.
  - d. Conformance with design intent.
  - e. When requested, furnish a working sample complete with housing, trim, 8' cord and plug, and specified lamp.

1.05 SUBMITTALS

- A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
  - 1. Complete bill of material listing (index) of all luminaires. Index shall be organized in the same sequence as the Luminaire Schedule (alphabetical.) Include in the index:
    - a. Type per the Luminaire Schedule.
    - b. Manufacturer.
    - c. Complete catalog number, including all accessories and appurtenances required for the installation.
    - d. Voltage.
    - e. Poles, arms, and brackets, if applicable.
    - f. Lamping, if applicable.
  - 2. Manufacturer's data sheets/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
    - a. Identify luminaire type on each sheet.
    - b. Clearly mark on each data sheet the specific item(s) being submitted. Obfuscate or otherwise delete options on data sheets that are not provided.
  - 3. Driver or transformer and/or lamp data sheets as applicable to submitted item.
  - 4. Manufacturer's installation instructions.
  - 5. Warranty.
  - 6. U.L. labeling information.
  - 7. Photometric Reports consisting of:



- a. Independent Testing Laboratories, Inc. or equal, photometric test report for each luminaire listed on the Luminaire Schedule. Test reports shall be based on Illuminating Engineering Society published test procedures and shall contain candlepower distribution curves in five lateral planes for luminaires with asymmetric distributions and luminance data for vertical angles above 45 degrees from nadir.
- b. Coefficient of utilization table.
- c. Zonal lumen summary including overall luminaire efficiency.
- 8. Shop Drawings:
  - a. Where noted in the Luminaire Schedule, submit Shop Drawings from Manufacturer detailing modified or custom luminaires indicating dimensions, weights, methods of field assembly, components, features, accessories, methods of support, etc.
- 9. Mock-ups: Provide mock-up luminaire samples where "MOCK-UP" is indicated in the Luminaire Schedule. Refer to Part 3 – Execution for requirements.

1.06 OPERATION AND MAINTENANCE MANUAL

- A. Supply operation and maintenance manuals in accordance with the requirements of Section 260010: Basic Electrical Requirements, to include the following:
  - 1. An updated index per 1.05-A.
  - 2. One complete set of final submittals of actual product installed, including product data and shop drawings.
  - 3. Instructions for routine maintenance.
  - 4. Pictorial parts list and parts number.
  - 5. Telephone numbers for authorized parts and service distributors.

1.07 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new, unused, and currently under production.
- B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.

1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery: Luminaires shall not be delivered to the Project site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable. Equipment damaged during shipment shall be replaced and returned to Manufacturer at no cost to Owner.
- B. Storage: Store in a clean, dry, ventilated space free from temperature extremes. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris and traffic. Provide heat where required to prevent condensation.
- C. Handling: Handle in accordance with Manufacturer's written instructions. Be careful to prevent internal component damage, breakage, denting and scoring. Damaged units shall not be installed. Replace damaged units and return equipment to Manufacturer.

1.09 WARRANTY

- A. Units and components offered under this Section shall be covered by a 1-year parts and labor warranty for malfunctions resulting from defects in materials and workmanship. Warranty shall begin upon acceptance by the Owner.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.
1. Luminaires, Poles, and Exit Signs: as listed in the Luminaire Schedule.
  2. Light-Emitting Diode (LED) Arrays:
    - a. Cree.
    - b. Nichia.
    - c. Citizen.
    - d. Lumileds.
    - e. Samsung.
    - f. Lumenetix Araya.
    - g. Xicato.
    - h. Bridgelux.
    - i. LEDs provided by Luminaire Manufacturer listed in the Luminaire Schedule: meeting the technical and warranty requirements of this Section.
  3. LED replacement and integral-driver lamps:
    - a. General Electric.
    - b. Osram.
    - c. Cree.
    - d. Maxlite.
    - e. Green Creative.
    - f. Soraa.
  4. LED drivers (DC output):
    - a. eldoLED.
    - b. Lutron.
    - c. Signify Advance.
    - d. Osram.
    - e. Q-Tran.
    - f. Universal Lighting Technologies.
    - g. Drivers provided by Luminaire Manufacturer listed in the Luminaire Schedule: meeting the technical and warranty requirements of this Section.

5. Transformers for LED systems (AC output):
  - a. Q-Tran.
  - b. Hatch.
  - c. Semper Fi.
  - d. Transformers provided by Luminaire Manufacturer listed in the Luminaire Schedule: meeting the technical and warranty requirements of this Section.
6. Unit battery equipment:
  - a. Philips Bodine.
  - b. Myers/Iota.
  - c. Unit battery equipment provided by Luminaire Manufacturers listed in the Luminaire Schedule: meeting the technical and warranty requirements of this Section.

B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

## 2.02 GENERAL

- A. Luminaires new and complete with mounting accessories, junction boxes, trims, and lamps.
- B. Luminaire assemblies U.L. listed appropriate to mounting conditions and application. All labels affixed to the luminaire shall be in a location not visible from normal viewing angles.
- C. Each luminaire family type (downlights, etc.) supplied by only one manufacturer.
- D. Recessed luminaires installed in fire rated ceilings and using a fire rated protective cover shall be thermally protected for this application and shall carry a fire rated listing.
- E. Luminaires installed under canopies, roofs or open areas and similar damp or wet locations shall be UL listed and labeled as suitable for damp or wet locations.
- F. Luminaires shall bear the IP rating appropriate for the application.
- G. Luminaires shall be free of light leaks and shall be designed to provide sufficient ventilation of light engines, including ventilation holes where required.

## 2.03 LUMINAIRE CONSTRUCTION

- A. All sheet metal Work shall be free from tool marks and dents and shall have accurate angles bent as sharp as compatible with the gauges of the required metal. 20-gauge (0.7-mm or 0.027-inch) minimum.
  1. Finish: Baked white dry polyester powder, unless otherwise specified, with a minimum average reflectance of 85% on all exposed and light reflecting surfaces. Steel components shall be prepared for finishing with a 5-step zinc phosphating process prior to painting.
  2. Luminaire (including all painted component parts) shall be painted after fabrication unless specifically noted in the Luminaire Schedule.
- B. Extruded Aluminum Housings: One-piece housing of AA 6063 T5 extruded aluminum with 0.14 minimum thickness smooth and free of tooling lines in one uninterrupted section of 1-foot to 24-foot with the cross sectional dimensions as indicated in the Luminaire Schedule.
- C. Die-Cast Aluminum Housings:

1. Single-piece casting to ensure water tightness.
  2. Low copper (<0.7% Cu) aluminum alloy.
  3. Minimum Class 4 Consumer Grade per NADCA Standards.
- D. All surfaces shall be cleaned and dressed to eliminate all exposed sharp edges or burrs.
- E. All intersections and joints shall be formed true and of adequate strength and structural rigidity to prevent any distortion after assembly.
- F. End Plates: Die cast end plates shall be mechanically attached without exposed fasteners. End caps shall be minimum 0.125" thick.
- G. All mitered corners or joints shall be accurately aligned with abutting intersecting members. Sheet metal Work shall be properly fabricated so that planes will not deform (i.e. become concave or convex) due to normal expected ambient and operating conditions.
- H. Ferrous mounting hardware and accessories shall be finished using either a galvanic or phosphate primer/baked enamel process to prevent corrosion and discoloration of adjacent materials.
- I. Fasteners shall be manufactured of galvanized steel.
- J. Adjustable Lamp Mechanisms: To have aiming stops which can be permanently set to position lamp vertically and rotationally.
- K. Recessed luminaires: Equip with through-wire junction box. Box, driver, and replaceable components shall be accessible from the ceiling opening of the luminaire.
- L. Finish:
1. All exposed aluminum surfaces shall be treated with an acid wash and clear water rinse prior to painting. The luminaire shall then be electrostatically painted, or powder coated, and oven baked in the color indicated in the Luminaire Schedule.
  2. All exposed steel surfaces shall be treated with an acid wash and clear water rinse, then prime coated. The luminaire shall then be electrostatically painted, or powder coated, and oven baked in the color indicated in the Luminaire Schedule.
- M. Door Frames for lensed luminaires: White painted, flat aluminum with mitered corners.

## 2.04 SUSPENSION

- A. Suspension Devices, type as specified in the Luminaire Schedule:
1. Aircraft Cable: Stainless steel type - 3/32" nominal diameter, stranded, with positive pressure, field adjustable clamp at luminaire connection.
  2. Rigid Pendant: 1/2" nominal diameter or as specifically shown on drawings. Supplied by luminaire manufacturer when available as standard product. At luminaire end of stems, provide earthquake type swivel fitting to permit 45-degree swing in any direction away from vertical.
  3. Chain hangers: Length to suit mounting height if shown or as field conditions dictate. Use two heavy duty chains with "S" hooks at each suspension point. Length to suit mounting height as shown on Drawings.
- B. Suspension system must permit ±13-mm (1/2") minimum vertical adjustment after installation.
- C. Supports:

1. Provide internal safety cable from luminaire body to stud in outlet box.
  2. Carry luminaire weight to structure and provide horizontal bracing from suspension points to ceiling framing to prevent sideways shifting. Provide diagonal seismic restraint wires per code.
- D. Feed Point:
1. Flat-plate canopy to cover outlet box, with holes for support cable and power cord, concealed fasteners to permit splice inspection after installation.
  2. At the electrified connection provide straight cord feed.
  3. Power cord: white multi-conductor cord, parallel to support cable (aircraft cable); within pendant (rigid pendant); or flexible conduit (chain hanger).
  4. Where emergency feed is required, a separate feed point shall be provided.
- E. Non-feed Points:
1. 13-mm (½") O.D. polished chrome end sleeve, inside threaded ¼"-20, with 50-mm (2") diameter. Flat white plate to cover hole in ceiling. Top of cable with ball swaged on end, to fit inside sleeve.
  2. Contractor to provide support above ceiling as required.
- F. Suspension method shall allow adjustment to be made in hanging length to allow for variance in ceiling height.
- G. All exposed paintable suspension components shall have the same finish and color as the luminaire housing.

## 2.05 LAMPHOLDERS

- A. Of configuration and design to accept standard lamp bases.
- B. Wiring channels and lampholder mountings shall be rigid and accurately constructed.
- C. Integral-driver LED:
1. Medium screw base: Unglazed porcelain body or thermoplastic (PET GF) with copper-alloy screw shell. 660watt, 250volt rated.
  2. Bi-Pin base: Ceramic casing with mica cover plate, copper allow contact surfaces. Pin distance designed for lamp provided.

## 2.06 LED ARRAYS

- A. Minimum lumen maintenance per LM-80 measurements and TM-21 calculations: L90 at 60,000 hours.
- B. Maximum burnout: B90 at 200,000-hours.
- C. Free of mercury and toxic materials; RoHS compliant.
- D. Linear LED boards: LED pitch shall be consistent throughout the luminaire and shall remain consistent from the end of one board to the start of the next. LED pitch shall be the same from the endcap of the luminaire to the last LED on the board as the LED pitch throughout the luminaire. Luminaire shall have a continuous luminous appearance – bright or dark spots are not acceptable.
- E. White LEDs:

1. Interior
    - a. Correlated Color Temperature (CCT): 4000K
    - b. Minimum efficacy: 75 lumens per watt.
    - c. L70 lifetime: minimum 80,000-hours (extrapolated.)
    - d. Correlated Color Temperature (CCT); as specified in Luminaire Schedule. Maximum 3-step MacAdam ellipse variation throughout listed life (L70).
    - e. Color Rendering Index (CRI); minimum 80 Ra.
    - f. R9 value; minimum 30.
    - g. TM30 values;  $R_f > 75$ ,  $92 > R_g > 110$ .
  2. Exterior
    - a. Correlated Color Temperature (CCT): 4000K
    - b. Minimum efficacy: 100 lumens per watt.
    - c. L70 lifetime: minimum 100,000-hours (extrapolated.)
    - d. Correlated Color Temperature (CCT); as specified in Luminaire Schedule. Maximum 4-step MacAdam ellipse variation throughout listed life (L70).
    - e. Color Rendering Index (CRI); minimum 70 Ra.
    - f. R9 value; minimum 20.
    - g. TM30 values;  $R_f > 70$ ,  $80 > R_g > 120$ .
- F. Tunable White LEDs:
1. CCT range as specified in Luminaire Schedule.
  2. Color temperature at each "step" shall follow the Planckian Locus (Black Body Curve),  $\pm 50K$ .
  3. Color adjustment via separate 0-10volt input from driver.
  4. Submit Chromaticity curves for review.
- G. RGB Color LEDs:
1. As specified in Luminaire Schedule.
- 2.07 LED DRIVERS:
- A. LED drivers shall be integral to luminaire housing or remotely located, when specified, within 15 feet of diode assembly.
1. Luminaires shall be provided with the UL listed or equivalent driver and low voltage power supply as recommended by Manufacturer to insure proper and consistent lamp and luminaire performance. The number of LEDs per luminaire per power supply shall not be exceeded, and LEDs shall not be wired to a high capacity driver unless recommended by Manufacturer.
  2. Light Emitting Diode (LED) control gears shall operate with sustained variations of  $\pm 10\%$  in voltage and frequency without damage to the driver and have a power factor not less than 90%. Regulations:  $\pm 5\%$  across the listed load range.

3. Driver input current shall have Total Harmonic Distortion (THD) of less than 20%. The Driver shall have a Class A sound rating unless otherwise specified.
4. Control gear shall be rated for 50-degree C ambient temperature.
5. All control gear shall facilitate smooth, flicker-free dimming from 100% to 10%, 1% or 0.1% as noted on the Luminaire Schedule.

## 2.08 LENSES

### A. Acrylic:

1. Lenses shall be extruded or injection molded crystal clear 100% virgin acrylic (except as indicated otherwise). For lenses with male pattern of pyramids or cones, specified minimum thickness refers to distance from flat surface to base of pyramids (cones) or thickness of undisturbed material. For lenses with female pattern, specified minimum thickness refers to overall thickness of material.
2. Lenses shall fully eliminate lamp images when viewed from all directions within 45 to 90-degree angles from vertical, where the ratio of lamp spacing to the distance from lamp underside to top of lens does not exceed 1.50. Within the viewing angle from 0 to 45-degrees the ratio of maximum brightness (under a lamp) to minimum brightness (between lamps) shall not exceed 3 to 1.
3. Finishes (i.e. sandblasting, etching, polishing) shall be performed as described in the Luminaire Schedule.
4. Plastic electrical light diffusers must meet the requirements of Section 2-5209, CAC, Flame Spread Rating.
5. Prismatic Acrylic:
  - a. Extruded of clear virgin acrylic plastic, 0.125" minimum overall thickness, 0.100" nominal unpenetrated thickness, Pattern 12 with flat sided female prisms running at 45 degrees off panel axis unless otherwise specified in the luminaire schedule. Concave prisms are not acceptable.
6. Opal acrylic:
  - a. Extruded or injection molded of virgin acrylic plastic, 0.080" minimum overall thickness.

## 2.09 REFLECTOR CONES

- A. Reflector cones shall be manufactured of uniform gauge, not less than 0.032" thick, high purity aluminum, Alcoa 3002 alloy, free of spin marks or other defects or blemishes caused during manufacturing.
- B. The finish on the inner surface of the reflector shall be as described in the Luminaire Schedule and as produced by the Alzak process. The reflector shall have an anodic coating of not less than four mils thick. The reflector inner surface shall be free of water spotting and shall maintain a reflectivity ratio of not less than 83% on clear specular finishes. The reflectors shall have a low iridescence finish.
- C. All luminaires using Alzak reflector cones shall be supplied by the same manufacturer unless directed otherwise in Luminaire Schedule.

- D. Provide 45-degree lamp and lamp imaging cut-off unless otherwise specified in the Luminaire Schedule. Where upper reflector is separated from cone, cut-off shall be 45-degrees unless otherwise noted.
- E. Plastic materials shall not be used for reflector cones or aperture plate materials.
- F. Luminaires in which reflector cones are riveted or welded to the housing or where removal of the cone requires pressure to be applied to the finished surface of the reflector shall not be acceptable.
- G. Cone flange shall be formed as an integral part of the cone and shall have identical color and finish as the cone, except when specified otherwise in the Luminaire Schedule. The flange major surface shall be perpendicular to the cone axis. The width of the flange shall adequately cover the ceiling opening without light leaks. No luminaire parts (housing, mounting frame, etc.) shall be visible between the ceiling surface and the edge of the cone flange.
- H. Reflector cone retention devices shall not deform the cone in any manner.

## 2.10 TRACK LIGHTING SYSTEMS

- A. Lighting Track: Extruded aluminum track with extruded poly-vinyl insulator. 20amp copper conductor strips with separate ground to provide electrical and mechanical connection for the specified track mounted luminaires.
  - 1. Line Voltage Dimming: Number of circuits as indicated in luminaire schedule, with separate neutrals per circuit.
  - 2. 0-10V Dimming: Labeled and listed for the application.
  - 3. Wireless Dimming: Provide with QR code to allow users to access the associated wireless application.
- B. Provide connectors, elbows, stems, feed ends, end caps and fittings to make a complete system.
- C. Track Fittings: To provide positive mechanical and electrical connection for track heads to track. Removable fitting either twists into or snaps into specified lighting track.
- D. Luminaire dimensions: Proper for the various wattage noted on the plans and as recommended by the luminaire manufacturer or as specified.
- E. Adjustable Lamp Mechanisms: To have adjustable aiming which can be set to position lamp vertically and rotationally.
- F. Drivers: Integral to track fitting, to provide proper DC current to LED arrays.
- G. Finish: All visible surfaces to be of color and texture as directed in Luminaire Schedule.
- H. Labels: Track and track fittings shall be compatible and be U.L. labeled and listed as a system.

## 2.11 POLES

- A. Wind-load strength: 80 mph and 1.3 gust factor for total support assembly, including pole, base and anchorage, where used, to carry the combined Effective Projected Area (EPA) rating of the luminaire heads, arms, supports, and appurtenances at the indicated heights above grade without deflection or whipping.
- B. Pole shafts:
  - 1. Round straight, round tapered, square straight, or square tapered as noted on the Luminaire Schedule.



2. Steel poles: Steel tubing conforming to ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psi. Single piece construction up to 40-feet in height.
- C. Arm, bracket and tenon mount materials: Finish to match poles.
- D. Mountings, fastenings, and appurtenances: Corrosion-resistant components compatible with the poles and luminaires that will not cause galvanic action at contact points. Provide mountings that will correctly position the luminaire to provide the indicated light distribution.
- E. Handhole: Provide handhole and cover near base of pole shaft for access to wiring compartment.
- F. Grounding lug: Provide grounding lug for grounding conductor with access through handhole.
- G. Pole bases: Anchor type with galvanized steel hold-down or anchor bolts, leveling nuts and bolt covers.
- H. Anchor bolt covers: Spun or two-piece gravity held unless otherwise specified.
- I. Pole-top tenons: Fabricated to support the luminaire indicated and securely fastened to the pole top.

## 2.12 LIGHTING TRANSFORMERS

- A. Low voltage transformers:
  1. Low voltage transformers shall be core and coil construction, unless otherwise noted.
  2. Primary voltage shall be as noted in Luminaire Schedule, secondary voltage 12volt AC, unless otherwise noted.
  3. Sound rating shall be the best available. Replace excessively noisy transformers at no cost to the Owner.

## 2.13 UNIT BATTERY EQUIPMENT

- A. LED Emergency Power Supplies
  1. Standard Features:
    - a. Safety compliance to UL 924; CAN/CSAC22.2 No.141-10 and NFPA requirements for 90-minute egress
    - b. Open circuit / short circuit protection
    - c. Operating temperature: 32-degree F/0-degree C to 122-degree F/50-degree C
  2. Test switch / charging indicator light
  3. Emergency reaction time < 1-sec
  4. Powder coat steel, stainless or galvan-nealed case
  5. Field-replaceable NiCd battery pack (x2) with quick connect
  6. Min. lead wire length: 6in UL 1452 solid / #18 AWG 1000volt / 90-degree C

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Contractor shall thoroughly examine Project site conditions for acceptance of luminaire installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

### 3.02 PREPARATION

- A. Architectural Plans shall govern exact ceiling construction and mounting conditions for all luminaires. Locate as shown on the architectural elevations and reflected ceiling plan.
- B. Consult Architectural Drawings for details of ceiling construction, finish, and other applicable details.
- C. Contractor shall be responsible for coordination of luminaire mounting and compatibility with ceiling construction.
- D. Luminaires in areas where exposed or concealed pipe and ductwork prevents direct access to the structural ceiling shall be provided with appropriate support system to install luminaire below obstructions to avoid conflicts with same.

### 3.03 ARCHITECTURAL COORDINATION

- A. Where luminaires are mounted in architectural coves, soffits, valances, or cabinets and are given an overall length, the Contractor shall verify all lengths in the field prior to releasing order.
- B. Where luminaires are surface mounted or suspended to match the length of walls or other architectural elements, the Contractor shall verify all lengths in the field prior to releasing order.
- C. Mounting heights specified on drawings:
  - 1. Wall mounted luminaires: shall be to centerline of luminaire.
  - 2. Pendant mounted luminaires: shall be to bottom of luminaire unless specifically identified in the Luminaire Schedule or on drawings.

### 3.04 INSTALLATION

- A. Install luminaires in accordance with Manufacturer's written instructions, as indicated on the Drawings and as specified herein.
- B. Contractor shall be responsible for all supports, hangers, and hardware necessary for a complete installation.
- C. Luminaires shall be plumb, level, square, in straight lines and without distortion.
- D. Remedy light leaks that may develop after installation of recessed or enclosed luminaires.
- E. Adjustable luminaires shall be installed with "dead" zone of rotation away from intended aiming point.

### 3.05 LUMINAIRE SUPPORTS

- A. Physical (gravity) supports:
  - 1. Recessed luminaires in wood framed ceilings shall be supported by 2" x 4" hangers fastened to adjacent ceiling joists.
  - 2. Recessed downlights in wood frame ceilings shall be supported with Manufacturers supplied bar hangers and shall be installed according to the Manufacturer's instructions.
  - 3. Surface mounted luminaires solely supported by recessed boxes in a gypsum board ceiling shall have a 1-1/8" steel bar screwed or welded to the back of the box. This steel bar must be long enough to span two ceiling support channels and shall be attached to the channels by twisting wire around the bar and the support channel. For luminaires weighing over 50-pounds, provide studs in recessed box.

4. Support surface mounted luminaires more than 18" wide at or near each corner or edge, in addition to support from outlet box.
5. Support recessed downlights manufactured with built-in brackets by twisting wire around the bracket and two adjacent ceiling support channel runners on either side of the luminaire.
6. Support outlet boxes as specified in Section 260533: Boxes. Provide all boxes with grounding pigtail.
7. On concrete ceilings, use one of the following for supporting luminaires other than by outlet box:
  - a. Preset concrete inserts, provided inserts are completely covered by the luminaire after installation.
  - b. 1/4-20 threaded appropriate length wedge type anchor.

B. Seismic supports:

1. Recessed luminaires in suspended ceilings shall be supported by connecting two support wires to the luminaire at diagonal opposite corners for luminaires weighing 56 pounds or less. Connect four wires, one at each corner for luminaires weighing more than 56 pounds.
2. Surface mounted luminaires on suspended ceilings shall be attached to the main ceiling runner with at least two positive clamping devices and shall have an additional support wire attached to each clamping device and to the structure above.
3. Recessed downlight luminaires in suspended ceilings shall be supported by connecting one support wire to the luminaire housing.
4. All suspended luminaires shall be able to swing 45-degrees from vertical in any direction without obstruction.
  - a. Furnish suspended rigid pendant luminaires with universal joint type hanger canopy and longitudinal sway adapter at each stem, to permit 45-degree swivel on 360-degree circle at canopy and 45-degree longitudinal movement at sway adapter.
  - b. Submit Drawings of hanger assembly for review prior to ordering.
  - c. If suspended luminaire is not free to swing 45-degrees in any direction, without obstructions, provide seismic restraint to prevent contact in conformance with California Uniform Building Code, Section 2330, Seismic Design.
5. All recessed modular luminaires shall be furnished with earthquake clips where installed in tee bar ceiling.

3.06 INSTALLATION OF POLES

- A. General: Store poles on decay-resistant treated skids at least 1-foot above grade and vegetation. Support pole to prevent distortion and arrange to provide free air circulation.
- B. Metal poles: Retain factory-applied pole wrappings until just before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.
- C. Wood poles: Do not drag treated poles along the ground. Do not handle poles with tongs, cant hooks and other pointed tools capable of producing indentation more than ¼-inch in depth. Do not apply tools to ground line section of poles.
- D. Pole installation: Use fabric web slings (not chain or cable) to raise and set poles.

3.07 CONCRETE FOUNDATIONS

- A. Construct concrete foundations conforming to Division 03, Section "Cast-In-Place Concrete."
- B. Utilize manufacturer's bolt templates to properly position anchor bolts.
- C. Provide leveling nut to anchor bolt prior to pole base. After pole leveling, pack non-shrink grout between pole base and concrete foundation.
- D. Comply with details and Manufacturer's recommendations for reinforcing, anchor bolts, nuts and washers.

3.08 ATTIC STOCK

- A. Spare Parts: Provide spare parts totaling 5 percent of the quantity specified, or two total, whichever is greater, of the following:
  - 1. Luminaires:
  - 2. Lenses:
  - 3. LED Drivers:
  - 4. LED Modules:

3.09 IDENTIFICATION SYSTEM

- A. All concealed junction box cover plates for the lighting branch circuit system shall be clearly marked with a permanent black ink felt pen identifying the branch circuit (both panel designation and circuit number) contained in the box.

3.10 FIELD QUALITY CONTROL

- A. Visual and mechanical inspection:
  - 1. Inspect for physical damage, defects, alignment and fit.
  - 2. Perform operational test of each luminaire after installed, circuited, and energized.
  - 3. Perform emergency operational test of all luminaires connected to emergency circuiting by simulating normal power source failure.
- B. Contractor shall replace at no cost to the Owner all equipment which is found defective or do not operate within factory specified tolerances.

3.11 MOCK-UPS

- A. The purpose of the mock-up is to study the general appearance and performance of and to make comparisons between the various lighting systems. At that time, certain minimal test variations may be requested as to lamp location, lamp type, reflector shape, color, etc. Final modifications, if any, shall be considered a part of these Specifications and shall be accomplished with no additional cost to the Owner.
- B. Where noted in the Luminaire Schedule, the Contractor shall provide sample(s) for use in full-size field mockup of specific luminaires.
- C. The Contractor shall allow time in the bid and be responsible for procuring and installing a sample luminaire on the Project for review, prior to acceptance and final installation.
- D. This mock-up will be required to be coordinated and reviewed with the Owner's Representative and the Architect or Engineer.

- E. The Contractor shall be responsible for providing the labor and materials for the field mock-up including, but not limited to, special rigging or scaffolding and adjustments in the field, as directed by the Architect or Engineer.
- F. The mock-up installation shall closely conform to the conditions of the actual final installation as to height, distance from adjacent surfaces, number and type of lamps, material, color, etc.
- G. The Contractor shall submit a written description of each proposed mock-up with Drawings in order to obtain Architect's approval prior to commencement of each mock-up.
- H. Exterior mockups will occur at night, starting 2-hours after local sunset. Dates to be coordinated with design team to suit schedules. Contractor to propose multiple dates at least 4 weeks in advance.
- I. Allow two, 6-hour mockup sessions per luminaire. The second mockup, if required, will occur after additional or alternate equipment is available.
- J. Contractor to provide all required security, sidewalk closures, lifts, walkie-talkies (4 minimum) and manpower to make changes to color and intensity of the temporary luminaires.
- K. Mockup luminaire shall not be used for final permanent installation unless approved by the design team.

### 3.12 ADJUSTING AND AIMING

- A. Aiming will occur at night under the direction of the Owner's Representative and the Architect or Engineer. The Contractor shall be responsible for providing the labor and materials for field aiming. This shall include, but not limited to, special rigging or scaffolding, adjusting luminaires in field, testing of various lenses or louvers, as directed by the Architect or Engineer.
- B. Aim all directional luminaires, including but not limited to luminaires described in the Contract Documents or by the luminaire manufacturer as "aimable," "adjustable," or "asymmetric" as follows:
  - 1. To provide the lighting pattern for which the luminaire is designed.
  - 2. To provide the lighting pattern as shown on the drawings.
  - 3. To predetermined aiming points as shown on the drawings.
  - 4. Where aiming cannot be determined, request, in writing, clarification from the Specifier, indicating luminaires needing clarification.
- C. Re-aim luminaires as determined by Architect during final project walkthrough.

### 3.13 CLEANING

- A. Clean luminaires prior to Project closeout in accordance with Manufacturer's recommended materials and methods.
- B. Remove all debris, fingerprints, and packaging remnants.

END OF SECTION

SECTION 27 00 00  
COMMUNICATION BASIC REQUIREMENTS

REVISION SUMMARY

All Users and Designers! This page is for your information only to provide information on the latest update to this specification so that you don't have to traipse line by line looking for the last edit. Please delete this page prior to issuance.

09/30/2022 – Initial Section creation/edits

01/20/2023 – Edits from meeting with Bob Lyons and Aron Jones

03/15/2023 – updates from CB Wire Project

01/31/2025 – Annual update.

DISTRICT DESIGN STANDARDS

All Users and Designers! The information shown below is provided by the District to convey the District's thought process on manufacturers, products, procedures, etc. These items are to assist the design team with understanding what to use as part of the design along with those items that the District does not want to be installed or used on their school sites. Please delete this page prior to issuance.

Designer to evaluate:

1. The design team must verify all existing site conditions. The existing conditions must be verified and reviewed against "Record Drawings" provided by the District.
2. If no "Record Drawings" currently exist, the engineer/designer shall develop such drawings as close as possible actual conditions so the bidding contractor will have accurate information for the bidding process.
3. If a specific scope of work necessitates excavation or minor destructive investigation, the design team shall coordinate with District/District Representative as to who will obtain an underground locator service. The District Maintenance & Operations personnel and/or General Contractor, if selected, will assist if necessary and if requested.
4. The identification and abatement of existing asbestos containing materials shall be designated and abated by a separate consultant hired by the District and will be provided to the design team.

Designer to include:

1. Appropriate space for data communication facilities (rooms). These rooms are typically identified as Minimum Point of Entry (MPOE), main distribution frame (MDF), or intermediate distribution frame (IDF) rooms.
2. Dedicated MDF and IDF rooms conforming to the following requirements are **REQUIRED** for new construction.
3. MPOE design standards.
  - a. Provide fire rated  $\frac{3}{4}$ " plywood on all walls requiring utility MPOE equipment anchoring, with fire rated label clearly shown for inspection.
  - b. Utilize rack mount MPOE hardware where applicable and available from utility provider(s).

- c. Provide 1 ea. 120vac/20amp dedicated electrical circuit for MPOE connectivity.
4. Each site shall have one MDF, and may or may not share space with the MPOE. This room shall be dedicated to the MDF (and MPOE when required) functions only.
5. Physical security is very important for supporting the critical systems (Technology, data, electronic fire safety and security systems) that are housed in a MDF and IDFs.
6. There shall be a minimum of one IDF per wing and per floor (if area is not served by the MDF). Depending on the distances of anticipated cable runs (290 foot/90-meter limit) and the quantity of cables to be pulled, there might be a requirement for additional IDFs per floor.
7. The MDF and each of the IDF rooms shall be equipped with an HVAC unit, properly sized for proposed active equipment. The HVAC unit shall NOT be mounted directly above any electronic equipment to avoid any potential condensate water damage.
8. Minimum room size for a new dedicated MDF shall be as outlined below, which differs depending on whether it is intended for an Elementary School 6'x10' (60 Sq.Ft.), Middle School 8.5'x10' (85 Sq.Ft.), or High School 11'x10' (110 Sq.Ft.).
9. MDF room design standards:
- a. All walls in the dedicated MDF room shall be covered with  $\frac{3}{4}$ " fire-rated plywood. If the plywood is to be painted with fire-retardant paint, a minimum of one of the plywood rating stamps must be protected so it remains visible after painting.
  - b. All new MDF rooms shall have 4-post rack(s) installed. Each side that is exposed to the room shall have a solid side panel installed.
  - c. Multiple floor mounted racks shall be organized in rows with vertical wire management (6" min.) in between each rack and on each end. Adequate workspace shall be 36" in front and behind each rack.
  - d. UL listed ladder rack/cable management on top of each rack connected to all 4 walls. Ladder rack height shall be min. 6" above highest equipment enclosure.
  - e. Adequate lighting and electrical convenience receptacles.
  - f. Appropriately sized (quantity/ampage) electrical circuits located at top of racks.
  - g. Wall mounted ground bus bar, connected to appropriate electrical ground.
  - h. Appropriately sized rack mounted uninterruptable power supply (UPS) with environmental monitoring.
10. IDF room design standards shall include:
- a. All walls in dedicated IDF rooms shall be covered with  $\frac{3}{4}$ " fire-rated plywood. If the plywood is painted with fire-retardant paint, at minimum one of the plywood rating stamps must be protected so it remains visible after painting.
  - b. When required - multiple floor mounted racks shall be organized in rows with vertical wire management (6" min.) in between each rack and on each end. Adequate workspace shall be 36" in front and behind each rack.
  - c. When required with racks - UL listed ladder rack/cable management on top of each rack connected to all 4 walls. Ladder rack height shall be min. 6" above highest equipment enclosure.
  - d. Adequate lighting and electrical convenience receptacles.
  - e. Appropriately sized (quantity/ampage) electrical circuits for top of racks.
  - f. Wall mounted ground bus bar and connected to appropriate electrical ground.

g. When required with racks - Appropriately sized rack mounted uninterruptable power supply (UPS) with environmental monitoring.

11. IDF non-dedicated room standards (**RETROFIT/MODERNIZATION ONLY**):

a. A lockable network cabinet (keyed to District standard)



SECTION 27 00 00  
COMMUNICATIONS BASIC REQUIREMENTS

**PART 1 - GENERAL****1.01 SUMMARY**

- A. This Section specifies the common administration basic requirements and common methods for all low voltage systems installation work included under Division 27 and 28 (and other Divisions). Where those requirements differ from the requirements of this section, the more stringent shall govern.

**1.02 STANDARDS, REGULATIONS, AND CODES REFERENCES**

- A. The following Standards, Regulations and Codes apply to work specified in the Contract Documents.
1. Applicable State and Local Codes.
  2. California Building Code and California Electrical Code, Current Editions.
  3. BICSI TDMM (Telecommunications Distribution Methods Manual), 11th Edition 2006.
  4. ANSI/TIA/EIA-568-B.1. Commercial Building Telecommunications Cabling Standard,
  5. ANSI/TIA/EIA-568-B.1-2. Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements, Addendum 2, Grounding and Bonding Specifications for Screened Balanced Twisted-Pair Horizontal Cabling.
  6. ANSI/TIA/EIA-568-B.1-3. Commercial Building Telecommunications Cabling Standard.
  7. ANSI/TIA/EIA-568-B.1-4. Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements, Addendum 4, Recognition of Category 6 and Category Cat 6A and 50 nm Laser-Optimized 50/125 um Multimode Optical Fiber Cabling.
  8. ANSI/TIA/EIA-568-B.1-2. Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components.
  9. ANSI/TIA/EIA-568-B.2-1. Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components, Addendum 1, Transmission Performance Specifications for 4-Pair 100 Ohm Category 6 Cabling.
  10. ANSI/TIA/EIA-568-B.2-10 (draft 2.0). Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components, Addendum 10, Transmission Performance Specifications for 4-Pair 100 Ohm Augmented Category 6 Cabling.
  11. ANSI/TIA/EIA-568-B3.3 Optical Fiber Cabling Components Standard.
  12. TIA-569-B. Commercial Building Standard for Telecommunications Pathways and Spaces.
  13. ANSI/TIA/EIA-606-A. Administration Standard for Commercial Telecommunications Infrastructure.
  14. ANSI/TIA/EIA-607-A. Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
  15. TIA/EIA TSB-67 Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems.

## 16. TIA/EIA TSB-72 Centralized Optical Fiber Cabling Guidelines.

## 1.03 DEFINITIONS

- A. The following is a list of abbreviations generally used in Divisions 27 & 28:
1. ADA - Americans with Disabilities Act
  2. AHJ - Authority Having Jurisdiction
  3. ANSI - American National Standards Institute
  4. APWA - American Public Works Association
  5. ASTM - American Society for Testing and Materials
  6. CBC - California Building Code
  7. CEC - California Electrical Code
  8. CFC - California Fire Code
  9. FCC - Federal Communications Commission
  10. HVAC - Heating, Ventilating and Air Conditioning
  11. IEC - International Electro-technical Commission
  12. IEEE - Institute of Electrical and Electronics Engineers.
  13. IETA - International Electrical Testing Association
  14. FM - FM Global
  15. NEMA - National Electrical Manufacturers Association
  16. NFPA - National Fire Protection Association
  17. OSHA - Occupational Safety and Health Administration
  18. UL - Underwriters Laboratories Inc.
- B. Provide: To furnish and install, complete and ready for the intended use.
- C. Furnish: Supply and deliver to the project site, ready for unpacking, assembly, and installation.
- D. Install: Includes unloading, unpacking, assembling, erecting, installing, applying, finishing, protecting, cleaning, and similar operations at the project site to complete items of work furnished by others.
- E. Following is a list of commonly used terms:
1. Active Equipment: Electronic equipment used to develop various WAN and LAN services.
  2. Backbone: Collective term sometimes used to describe the campus and vertical distribution subsystem facilities and media interconnecting service entrances, communications rooms, and communications cabinets.
  3. Bonding: Permanent joining of metallic parts to form an electrically conductive path which will assure electrical continuity and the capacity to safely conduct currents likely to be imposed on it.
  4. Cabinet: Wall-mounted modular enclosure designed to house and protect electronic equipment.

5. Cable Tray: Vertical or horizontal open supports, usually made of aluminum or steel, that are fastened to a building ceiling or wall. Cables are laid in and fastened to the trays. A cable tray is not a raceway.
6. Campus: Grounds and buildings of a multi-building premises environment.
7. Channel: The end-to-end transmission path between two points at which application specific equipment is connected; may include one or more links, cross-connect jumper and/or patch cords, and work area station cords. Does not include connections to active equipment.
8. Cross-Connect: Equipment used to terminate and tie together communications circuits.
9. Cross-Connect Jumper: A cluster of twisted-pair conductors without connectors used to establish a circuit by linking two cross-connect termination points.
10. Fiber Optic Distribution Unit (FDU): Cabinet with terminating equipment used to develop fiber optic cross-connect facilities. Also known as LIU.
11. Grounding: a conducting connection to earth, or to some conducting body that serves in place of earth.
12. Hinged Cover Enclosure: Wall-mounted box with a hinged cover that is used to house and protect electrical devices.
13. Horizontal: Pathway facilities and media connecting the MDF or IDF to Telecommunications Outlets.
14. Intermediate Distribution Frame (IDF): Data networking equipment rack and/or location that serves an individual area, floor or building. Downstream from the MDF.
15. Jack: Receptacle used in conjunction with a plug to make electrical contact between communications circuits, e.g., eight-position/eight-contact modular jacks.
16. Link: A transmission path between two points, not including terminal equipment, work area cables, and equipment cables; one continuous section of conductors or fiber, including the connecting hardware at each end.
17. Local Area Network (LAN): Data transmission facility connecting several communicating devices, typically Ethernet and the network is limited to a single campus.
18. Main Distribution Frame (MDF): Initial (main) data network equipment rack and/or location. Only one MDF occurs per site and may serve many downstream IDFs.
19. Media: The type of cable (e.g., twisted-pair, coaxial, or fiber optic) used to provide signal transmission paths.
20. Minimum Point of Entry (MPOE): The location where the service provider hands off connection and responsibility for service to on-premise customer owned equipment.
21. Modular plug: An eight-position, eight-conductor end-of-wire electrical connector used with Category rated cable.
22. Passive Equipment: Non-electronic hardware and apparatus, e.g., equipment racks, cable trays, electrical protection, wiring blocks, FDUs, etc.
23. Patch Cord: A length of copper or fiber cable with connectors on both ends used to join communications circuits at MDF/IDF and end stations.
24. Patch Panel: System of terminal blocks or connectors used with patch cords that facilitate the administration of cross-connect fields.

- 25. Pathway: Facility for the placement of communications cable. A pathway facility can be composed of several components including conduit, wireway, cable tray, surface raceway, underfloor systems, raised floor, ceiling support wires, etc.
- 26. Protectors: Electrical protection devices used to limit foreign voltages on metallic communications circuits.
- 27. Raceway: An enclosed channel designed expressly for holding wires or cables; may either conductive metal or insulating plastic. The term includes conduit, tubing, wireway, underfloor raceway, and surface raceway; does not include cable tray.
- 28. Rack: An open or enclosed structure, typically made of aluminum or steel, used to mount equipment; usually referred to as an equipment rack. Maybe freestanding and floor mounted or a wall mounted cabinet. Industry standard 19" width spacing.
- 29. Wiring Block: Punch down terminating equipment used to develop twisted pair cross-connect facilities.

#### 1.04 PRODUCT AVAILABILITY

- A. Products with long lead times are to be brought to the attention of the project manager.

#### 1.05 PRODUCT SUBMITTALS

- A. See Division 01 Submittals for more requirements

#### 1.06 SUBSTITUTION LIMITATIONS

- A. Equivalent product(s) may be considered for substitution for those products specified, however, the equivalent product(s) must be approved, and show demonstrated and documented equivalence to the product(s) specified. Documentation includes, but is not limited to, product samples, data sheets, and actual test data. The request for product substitution, and supporting documentation, must be submitted to the Project Manager/Designer in writing.
- B. See Division 01 Substitutions for more requirements

#### 1.07 QUALITY ASSURANCE

- A. The Contractor is to conform to requirements of the latest adopted version of the CEC with amendments by local AHJs.
- B. The Contractor is to conform to the latest adopted version of the CBC with amendments by local AHJs.
- C. The Contractor is to obtain and pay for electrical permits, plan review, and inspections from local AHJs.

- D. The Contractor is to furnish products listed by UL or other testing firm acceptable to AHJ.
- E. The Contractor is to conform to requirements of the Service Providers (i.e., electric, telephone, broadband and cable television).
- F. Contractor Qualifications:
  - 1. The Contractor shall have a minimum of five years' experience in the design, installation, testing, and maintenance of low-voltage systems.
  - 2. The Contractor shall maintain a local service facility which stocks spare devices and/or components for servicing systems.
  - 3. The Contractor shall have performed successful installation and maintenance of at least three projects similar in scope and size. The Contractor must be able to provide project references for these three projects, including scope of Work, project type, owner/user contact name and telephone number.
  - 4. For sections requiring installation personnel to be certified by the manufacturer, the Contractor selected for this project shall provide current certificates for all technicians working on the project.
  - 5. The Contractor shall hold and maintain a valid California C-7 or C-10 State Contractors License, and can exhibit validity upon request.
  - 6. The Contractor shall provide a list of test equipment proposed for use in verifying the installed integrity of copper and fiber optic cable systems used.
  - 7. The Contractor shall provide the resume for the contractor's Project Manager and on-site Installation Supervisor who will be assigned to this project.
  - 8. The Contractor shall provide a list of technical product training attended by the contractor's personnel that will install the specified manufacturer system.
  - 9. The Contractor shall provide a list of Sub-Contractor(s) who will assist the Contractor in the performance of this work.

#### 1.08 SEQUENCING AND SCHEDULING

- A. For the proper execution of the work, the Contractor shall cooperate with other trades and contracts as needed.
- B. To avoid installation conflicts, the Contractor shall thoroughly examine the complete set of Contract Documents, and resolve conflicts with Project Manager/Designer prior to installation.
- C. Prior to installation of communications cable to equipment requiring connections, examine the manufacturer's shop drawings, wiring diagrams, product data, and installation instructions. Verify that the electrical characteristics detailed in the Contract Documents are consistent with the electrical characteristics of the actual equipment being installed. When

inconsistencies do occur, the Contractor shall request clarification from Project Manager/Designer.

#### **1.09 SHOP DRAWINGS**

- A. Shop Drawings: When required by individual Specification Sections, the Contractor shall provide shop drawings which include physical characteristics, electrical characteristics, device layout plans, point-to-point wiring diagrams for all connections, and the like. Refer to individual Specification Sections for additional requirements for the shop drawings.

#### **1.10 WARRANTY**

- A. The Contractor shall provide an extended manufacturer's warranty on the Backbone and Horizontal Communications systems as specified in other sections of Division 27.

#### **1.11 CLOSE OUT DOCUMENTS**

- A. The Contractor shall provide final coordination drawings, with as-built information added, which are to be submitted as record drawings at completion of project.
- B. Record Drawings:
  - 1. Show changes and deviations from the Construction Drawings (including Addendums and change order documents).
  - 2. Show exact routes of pathway facilities and service entrance conduits.
  - 3. Show the exact location of racks, cabinets, mounting frames and the like.
- C. Operation and Maintenance Documentation: Provide copies of certificates of code authority acceptance, product data, guarantees, warranties, installation guides, maintenance guides and the like.
- D. Inspection and/or testing: Submit testing reports for testing that was performed.

**PART 2 PRODUCTS****2.01 MANUFACTURERS**

- A. Provide like items from one manufacturer, such as wire/cable, jacks, modular plugs, patch panels, equipment connection cords, wall plates, and the like. See individual sections for detailed information.

**2.02 MATERIALS**

- A. Provide new electrical materials of the type and quality detailed, listed by UL, bearing their label wherever standards have been established. Indicated brand names and catalog numbers are used to establish standards of performance and quality.
- B. Provide material and equipment that is acceptable to AHJ as suitable for the use indicated. For example, provide plenum rated cable in ceilings that are utilized as air return plenums.
- C. Include special features, finishes, accessories, and other requirements as described in the Contract Documents regardless of the item's listed catalog number.
- D. Provide incidentals not specifically mentioned herein or noted on Drawings, but needed to complete the system, in a safe and satisfactory working condition.

**PART 3 - EXECUTION****3.01 EXAMINATION****A. Construction Documents:**

1. Drawings are diagrammatic with symbols representing communications equipment, outlets, accessories, and wiring.
2. Examine the entire set of Drawings to avoid conflicts with other systems. Determine the exact route and installation of communications wiring and equipment with conditions of construction.

**3.02 INSTALLATION**

- A. Install communications equipment completely as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of the communications equipment, and examine the instructions thoroughly. When requirements of the installation instructions conflict with the Contract Documents, request clarification from Project Manager/Designer prior to proceeding with the installation.
- B. Do not install communications equipment in obvious passages, doorways, scuttles, or crawl spaces, which would impede or block the passage's intended usage.
- C. Do not install communications equipment in locations where it would obviously be subject to damage during normal use.

**3.03 FIELD QUALITY CONTROL**

- A. Tests: Conduct tests of equipment and systems to demonstrate compliance with requirements specified in Division 27 & 28. Refer to individual Specification Sections for required tests. Testing documentation is to be included in Closeout Documents.

**3.04 CLEANING**

- A. Remove all dirt and debris caused by the execution of the work.
- B. Leave the entire communications system installed under this Contract in a clean, dust-free, and proper working order.
- C. Vacuum and clean interiors of new and modified electrical signal and communication equipment enclosures.

END OF SECTION



SECTION 27 05 00  
COMMON WORK RESULTS FOR COMMUNICATIONS

REVISION SUMMARY

All Users and Designers! This page is for your information only to provide information on the latest update to this specification so that you don't have to traipse line by line looking for the last edit. Please delete this page prior to issuance.

09/30/2022 – Initial Section creation/edits  
1/20/2023 – edits after review with Bob Lyons and Aron Jones  
2/28/2023 - edits after reviews with the District  
04/04/2023 – Added Div 07 to references, reconcile with Div 26  
10/27/2023 – updated for AT&T/Comcast  
01/31/2025 – Annual edits added painting

DISTRICT DESIGN STANDARDS

All Users and Designers! The information shown below is provided by the District to convey the District's thought process on manufacturers, products, procedures, etc. These items are to assist the design team with understanding what to use as part of the design along with those items that the District does not want to be installed or used on their school sites. Please delete this page prior to issuance.

09/30/2022 – Designer to evaluate:

1. Existing pathways: Existing pathways shall be utilized whenever possible. Additional exposed pathways (conduits or exposed raceways) shall only be implemented in the design documents with District approval.
2. Conduit size: All new conduits shall be sized accordingly to achieve a 40% maximum fill ratio.

09/30/2022 – Designer to include:

1. If cable pathway is exposed in occupied areas, provide solid bottom cable tray pathways, either center hung, or wall mounted.
2. District standards for site underground conduit is 4 ea. 2". (see 10/27/2023 update).
3. AT&T requirement for conduit is 2 ea. 4" (see 10/27/2023 update).
4. Comcast requirement for conduit is 1 ea. 2".
5. District preference for other low voltage service provider conduit is 1 ea. 2".
6. All wall junction boxes larger than 8" shall have a hinged lid.
7. All in-ground pull boxes with metal lids shall have the word "COMM" welded to the lid.
8. All conduit, boxes and supports shall be primed and painted to match existing conditions, adjacent roof surface or to best match building body color.
9. Cable bundles less than 24 ea. shall be routed utilizing J-Hooks.
  - a. Fiber Optic and Service Provider cable bundles shall be routed utilizing ORANGE colored J-Hooks.

- b. Data Cat6A copper cable bundles less than 24 ea. shall be routed utilizing non-colored J-Hooks.
- c. CCTV, Electronic access control cable bundles shall be routed utilizing BLUE colored J-Hooks. (see 01/31/2025 update)
- d. Clock, intercom, and Audio-Visual (non-data) cable bundles shall be routed utilizing YELLOW colored J-Hooks.
- d. EMS and Lighting Control low voltage cables shall be routed utilizing GREEN colored J-Hooks.
- 10. Cable bundles more than 24 ea. shall be routed in a cable tray/wire basket above the ceiling. The cable tray/wire basket shall be routed down corridors if possible. A product such as Snake-Tray, sized and specified to allow proper fill ratio and mounting requirements is acceptable.
- 11. If cable pathway is exposed in occupied areas, provide solid bottom cable tray pathways, either center hung, or wall mounted.
- 12. For new construction – Fire Alarm pathways shall be in red painted conduit. (see 01/31/2025 update)

10/27/2023

- 1. For AT&T feeds with no copper a single 4" conduit for underground is acceptable.

01/31/2025

- 1. For new construction, exposed Fire Alarm pathways to be in red painted conduit.
- 2. Red painted j-hooks are to be used for non-exposed accessible free-air Fire Alarm pathways.
- 3. Low voltage in-ground boxes to have metal traffic-rated lids.
- 4. CCTV, Electronic Access Control and Intrusion cable bundles shall be routed utilizing BLUE colored J-Hooks.
- 5. District standard for site underground and above ground back-bone conduit is 5 ea. 2".
- 6. A dedicated 4" conduit pathway for AT&T service is to be provided.
- 7. Comcast/other providers require one ea. 2" conduit pathway and one ea. 2" spare conduit pathway.

SECTION 27 05 00  
COMMON WORK RESULTS FOR COMMUNICATIONS

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This section specifies the basic materials and methods for all low voltage pathways installation work included under Division 27 and 28. Where those requirements differ from the requirements of this section, the more stringent shall govern.
- B. This section adds refinements to Division 26 that apply to Communications and extra-low-voltage systems.

1.02 SCOPE

- A. Materials and/or methods for the following.
  - 1. Communication services
  - 2. Grounding
  - 3. Fasteners
  - 4. Hangers and supports
  - 5. Conduits/Backboxes/Raceways
  - 6. Underground
  - 7. Sleeves and penetrations

1.03 SUBMITTALS

- A. Submittals shall be done in accordance with District submittal procedures, see Division 01 Submittals for requirements.

1.04 RELATED REQUIREMENTS

- A. Division 07 – Thermal and Moisture Protection
- B. Section 09 91 00 - Painting
- C. Division 26 – Electrical
- D. 27 00 00 – Communications Basic Requirements

1.05 REFERENCES

- A. ANSI American Nation Standards Institute
- B. NFPA 70 – National Electrical Code
- C. UL Underwriters Laboratory
- D. California Building Code (CBC)
- E. California Electrical Code (CEC)

1.06 WARRANTY

- A. Refer to Division 01 — Warranties

**PART 2 – PRODUCTS**

2.01 All products used on this project shall bear the label of- and be approved by Underwriters Laboratories unless otherwise approved in writing by District.

2.02 FASTENERS

A. Mounting hardware and anchors recommended by the manufacturer of any material that shall be mounted to the building or structure.

1. Sheet rock / drywall / wall board: Easy Anchor, toggle bolt, other spread type anchor with load distribution, or approved equivalent.
2. Concrete / cinder block / solid masonry: Expanding compression type lag, expanding compression type bolt, expanding compression type, all-thread with nuts, or approved equivalent.
3. Tile / Stucco / hollow masonry: Toggle bolts or approved equivalent.
4. Wood: Lag screws, wood screws, or approved equivalent.
5. Metal: Beam clamps, sheet metal screws, self-drilling screws or approved equivalent.

2.03 HANGERS AND SUPPORT

A. D-RINGS

1. Commercial grade

B. J-HOOKS

1. Commercial grade
2. Colored coded by system:
  - a. No color = Data
  - b. Orange = Fiber optic cables and service provider feeders
  - c. Blue = CCTV, Electronic Access Control, and Intrusion
  - d. Yellow = Clock, Intercom, and Audio-Visual (non-data)
  - e. Green = EMS and lighting controls
  - f. Red = Fire Alarm

2.04 SURFACE RACEWAY

A. The District has standardized the use of Wiremold 800, 2300, 5400 and 5500 series for non-metallic surface raceway.

2.05 CONDUITS AND ACCESSORIES

A. CONDUITS

1. See Division 26 for additional requirements.
2. For new construction, exposed Fire Alarm pathways to be in red painted conduit.
3. All new conduits shall be sized accordingly to achieve a 40% maximum fill ratio with initial cables installed.
4. Underground conduits shall be Schedule 40 PVC.

B. INNERDUCT

1. Orange corrugated HDPE (High Density Polyethylene) Innerduct shall be used for fiber optic cable protection in interior locations.
2. Fabric multi-cell innerduct is approved for underground conduits 2" and larger.

C. FITTINGS:

1. See Division 26 for additional requirements.
2. Commercial grade.
3. Compression type.
2. Conduit bodies and any other sharp bend fittings are strictly prohibited for communication Cat6A and fiber optic cables. Appropriate conduit sweeps are required.

D. PULL LINE

1. Minimum 1/8" diameter or larger braided line of polypropylene or continuous fiber polyolefin. The minimum breaking strength of 1/8 in. line is 200 lbs.

E. SLEEVES

1. All conduit sleeves shall be of sufficient quantity and size to achieve a 40% maximum fill ratio with initial cables installed.
2. Penetrations through rated assemblies to use EZ-Path or an approved equal.

**2.06 BACKBOXES AND JUNCTION BOXES**

- A. Galvanized one-piece or welded pressed steel type. Boxes for fixtures shall not be less than 4" square and shall be equipped with fixture stud. Boxes shall be at least 2-1/8" deep, 4" square for 1 or 2 gang devices, with device rings. Boxes mounted in wall or ceiling finished with 5/8" gypsum board shall be furnished with 5/8" deep device rings. Provide blank cover for all boxes without fixture or device. 4 11/16 and/or 5" square back boxes may be required for larger cable requirements.
- B. Junction boxes, larger than 8", located indoors shall be hinged, NEMA-1 rated.
- C. Junction boxes, larger than 8", located outdoors, or in wet or damp locations shall be hinged, NEMA-3R.
- D. Provide and install tamper-proof screws for all exterior box lids.
- E. Junction boxes used for Fire Alarm systems are to be red in color with red colored cover plates.

**2.07 GROUND BOXES**

- A. See Division 26 and below for additional requirements.
- B. Approved manufactures are Jensen, Christy or approved equivalent.
- C. All ground boxes shall have metal traffic-rated lids with permanent factory markings of COMM/COMMUNICATIONS/DATA/SIGNAL/FIRE ALARM.
- D. Minimum size is 17" x 30"
- E. 24"x36" ground boxes are required for 90-degree turns in underground pathway, or 3-way underground pathway connections.
- E. For dedicated AT&T service feeds, the minimum requirement is a 36"x48" Intercept pull-box at service tie-ins. Refer to current AT&T documents/requirements.
- F. For Comcast service feeds the minimum requirement is a 24" x 36" at service tie in; 17"x30" inline ground boxes are acceptable.

**2.08 PENETRATION SEALING**

- A. Firestopping: Provide UL Listed firestopping materials for all penetrations through rated assemblies (walls / floors). See Division 07 for more information.

- B. Draft stopping: Use foam sealant around conduit penetrations (in non-rated assemblies) to prevent passage of air, smoke, and/or toxic gas. See Division 07 for more information.
- C. Weatherproofing: Use weatherproof sealant around conduit penetrations in exterior walls to prevent the intrusion of water. See Division 07 for more information.

## **2.09 GROUNDING BUS BAR**

- A. Copper bus bar 2"x10"x1/4" minimum size with stand-off brackets and insulators, pre-drilled and threaded mounting holes (hole qty. 12 or greater) for equipment grounding lug attachment.



**PART 3 - EXECUTION**

**3.01 COMMUNICATION SERVICES**

- A. Install inground boxes, conduits, and terminal cabinets per service provider requirements.

**3.02 GROUNDING**

- A. Ground fittings shall be UL approved for each application and installed and/or connected to system in accordance with current CEC Code requirements.
- B. See Division 26 for additional requirements.
- C. Install grounding bus bar per manufacturer's instructions in each MDF and IDF.

**3.03 HANGERS AND SUPPORTS**

- A. Install hangers and supports per manufacturer's written instructions.
- B. Hanger spacing shall be 48" or less and within 12" of sleeves and/or junction/back boxes.

**3.04 LOW VOLTAGE PATHWAY/RACEWAYS**

- A. EMT conduit may be used at following locations (see Division 26 for additional requirements):
  - 1. In dry locations in furred spaces.
  - 2. In partitions other than concrete or solid masonry.
  - 3. In protected exterior locations not exposed to direct weather.
- B. Rigid steel conduit and fittings shall be used for vertical risers and on top of all roofs, overhangs, walkways, canopies, or any other location exposed to direct weather. See Division 26 for additional requirements.
- C. Furnish and install pull lines in all unused (empty) conduits or raceways. All pull lines shall be permanently tagged with identification at both ends.
- D. Install exposed conduits neatly, parallel to or at right angles to structural members. Maintain a minimum of 12 inches of clearance from steam or hot water pipes. All installed strut channel supports should allow for future conduit attachments. The width of strut channel to match the width of the closest attached junction box. See design document details for attachment requirements.
- E. Install j-hooks pathways perpendicular/parallel to building structure – no diagonal runs.

- F. Supports: Support conduit with two-hole straps or strut channel where shown in design documents and/or specified. Coordinate supports with architectural details. Secure to wood structure by means of bolts or lag screws, to metal by means of shallow self-tapping screws, to concrete by means of insert or expansion bolts, to brickwork by means of expansion bolts, and to hollow masonry or stucco by means of toggle bolts.
- G. Spacing for all EMT and rigid steel conduit supports shall be as follows, unless otherwise specified in design documents details:
  - 1. Surface conduit spacing and supports and unless otherwise specified or shown on drawing details:
    - a. EMT – Size 3/4" to 2" – 4' maximum spacing (3 each supports per 10' conduit length) and 12" from each end of conduit at coupling, connector, or 90-degree bend.
    - b. Rigid steel – Size 3/4" to 2" – 4' maximum spacing (3 each supports per 10' conduit length) and 12" from each end of conduit at coupling, connector, or 90-degree bend.
- H. If conduit is designated for low voltage use, no more than a total of 360 degrees of conduit bend radius will be allowed between pull/junction boxes.
- I. All junction boxes shall be connected to conduits using appropriate connecting hardware (i.e. box connectors).
- J. Clean, prep and paint with existing matching wall color all exposed conduit, junction boxes, channel strut, fittings, and accessories.
- K. Before pulling any conductors into an underground PVC conduit (new or existing), the conduit shall be first be proofed by pulling through a mandrel of a diameter ¼ in. smaller than the conduit inside dia., followed by a swab of the same diameter as the conduit inside diameter.
- L. Non-metallic raceway to be installed with mechanical fasteners only, do not remove adhesive tape backing.
- M. Capping
  - 1. Cap conduits with manufactured seals during construction. Swab out conduits before installing wires.

2. Cap all empty conduits below grade and in pull boxes with manufacturer's caps to prevent entrance of debris; attach pull string to cap.

N. Underground Conduit

1. Service provider conduits shall be:
  - a. AT&T – one ea. 4" (fiber only) or two ea. 4" (fiber and copper)
  - b. Comcast – one ea. 2"
2. #10 tracer wire or tracer tape is required for all underground Division 27 PVC conduits.

3.05 J-BOXES

- A. Screws shall be used to attach boxes, and must be accurately placed for finish, independently and securely supported by adequate wood backing or by manufactured adjustable channel type heavy-duty box hangers.
  1. Boxes shall be attached to metal studs with metal box hangers.
  2. Boxes installed in masonry tile or concrete block construction shall be secured with auxiliary plates, bars, or clips, and be grouted in place.
- B. Locate outlets at the following heights unless otherwise noted on Drawings, Specifications, current CBC, or as required to meet ADA handicap requirements.
  1. Data Outlets: Same height as electrical outlets
  2. Telephone Wall Outlets: Above counter/backsplash height or at electrical switch height.
- C. Boxes shall be placed within 18" of electrical outlets.
- D. For sound control, separate outlets on opposite sides of walls with a 16" minimum separation. Where outlets are less than 16" or in sound rated walls, seal airtight with fire rated sheet putty pads. Fill gap between junction box and wall with acoustical sealant all around perimeter of junction box. Fill conduits larger than 1 1/4" with fire rated putty.
- E. Installation of conduit and outlet boxes in fire-resistive walls, floors, floor-ceiling or roof-ceiling assemblies shall comply with Title 24, Part 2, Section 713.

3.06 GROUND BOXES

- A. To be installed per Division 26 requirements.

- B. Provisions are to be made for supporting cables from the box sides (i.e., j-hooks, d-rings)
- C. Install a 36" x 48" ground box for service provider AT&T at service tie-in location and/or a 24" x 36" ground box for service provider Comcast at service tie-in location. If less than 360-degrees of bend, and less than 200 feet in distance, it is acceptable to stub directly into the MPOE. If greater than 360-degrees of bend, or greater than 200 feet in length, then additional in-line ground boxes are required (17" x 30"). See section Part 2 – Products for more information.

### 3.07 CONDUIT PENETRATIONS AND SLEEVES

#### A. PENETRATIONS:

- a. Where conduit passes through walls, ceilings, or floors, with connection points to junction boxes or raceways mounted to both sides of the same wall, provide a threaded conduit and secured in place with locking rings on both sides.
- b. Where the conduit passes through walls, ceilings, floors with connection points to junction boxes or raceways not mounted to the same wall as the penetration, provide EMT conduit and secured in place with strut channel.

#### B. SLEEVES

- a. Conduit sleeves are to extend 6" past wall surface and be securely attached to the building structure, with plastic bushings on both ends.
- b. For rated assemblies use EZ-Path sleeves and install per manufacturer's instructions.

#### C. FIRE STOPPING

- 1. Seal all conduit penetrations through fire-rated walls and floors in a manner that is fire and smoke tight in conformance with current CBC and current CEC. See Division 07 for more information.

#### D. DRAFT STOPPING

- 1. All non-fire-rated walls must be draft-stopped and sealed. Submit method to be used for approval by inspector and/or project manager. Mineral wool is one product that may be used. See Division 07 for more information.

#### E. WEATHER SEALING

1. All exterior penetrations shall be sealed watertight. The contractor shall use silicone rubber caulk or other approved methods and materials. Submit methods and materials to inspector and/or project manager. See Division 07 for more information.

**3.08 CLEANING**

- A. Clean all work prior to concealing, painting, and acceptance. Performed in stages if directed.
- B. Clean and repair soiled or damaged painted exposed work before final acceptance in a manner to match adjoining work.
- C. Remove debris from inside and outside of equipment and enclosures.

**3.09 PAINTING**

- A. Paint exposed conduit and j-boxes occurring in finished areas with existing matching wall color. See 09 91 00 – Painting

**3.10 FINAL DOCUMENT SUBMITTALS**

- A. See 27 00 00 for more information.

**END OF SECTION**

SECTION 27 10 00  
STRUCTURED CABLING

REVISION SUMMARY

All Users and Designers! This page is for your information only to provide information on the latest update to this specification so that you don't have to traipse line by line looking for the last edit. Please delete this page prior to issuance.

09/30/2022 – Initial Section creation/edits  
01/09/2023 – Added section 3.08 LABELING, Updated Appendix A  
01/20/2023 – updates from meeting with Bob Lyons and Aron Jones  
02/28/2023 - updates from meeting with District  
06/20/2023 - updates for Appendix A, certification, warranty  
09/11/2024 – update fiber LIU due to discontinued component  
11/01/2024 - Updated data patch cord to White  
11/12/2024 – Updated fiber part number  
1/31/2025 – Annual update.

DISTRICT DESIGN STANDARDS

All Users and Designers! The information shown below is provided by the District to convey the District's thought process on manufacturers, products, procedures, etc. These items are to assist the design team with understanding what to use as part of the design along with those items that the District does not want to be installed or used on their school sites. Please delete this page prior to issuance.

Designer to evaluate:

1. If copper feeders are needed for the project.

Designer to include:

1. Fiber optic cable:
  - a. Fiber feeder from the MDF to each IDF.
  - b. Each MDF/IDF shall have a rack mounted Fiber Optic Distribution Unit (also known as LIU) at top of the rack.
  - c. New fiber optic cable shall be 24-strand OS2 single-mode fiber with LC connectors.
2. Copper Cat cable and Jacks to be Cat6A
  - a. All cabling shall be:
    - i. Data/default = Cat6A reduced diameter White jacket
    - ii. CCTV cameras/Access Control only = Cat6A reduced diameter Blue jacket
  - b. Patch cords:
    - i. Data = White color
    - ii. AP = Green color
    - iii. CCTV = Blue color

- iv. Clock/Intercom = Yellow color
  - v. Access Control = Black color
- b. All data jacks shall be:
- i. Keystone style
  - ii. Data = White color
  - iii. AP = Green color
  - iv. CCTV = Blue color
  - v. Clock/Intercom = Yellow color
  - vi. Access Control = Black color
3. Patch panel and switch port layout to support short patch cords (less than 12") and a 1-to-1 relationship so 100% of station jacks are active. Patch panel – switch – patch panel with NO extra spaces or wire managers shall be standard layout.
4. Classroom minimum connectivity
- a. Minimum connectivity is 2 data drops each side of whiteboard/teaching wall. For new construction, include at least 2 drops at the anticipated teacher desk location and at least 2 drops on each other wall.
  - b. 1 ea. Data drop for teacher phone mounted at ADA height of 42" to the right of the whiteboard.
  - c. For wireless access points each typical classroom shall have two data cables terminated to a 2-port surface mount box above the drop ceiling in the center of the room. Each of the access point data drops shall have a service loop of 20' installed directly above the ceiling where the access point is installed. The service loop shall be neatly coiled and secured to the structure above.
  - d. Exterior wireless access points are to have 2 data drops.
  - e. Data drops as needed for AV equipment, Environmental controls, lighting controls, electronic access controls, etc.
5. Admin area connectivity
- a. Reception areas should include 4 drops at each workstation.
  - b. Larger offices (Principal, etc.) should include 4 drops at the anticipated desk location and 2 drops on an adjacent wall (Total of 6 drops).
  - c. Small offices should include 2 drops on 2 adjacent walls (total of 4 drops).
  - d. Place drops at anticipated locations for copiers and other office equipment.
6. Other Outdoor and Indoor data connectivity:
- a. All connection of controls devices, intercoms, video surveillance, alarms, etc. to the network must be coordinated through Technology Services.
  - b. Irrigation Controls if networked, connect via hardwire. Wireless connections not acceptable unless prior approval from the District.
  - c. Outdoor (and Indoor) Lighting Controls if networked, connect via hardwire. Wireless connections are not acceptable unless prior approval from the District.

- d. Pool Controls if networked, connect via hardwire. Wireless connections are not acceptable unless prior approval from the District.
- e. Intercom control unit. Connect via hard wire.
- f. Fire Alarm Panel. Connect via hard wire.
- g. Intrusion Alarm Panel. Connect via hard wire.
- h. Card Access panel. Connect via hard wire.
- i. CCTV recording unit. Connect via hard wire.
- j. CCTV cameras. Connect via hard wire. Provide power for exterior pan-tilt-zoom cameras as required for operation.
- k. PoE switch port load needs to be coordinated with Technology Services for all the above listed systems.

01/31/2025

1. Added section 3.10



SECTION 27 10 00  
STRUCTURED CABLING

**PART 1 – GENERAL****1.01 SUMMARY**

- A. This section specifies equipment, accessories, materials, installation, configuration, and testing requirements for a complete and operable Structured Cabling communications system. The system shall provide highly reliable and high-performance data communication from main distribution frame (MDF) through each intermediate distribution frame (IDF) to end points requiring fiber optics and/or copper cabling and associated equipment.
- B. This section condenses sections 27 11 00 – Communications Equipment Room Fittings, 27 13 00 – Communications Backbone Cabling, 27 15 00 – Communications Horizontal Cabling and 27 16 00 – Communications Connecting Cords into one comprehensive section.

**1.02 SCOPE**

- A. The work will include but not be limited to the following objectives:
  - 1. Contractor shall furnish and install all required components and accessories as outlined in the design documents for a complete and operable turn-key system.
  - 2. Quality workmanship is a high priority for the District and the Contractor shall be held to a high-level of professional workmanship. Contractors unfamiliar with the District's standards shall familiarize themselves with the standards and requirements prior to beginning work
  - 3. The Contractor shall furnish and install fire-treated  $\frac{3}{4}$ " (three quarter inch) plywood for the MDF room (all walls, from floor level to 8' high) and IDF locations (as required or indicated in the design documents).
  - 4. The Contractor shall furnish and install a ground bus bar at the MDF and IDF rooms.
  - 5. The Contractor shall furnish and install all required racks and cabinets.
  - 6. The Contractor shall furnish and install all newly required conduit/raceway.
  - 7. The Contractor shall furnish and install all wire/cable (copper/fiber optic) as required.
  - 8. The Contractor shall terminate all strands of fiber at each fiber enclosure.
  - 9. The Contractor shall furnish and install termination at all end-point equipment (patch panels, jacks, wallplates, enclosures, etc.).
  - 10. The Contractor shall furnish and install all patch cords (copper/fiber).
  - 11. The Contractor shall test and certify (for warranty) the installed cable plant.

**1.03 RELATED REQUIREMENTS**

- A. Section 01 – General Requirements
- B. Section 27 00 00 – Communications
- C. Section 27 05 00 – Common Work Results for Communication Systems.

**1.04 INDUSTRY GUIDELINES AND STANDARDS**

- A. California Electrical Code (CEC) – Current adopted version
- B. California Building Code (CBC) – Current adopted version.
- C. ANSI/TIA-568.0-D – Generic Communications Cabling for Customer Premises.
- D. ANSI/TIA-568.1-D – Commercial Building Communications Cabling Standard Part 1: General Requirements.
- E. ANSI/TIA 568-C.2 – Balanced Twisted-Pair Telecommunications Cabling and Components Standards
- F. ANSI/TIA 568.3-D – Optical Fiber Cabling Components Standard
- G. ANSI/TIA-569-D – Commercial Building Standard for Telecommunications Pathways and Spaces.
- J. ANSI/TIA-606-B – Administration Standard for the Commercial Telecommunications Infrastructure.
- K. ANSI/JSTD-607-C – Commercial Building Bonding and Grounding (Earthing) Requirements for Telecommunications.

**1.05 QUALIFICATIONS**

- A. The contractor shall possess a California C7 or C10 license.
- B. The Contractor or Subcontractor shall have 5 years' documented experience.
- C. The Contractor and installers shall be certified by the product manufacturer.

**1.06 SYSTEM REQUIREMENTS**

- A. Any new installations or existing system modifications shall seamlessly integrate into the site's existing data cable plan system.

**1.07 CONTRACTOR "SHOP DRAWINGS" DESIGN REQUIREMENTS**

- A. See section 27 00 00 for requirements.

**1.08 SUBMITTALS**

- A. See section 27 00 00 for requirements.

**1.09 WARRANTY**

- A. Refer to Division 01 Warranty section.
- B. See section 27 00 00 for additional requirements.
- C. 25-year manufacturer's warranty/certification required for all copper and fiber cable plant installations.

**1.10 CLOSEOUT DOCUMENTS**

- A. See section 27 00 00 for requirements.

**PART 2 – PRODUCTS****2.01 GENERAL**

- A. See Appendix A at the end of this document for pre-approved materials.
- B. All products shall be new, unused and without blemishes and shall be of manufacturer's current and standard production.
- C. The Contractor shall confirm all equipment part numbers with the Project Manager or District prior to ordering equipment and updating submittals as required.
- D. The Drawings and Specifications indicate major system components, and may not show every component, connector, module, or accessory that may be required to support the operation specified. The Contractor shall provide all components needed for complete and satisfactory installation and operation.
- E. The Contractor shall install mounting hardware and anchors as recommended by the Manufacturer of the equipment that requires mounting to the building or structure and adhere to all code requirements. See section 27 05 00 for requirements.
- F. Product Availability
  - 1. The Contractor, prior to submitting a proposal, shall determine product availability and delivery time, and shall include such considerations into his proposed Contract Time.

**2.02 MANUFACTURERS AND PRODUCTS**

- A. See Appendix A at the end of this document for pre-approved materials.
- B. Product Substitutions require proof of equivalence and approval by District and/or its representative. Substitution requests to be submitted in writing.
- C. For maintenance and consistency with the existing installed base, data connectivity components (copper and fiber) shall be Superior Essex cable and Ortronics connectivity.

**2.03 COPPER/FIBER OPTIC CABLES AND COMPONENTS**

- A. All copper cables and components shall be Cat6A rated.
  - 1. Cable to be reduced diameter. White jacket for default cable, Blue jacket for CCTV and Access Control only.
  - 2. Jacks to be keystone style.
  - 3. All cables shall be terminated on keystones at IDF/MDF end. No modular plug terminations are permitted at IDF/MDF locations.

- B. Patch cords system/color:
  - 1. Data = White color
  - 2. AP = Green color (2 ea. req'd at each AP)
  - 3. CCTV = Blue color
  - 4. Clock/Intercom = Yellow color
  - 5. Access Control = Black color
  - 6. Fire Alarm/Intrusion Alarm = Red color
  
- C. Patch cord length
  - 1. At patch panel 12" typical or no more than 12" slack.
  - 2. Station-side patch cords to be 10' in length.
  
- D. Data jacks system/color:
  - 1. Data/default = White color
  - 2. AP = Green color
  - 3. CCTV = Blue color
  - 4. Clock/Intercom = Yellow color
  - 5. Access Control = Black color
  - 6. Fire Alarm/Intrusion Alarm = Red color
  
- E. Fiber Optic Cable:
  - 1. Minimum strand count is 24.
  - 2. All fiber optic cables and components shall be single single-mode OS2 rated.
  - 3. Fiber optic cable terminations shall be LC-Duplex style.

**PART 3 – EXECUTION**

**3.01 ACCEPTABLE INSTALLERS**

- A. The components making up the structure cabling system shall only be installed by Contractors who are qualified to install, service and maintain the system.
- B. Cable terminations (copper or fiber) shall be installed by manufacturer-certified technicians.
- C. The Contractor (or subcontractor listed at time of bid) must have at least five (5) years' experience before the Bid Opening Date.

**3.02 EXAMINATION**

- A. The Contractor shall be required to visit the installation site(s) prior to job bidding. The Contractor acknowledges that the failure to visit the site(s) will not relieve the Contractor of the responsibility for accurate bidding and performance of the Work.
- B. The Contractor shall report any discrepancies between the Specifications, Drawings, and Site Examination prior to the Bid Opening Date.

**3.03 PREPARATION**

- A. The Contractor shall order all required parts and equipment upon receipt of approved product submittals.
- B. The Contractor shall verify the availability of power where required.

**3.04 SHOP DRAWINGS**

- A. The Contractor shall create "Shop Drawings" per section 27 00 00 for this section.
- B. Submit drawings for review and approval by the Project Manager and/or Designer.

**3.05 INSTALLATION**

**A. ENTRANCE FACILITIES**

- 1. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and housing when so directed by service provider.
- 2. Install underground or aerial pathways complying with recommendations in TIA/EIA-569-A, "Entrance Facilities" Article.

**B. UNDERGROUND ENTRANCE PATHWAY**

1. Install the underground entrance pathway complying with Division 26.

**C. EQUIPMENT RACKS, CABINETS, ENCLOSURES AND ACCESSORIES**

1. Backboards:
  - a. Shall be installed behind the rack or cabinet if the cabinet is not able to be directly attached to two vertical wall studs.
  - b. Backboards shall be made of fire retardant or treated materials, squarely cut, and with sanded edges
  - c. Backboards shall be a minimum  $\frac{3}{4}$ " thick and large enough to secure it to two vertical wall studs.
  - d. The "FIRE RATED" stamp shall be visible.
  - e. Backboards shall be fastened with  $\frac{1}{4}$ " lag bolt and washer, non-recessed, with maximum spacing of 18" into 2 vertical studs. 1-1/2" embedment.
  - f. Visible portions (outside of cabinet) of Backboards shall be painted black.
2. All data & voice communications racks and cabinets shall be anchored in accordance with manufacturer's specifications, project specifications and/or drawn details, to walls and floors and grounded to building ground grid (not to water pipes etc.).
3. Securely mount equipment cabinet and racks to the building structure. A proper quantity of support fasteners shall be utilized. Typically lag bolts for wood installations, wedge anchors for concrete flooring. Submit data sheets for mounting fasteners for approval before installation. Mount equipment per DSA approved drawings/details.
4. Equipment cabinet mounted on or against walls will have 3-foot clearance in front of deepest component and accessible to rear for service.
5. MDF and all IDF's shall have at least one dedicated 120VAC 20-amp quad-receptacle each.
6. Patch Panels: Mount patch panels into the cabinet/rack. Match manufacturer of existing install or if new construction, see Appendix A.
  - a. Patch panel ports shall be grouped by Room and then by System (General Data, Intercom, AP, Other). Label the patch panel with the first port of each Room.
  - b. Exterior devices shall be grouped with the closest adjacent interior space.
  - c. Do not segregate patch panels by system unless specifically directed on the rack elevation.

7. Cable Management: Secure the cable bundle(s) to the rack strain relief and cable management behind the patch panels and cross connect block panels. Install horizontal cable management panels and brackets for routing and management of patch cables. Maintain TIA/EIA and BICSI standards on bundling, supporting and bend radius.
8. Surge Protected Outlet Strips: Required in MDF rack. Mount surge protected outlet strips per Manufacturer's directions. Refer to details on the Drawings for mounting location.

**D. MDF/IDF GROUNDING**

1. Refer to Section 27 05 00 Grounding for more requirements.
2. Locate the grounding bus bar to minimize the length of bonding conductors. Fasten to the wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 6 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
3. Bond metallic equipment (including ladder rack) to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

**3.06 WORKMANSHIP**

- A. Quality workmanship is a high priority for the District and the Contractor shall be held to a high-level of professional workmanship.
- B. The District' Project or Construction Manager will have the authority to reject Work which does not conform to the Drawings and Specifications.
- C. Comply with the highest industry standards, except when specified requirements indicate more rigid standards or more precise workmanship.
- D. Perform Work with persons experienced and qualified to produce workmanship specified.
- E. Maintain quality control over suppliers and Subcontractors.

**3.07 WIRE/CABLE (COPPER/FIBER OPTIC)**

- A. Design, layout, size, and plan new cable runs as required.
- B. All wire and cable passing through metalwork shall be sleeved by an approved grommet or bushing.
- C. Conduit/raceway fill shall not exceed 40 percent of interior cross-sectional area.



- D. Neatly dress and tie (Velcro) all cabling.
- E. UTP cabling shall conform to a 6-foot separation requirement from the main power panel, transformers, switchgear and/or starter motors adjacent to the MDF, IDF and termination locations.
- F. Fiber optic cables shall be installed from the MDF to each IDF.
- G. Orange corrugated HDPE (High Density Polyethylene) Innerduct shall be used for fiber optic cable protection in all interior locations.
- H. Spicing of fiber optic cable shall be done with fusion splices.
- I. When required copper feeders (minimum 4-pair) are to be installed from the MDF to each IDF.
- J. Maintain proper bend radius for all cable installations.
- K. Do not exceed cable manufacturer's instructions for installation pull load. Any cable damaged by excessive pull force shall be replaced by the installation contractor.
- L. Modular plug terminated link (MPTL) style wiring is acceptable for CCTV with modified single connector permanent link testing.

### **3.08 LABELING**

- A. MDF/IDF - Identification number in large font on front of cabinet.
- B. MDF, Fiber Optic LIU Ports – IDF number and room number
- C. MDF/IDF, Copper Patch Panel – Panels labeled P1, P2, P3, etc., ports labeled with room number.
- D. LAN Outlet – IDF number, patch panel number, patch panel port number.
- E. Cables to be labeled both ends with unique identifiers and from/to location identifiers. For Copper Cat cable IDF number, patch panel number, patch panel port number.
- F. T-bar ceilings shall have device labels attached next to the device for ceiling mounted equipment and at the tile for above ceiling equipment with device type and device ID points/IP address.

**3.09 CONDUIT AND RACEWAY INSTALLATION**

- A. See Division 26 and section 27 05 00 for additional requirements.
- B. Conduit bodies and any other sharp bend fittings are strictly prohibited for communications cabling (copper/fiber).
- C. Install proper radius conduit sweeps where required.

**3.10 COMISSIONING PREPARATION**

- A. 4 weeks prior to system turn up:
  - a. All jacks in patch panels are to be completely installed.
  - b. A worksheet is to be prepared by the Contractor indicating which switch port is assigned to what system (i.e. general data, intercom, AP, etc.) and the worksheet to be attached to the data switch.
  - c. Data switches are to be delivered to the District by the Contractor and coordinated with the District's Network Engineer.

**3.11 FIELD QUALITY CONTROL AND TESTING**

- A. All Fiber and Cat6a copper cable installations to be certified by testing with an certified test system that is approved by the manufacturer for warranty certification (typically a Fluke).
- B. Submit the Record Drawings (as-builts) to District for review prior to inspection.
- C. During the formal Test & Inspection (Commissioning) of the system, the Contractor shall have personnel available with tools and equipment to inspect wiring, devices, and system operation.
- D. If corrections are needed, the Contractor will be provided with a Punch-List of all discrepancies. Perform the needed corrections in a timely fashion.
- E. Notify the District when ready to perform a re-inspection of the installation.
- F. Provide 25-year manufacturer's warranty/certification documentation for all copper and fiber cable plant installations.

**3.12 CLOSEOUT DOCUMENTS**

- A. See section 27 00 00 for requirements.

## APPENDIX A – Pre-Approved Materials

| DESCRIPTION                                                                                | MFG                 | PART NUMBER     |
|--------------------------------------------------------------------------------------------|---------------------|-----------------|
| Rack Cabinet 7' (43U), 41" Deep                                                            | Chatsworth Products | Z4-21N-113C-C12 |
| Wall Mount Cabinet 24" (12 RU) 30" Deep ( <i>retrofit only, not for new construction</i> ) | Chatsworth Products | 12419-724       |
| CUBE-iT Fan Kit                                                                            | Chatsworth Products | 40972-001       |
| 20 AMP Power Strip                                                                         | Chatsworth Products | 12848-701       |
| Standard Busbar                                                                            | Chatsworth Products | 10622-010       |
| 12" Ladder Rack 10'                                                                        | Chatsworth Products | 11275-712       |
| Ladder Rack Triangular Support Bracket                                                     | Chatsworth Products | 11746-712       |
| Ladder Rack Wall Angle Support 12"                                                         | Chatsworth Products | 11421-712       |
| Ladder Rack Butt-Splice Kit                                                                | Chatsworth Products | 11301-712       |
| Ladder Rack Foot Kit                                                                       | Chatsworth Products | 11309-701       |
| 19" Horizontal Cable Manager                                                               | Ortronics           | 808004759       |
| Patch Panel 24-port 1-RU (Black)                                                           | Ortronics           | OR-SPKSU24      |
| Patch Panel 48-port 2-RU (Black)                                                           | Ortronics           | OR-SPKSU48      |
| Patch Panel Cable Management Support Bar                                                   | Ortronics           | OR-CMBFR0RU     |
| Faceplate, 2-port (White)                                                                  | Ortronics           | KSFP2-88        |
| Faceplate, 4-port (White)                                                                  | Ortronics           | KSFP4-88        |
| Surface Mount, 2-port (White)                                                              | Ortronics           | KSSMB2          |
| Faceplate, 1-port Phone Hanger (Stainless)                                                 | Ortronics           | 403STJ1WP       |
| Cat6A Data Jacks (White)                                                                   | Ortronics           | KT2J6A-88       |
| Cat6A Data Jacks (Green)                                                                   | Ortronics           | KT2J6A-45       |
| Cat6A Data Jacks (Blue)                                                                    | Ortronics           | KT2J6A-36       |

|                                                                   |                     |                                          |
|-------------------------------------------------------------------|---------------------|------------------------------------------|
| Cat6A Data Jacks (Yellow)                                         | Ortronics           | KT2J6A-44                                |
| Cat6A Data Jacks (Black)                                          | Ortronics           | KT2J6A-00                                |
| Cat6A Data Cable, Riser<br>(White = default)                      | Superior Essex      | 6B-246-4A                                |
| Cat6A Data Cable, Plenum<br>(White = default)                     | Superior Essex      | 6B-246-4B                                |
| Cat6A Data Cable, Riser<br>(Blue = CCTV/Access<br>Control)        | Superior Essex      | 6B-246-2A                                |
| Cat6A Data Cable, Plenum<br>(Blue = CCTV/Access<br>Control)       | Superior Essex      | 6B-246-2B                                |
| Cat6A Data Cable,<br>Indoor/Outdoor (Black)                       | Superior Essex      | 6B-272-ER                                |
| Cat6A Data Cable, OSP<br>(Black)                                  | Superior Essex      | 04-001-A8                                |
| Extended Distance PPOE<br>Cable, OSP                              | Superior Essex      | PW04-401-48                              |
| Cat6A Patch Cord – for<br>Extended Distance links<br>only (Black) | Monoprice           | 44669                                    |
| Cat6A Patch Cord Slim<br>(White) (12" typ.)                       | Quiktron            | 576A-RD25-0xx (xx = length)              |
| Cat6A Patch Cord Slim<br>(Blue) (12" typ.)                        | Quiktron            | 576A-RD10-0xx (xx = length)              |
| Cat6A Patch Cord Slim<br>(Green) (12" typ.)                       | Quiktron            | 576A-RD20-0xx (xx = length)              |
| Cat6A Patch Cord Slim<br>(Yellow) (12" typ.)                      | Quiktron            | 576A-RD15-0xx (xx = length)              |
| Cat6A Patch Cord Slim<br>(Black) (12" typ.)                       | Quiktron            | 576A-RD35-0xx (xx = length)              |
| Fiber Optic LIU 1-RU                                              | Ortronics, Q-Series | EQ01U-CHC                                |
| Fiber Optic LIU 2-RU                                              | Ortronics, Q-Series | EQ02U-CHC                                |
| Fiber Optic LIU 4-RU                                              | Ortronics, Q-Series | EQ04U-CVC                                |
| Splice Tray                                                       | Ortronics, Q-Series | FST4-F012 w/ mounting bracket<br>WQS-STB |
| Fiber Optic Adapter                                               | Ortronics, Q-Series | OFP-LCQ24AC                              |

**STRUCTURED CABLING****27 10 00 - 16**

|                                                                             |                       |                     |
|-----------------------------------------------------------------------------|-----------------------|---------------------|
| <b>Fiber Optic LC Field Term<br/>Connector</b>                              | <b>Ortronics</b>      | <b>205KNF9SA-09</b> |
| <b>Fiber Optic Cable 24-strand,<br/>Single-Mode OS2,<br/>Indoor/Outdoor</b> | <b>Superior Essex</b> | <b>W4024K101</b>    |

END OF SECTION

SECTION 27 21 00  
DATA COMMUNICATIONS NETWORK EQUIPMENT  
REVISION SUMMARY

All Users and Designers! This page is for your information only to provide information on the latest update to this specification so that you don't have to traipse line by line looking for the last edit. Please delete this page prior to issuance.

09/30/2022 – Initial Section creation/edits

01/25/2023 – Edits after meeting with Bob Lyons and Aron Jones

02/28/2023 - Edits after meeting with District

04/17/2023 - Edits after meeting with District Tech Services

09/07/2023 – Edits after meeting with M&O

02/12/2024 – Edits after meeting with Tech Services/ Chris Ralston (delete Aruba)

02/27/2024 – Updated Appendix A for Cisco wireless access points from Tech Services

08/09/2024 – Updated Appendix A after meeting w/ Vincent & Aron

1/31/2025 – Annual update switch programming by District clarification.

DISTRICT DESIGN STANDARDS

All Users and Designers! The information shown below is provided by the District to convey the District's thought process on manufacturers, products, procedures, etc. These items are to assist the design team with understanding what to use as part of the design along with those items that the District does not want to be installed or used on their school sites. Please delete this page prior to issuance.

Designer to evaluate:

1. eRate considerations and/or requirements
2. Current network data equipment (switches/wireless access points) manufacturer is Cisco.
3. All equipment is to be Contractor-Furnished, Contractor-Installed.
4. All equipment shall be provided with all required licenses.

## SECTION 27 21 00

## DATA COMMUNICATIONS NETWORK EQUIPMENT

**PART I - GENERAL**

## 1.01 SUMMARY

- A. This section specifies equipment, accessories, materials, installation, configuration, and testing requirements for a complete and operable data network system. The system shall provide reliable and high-performance data communication throughout the site.

## 1.02 SCOPE

- A. The work will include but not be limited to the following objectives:
1. Provide, coordinate, and install all required equipment, licenses, and accessories as outlined in the design documents for a complete and operable system.
  2. Labor and Materials: The Contractor shall provide and pay for all labor, supervision, materials, accessories, components, equipment, tools, utilities, construction equipment and machinery, transportation, and other facilities and services necessary for the proper execution, operation, and completion of a turn-key system to the District.
  3. Data Communications Network Equipment: Includes, but is not limited to:
    - a. Routers
    - b. Firewalls
    - c. Networking Switches
    - d. Wireless Access Points
    - e. Licenses
    - f. Uninterruptible Power Supplies (UPS)
  4. Data Switches to be programmed by the District. The Contractor shall coordinate, deliver and pickup Data Switches from the District.

## 1.03 RELATED REQUIREMENTS

- A. Division 01 - General Requirements
- B. Section 27 00 00 - Communications
- C. Section 27 05 00 - Common Work Results for Communication Systems.

D. Section 27 10 00 - Structured Cabling

1.04 QUALIFICATIONS

A. Contractor shall be located within 50 miles or less from the project site to support 2-hour response time.

B. Five years' experience installing data network equipment and systems.

1.05 SYSTEM REQUIREMENTS

A. Any new installations or existing system modifications shall seamlessly integrate into the site's existing data network infrastructure.

1.06 CONTRACTOR "SHOP DRAWINGS" DESIGN REQUIREMENTS

A. See section 27 00 00 for requirements.

1.07 SUBMITTALS

A. See section 27 00 00 for requirements.

1.08 WARRANTY

A. Refer to Division 01 Warranty section.

B. See section 27 00 00 for additional requirements.

1.09 CLOSEOUT DOCUMENTS

A. See section 27 00 00 for requirements.

**PART 2 - PRODUCTS**

2.01 GENERAL

A. See Appendix A at the end of this document for pre-approved materials.

B. All products shall be new, unused and without blemishes and shall be of manufacturer's current and standard production.

C. Drawings and Specifications indicate major system components, and may not show every component, connector, module, or accessory that may be required to support the operation



specified. Contractor shall provide all components needed for complete and satisfactory installation/operation.

D. Product Availability

1. Contractor, prior to submitting a proposal, shall determine product availability and delivery time, and shall include such considerations into his proposed Contract Time.
2. Subject to compliance with these specifications, products and systems included in this section are to be installed as specified by the manufacturer of the system or engineer approved equal.

2.02 EQUIPMENT

A. The District's preferred manufacturer for:

1. Routers - Cisco
2. Firewalls - Cisco
3. Networking Switches – Cisco
4. Wireless Access Points - Cisco
5. UPS – N1C

B. Substitutions require proof of equivalence and approval by District and/or its representative.

C. All equipment shall be provided with Licenses as required for seamless integration with the District's network infrastructure.

**PART 3 - EXECUTION****3.01 ACCEPTABLE INSTALLERS**

- A. The equipment shall only be installed by Contractors who are qualified to install and maintain the system.
- B. The Contractor (or subcontractor listed at time of bid) must have at least five (5) years' experience installing data network equipment before the Bid Opening Date.

**3.02 EXAMINATION**

- A. The Contractor shall be required to visit the installation site(s) prior to bidding for the job. The Contractor acknowledges that the failure to visit the site(s) will not relieve the Contractor of the responsibility for observing and considering those conditions which a Contractor would have observed and considered during a site visit, estimating properly the difficulty and cost of successfully performing the Work or proceeding to perform the Work without additional cost to District.
- B. The Contractor shall report any discrepancies between the Specifications, Drawings, and Site Examination prior to the Bid Opening Date.

**3.03 PREPARATION**

- A. The Contractor shall verify materials are readily available prior to submitting product submittals and notify the Project Manager of long lead time items.
- B. The Contractor shall order all required parts and equipment only after receipt of approved product submittals from the Project Manager.
- C. The Contractor shall coordinate with the District's Technology Services department for needed IP addresses at least 4 weeks prior to configuration/installation.

**3.04 SHOP DRAWINGS**

- A. The Contractor shall create "Shop Drawings" per section 27 00 00.

**3.05 WORKMANSHIP**

- A. Quality workmanship is a high priority for the District and the Contractor shall be held to a high-level of professional workmanship.
- B. The District's Project or Construction Manager will have the authority to reject Work which does not conform to the Drawings and Specifications.

- C. Comply with the highest industry standards, except when specified requirements indicate more rigid standards or more precise workmanship.
- D. Perform Work with persons experienced and qualified to produce workmanship specified.
- E. Maintain quality control over suppliers and Subcontractors.

### 3.06 PATHWAY AND EQUIPMENT INSTALLATION

- A. Install all conduit and pathway per design documents. Refer to 27 05 00 for additional information/requirements.
- B. Install all Cat6A cable per design documents. Refer to 27 15 00 for additional information/requirements.
- C. Equipment to be installed per manufacturer's instructions.
- D. Devices requiring PoE power shall be connected to a PoE switch in the MDF/IDF data rack – verify with Technology Services for available PoE power.

### 3.07 EQUIPMENT COMMISSIONING/CONFIGURATION

- A. See 27 10 00, 3.10 COMMISSIONING PREPARATION
  - 1. 4 weeks prior to system turn up:
    - a. All jacks in patch panels are to be completely installed.
    - b. A worksheet is to be prepared by the Contractor indicating which switch port is assigned to what system (i.e. general data, intercom, AP, etc.) and the worksheet to be attached to the data switch.
    - c. Data switches are to be delivered to the District by the Contractor and coordinated with the District's Network Engineer.
- B. The Contractor shall pick up the equipment from the District.
- C. The Contractor shall install the equipment and patch in all connections.
- D. All equipment to be fully configured and tested for functionality by the Contractor prior to District acceptance testing.

### 3.08 FIELD QUALITY CONTROL AND TESTING

- A. Upon reaching substantial completion, perform a complete test and inspection of the system. If found to be installed and operating properly, notify the District of readiness to perform the formal Test & Inspection of the complete system by the District or its representative. Make all adjustments/changes required from District/representative review.

- B. Submit the Record Drawings (as-builts) to District for review prior to inspection.
- C. During the formal Test & Inspection (Commissioning) of the system and have personnel available with tools and equipment to inspect wiring, devices, and system operation.
- D. If corrections are needed, the Contractor will be provided with a Punch-List of all discrepancies. Perform the needed corrections in a timely fashion.
- E. Notify the District when ready to perform a re-inspection of the installation.

### 3.10 AS-BUILT DRAWINGS

- A. See section 27 00 00 for requirements.

**APPENDIX A – Pre-Approved Materials**

| DESCRIPTION                                                                                    | MFG   | PART NUMBER                          |
|------------------------------------------------------------------------------------------------|-------|--------------------------------------|
| Network Switch (48G/4SFP+) (New Install)                                                       | Cisco | C9300L-48PF-4X-EDU                   |
| Network Switch (Existing Site Retrofit)                                                        | Cisco | C9300L-48UXG-4X                      |
| Network Switch License (DNA Essentials, 48-port, 3-yr)                                         | Cisco | C9300-DNA-E-48-3Y                    |
| Network Switch Secondary Power Supply                                                          | Cisco | PWR-C1-1100WAC-P                     |
| SFP transceiver                                                                                | Cisco | SFP-10G-LR                           |
| DAC Cable (9300 to previous gen switch)                                                        | Cisco | SFP-H10GB-CU1M                       |
| Stack Kit (9300 to 9300)                                                                       | Cisco | C9300L-STACK-KIT                     |
| Core Switch (16SFP+/2QSFP+)                                                                    | Cisco | C9500-24Y4C-EDU                      |
| Core Switch (larger sites)                                                                     | Cisco | C9500-48Y4C-EDU                      |
| Core Switch License (DNA Essentials, 3-yr)                                                     | Cisco | C9500-DNA-E-3Y                       |
| Core Switch Power Supply                                                                       | Cisco | PWR-C4-950WAC-R                      |
| Wireless Access Point (Interior)<br>(note: includes low-profile bracket and ceiling grid clip) | Cisco | C9130AXI-B                           |
| Ceiling Mount Bracket (Low-profile) for C9130AX                                                | Cisco | AIR-AP-BRACKET-1                     |
| Ceiling Mount Bracket (Universal/ Electrical Box) for C9130AX                                  | Cisco | AIR-AP-BRACKET-2                     |
| T-bar Mount Bracket (Recessed Tiles) for C9130AX                                               | Cisco | AIR-AP-T-RAIL-R                      |
| T-bar Mount Bracket (Flat Tiles) for C9130AX                                                   | Cisco | AIR-AP-T-RAIL-F                      |
| Wireless Access Point (Exterior/Surface)                                                       | Cisco | C9124-AXE-B with 4 Ea. AIR-ANT2568VG |
| Wireless Access Point (Exterior/ with Oberon)                                                  | Cisco | C9124-AXI-B                          |
| Wall/Pole Mount for C9124-AXI-B                                                                | Cisco | MNT-VERT1                            |

|                                                                                                  |          |                                                                                 |
|--------------------------------------------------------------------------------------------------|----------|---------------------------------------------------------------------------------|
| Exterior AP Enclosure                                                                            | Oberon   | 1021-00                                                                         |
| UPS (MDF 4-post) with network monitoring and external battery (2000VA, 50AH)<br>120VAC input     | N1C      | N1C.LR2000, N1C.L4850EBM2U<br>(For 2 post rack mount only - add N1C.24RAILKIT)  |
| UPS (MDF 4-post) with network monitoring and external battery (2000VA, 50AH)<br>208-240VAC input | N1C      | N1C.LR2000G, N1C.L4850EBM2U<br>(For 2 post rack mount only - add N1C.24RAILKIT) |
| UPS (IDF) with network monitoring (1000 VA)<br>120VAC input                                      | N1C      | N1C.L1000                                                                       |
| UPS (IDF) with network monitoring (1500 VA)<br>120VAC input                                      | N1C      | N1C.L1500                                                                       |
| UPS (IDF) with network monitoring (2000 VA)<br>120VAC input                                      | N1C      | N1C.L2000                                                                       |
| Long range point-to-point Ethernet & PoE Extender (Base)                                         | Veracity | VLS-1P-B                                                                        |
| Long range point-to-point Ethernet & PoE Extender (Camera)                                       | Veracity | VLS-1P-C                                                                        |

END OF APPENDIX A

END OF SECTION

SECTION 27 30 00  
VOICE COMMUNICATIONS

REVISION SUMMARY

All Users and Designers! This page is for your information only to provide information on the latest update to this specification so that you don't have to traipse line by line looking for the last edit. Please delete this page prior to issuance.

10/17/2024 – Initial Section creation/edits

1/22/2025 – Annual review

2/14/2025 – Updated for new Cisco Webex phone system

DISTRICT DESIGN STANDARDS

All Users and Designers! The information shown below is provided by the District to convey the District's thought process on manufacturers, products, procedures, etc. These items are to assist the design team with understanding what to use as part of the design along with those items that the District does not want to be installed or used on their school sites. Please delete this page prior to issuance.

~~2-143-2025~~

~~PLEASE NOTE: The District has selected Cisco Webex Calling as their new cloud phone system.~~

~~1-301-2025~~

~~PLEASE NOTE: The District is in the process of evaluating a new phone system. Please verify with the District that this section is still valid.~~

Designer to include/evaluate:

1. ~~Telephone-IP Phone set style/model~~Sets appropriate for space/use.
2. 5G Gateway
3. All new construction should include new contractor-furnished VOIP equipment (handsets and VOIP 5G gateway). Do not assume existing equipment will be re-deployed at a new site.
4. Modernization projects should include new contractor-furnished VOIP equipment (handsets) when scope/budget allows.
5. District standard classroom phone location is wall mounted to the right of the whiteboard/teaching wall. The left side of the whiteboard or near the teacher desk are acceptable alternate locations. Phones should NOT be placed near the doorway.
6. ~~The District currently has a surplus of VOIP phone licenses and does not require additional licenses to be provided by the construction project.~~
7. Coordinate VOIP and/or analog phone handoff requirements for special equipment like elevators and/or handicap lifts.

SECTION 27 30 00  
VOICE COMMUNICATIONS

**PART I - GENERAL**

1.01 SUMMARY

- A. This section specifies equipment, accessories, materials, wire, installation, configuration, and testing requirements for a complete and operable Voice Communications system.

1.02 SCOPE

- A. The work will include but not be limited to the following objectives:
1. Labor and Materials: The Contractor shall provide and pay for all labor, supervision, materials, accessories, components, equipment, tools, transportation, and other facilities and services necessary for the proper installation of a turn-key Voice Communication system to the District.
  2. The contractor will coordinate with the District in writing for any needed information (i.e. IP addresses, etc.) 10 business days prior to date the information is needed.
  3. Voice Communication system equipment: Includes, but is not limited to:
    - a. VoIP ~~Telephone~~-Phone Sets
    - b. VoIP 5G Gateway
    - c. Wire
  4. VoIP ~~Telephone~~-Phone Sets are to use District standard network cabling, see Section 27 10 00.

1.03 RELATED REQUIREMENTS

- A. Division 01 – General Requirements
- B. Section 27 00 00 - Communications
- C. Section 27 05 00 – Common Work Results for Communication Systems.
- D. Section 27 10 00 – Structured Cabling

1.04 REFERENCES

- A. See section 27 00 00 for requirements.



## 1.05 DEFINITIONS

- A. See section 27 00 00 for requirements.

## 1.06 SYSTEM REQUIREMENTS

- A. Any new installations or existing system modifications shall seamlessly integrate into the site's existing Voice Communication system where applicable.

## 1.07 SUBMITTALS

- A. See section 27 00 00 for requirements.

## 1.08 CONTRACTOR "SHOP DRAWINGS" DESIGN REQUIREMENTS

- A. See section 27 00 00 for requirements.

## 1.09 QUALIFICATIONS

- A. Contractor shall be located within 50 miles or less from the project site to support 2-hour response time.
- B. Five (5) years' experience installing communications equipment systems.

## 1.10 CERTIFICATIONS

- A. See section 27 00 00 for requirements.

## 1.11 WORKMANSHIP

- A. Quality workmanship is a high priority for the District and the Contractor shall be held to a high-level of professional workmanship.
- B. The District's Project or Construction Manager will have the authority to reject Work which does not conform to the Drawings and Specifications.
- C. Comply with highest industry standards, except when specified requirements indicate more rigid standards or more precise workmanship.
- D. Perform Work with persons experienced and qualified to produce workmanship specified.
- E. Maintain quality control over suppliers and Subcontractors.

F. Contractor shall be responsible for scheduling Subcontractors in a timely fashion.

1.12 WARRANTY

A. Refer to Division 01 Warranty section.

B. See section 27 00 00 for additional requirements.

1.13 CLOSEOUT DOCUMENTS

A. See section 27 00 00 for requirements.

**PART 2 - PRODUCTS****2.01 GENERAL**

- A. Manufacturers — The District's VOIP Phone equipment is Cisco. See Appendix A at the end of this document for pre-approved materials.
- B. All products shall be new, unused and without blemishes and shall be of manufacturer's current and standard production.
- C. Drawings and Specifications indicate major system components, and may not show every component, connector, module, or accessory that may be required to support the operation specified. The Contractor shall provide all components needed for complete and satisfactory installation and operation.
- D. Product Availability
  - 1. The Contractor, prior to submitting a proposal, shall determine product availability and delivery time, and shall include such considerations into their proposed Contract Time.
  - 2. Subject to compliance with these specifications, products and systems included in this section are to be installed as specified by the manufacturer of the system or engineer approved equal.

**2.02 EQUIPMENT**

- A. See Appendix A at the end of this document for pre-approved materials.
- B. Substitutions require proof of equivalence and prior approval by District and/or its representative before ordering.

**PART 3 - EXECUTION****3.01 ACCEPTABLE INSTALLERS**

- A. The equipment shall only be installed by Contractors who are qualified to install and maintain the system.
- B. The Contractor (or subcontractor listed at time of bid) must have at least five (5) years' experience installing electronic clock equipment before the Bid Opening Date.

**3.02 EXAMINATION**

- A. The Contractor shall be required to visit the installation site(s) prior to bidding the job. The Contractor acknowledges that the failure to visit the site(s) will not relieve the Contractor of the responsibility for observing and considering those conditions which a Contractor would have observed and considered during a site visit, estimating properly the difficulty and cost of successfully performing the Work or proceeding to perform the Work without additional cost to District.
- B. The Contractor shall report any discrepancies between the Specifications, Drawings, and Site Examination prior to the Bid Opening Date.

**3.03 PREPARATION**

- A. The Contractor shall verify materials are readily available prior to submitting product submittals and notify the District's Project Manager of long lead time items.
- B. The Contractor shall order all required parts and equipment only after receipt of approved product submittals from the District's Project Manager.
- C. Submit and receive approval for shop drawings prior to work commencement.

**3.04 PATHWAY INSTALLATION**

- A. See Division 26 and Section 27 05 00 for requirements and more information.
- B. Existing Construction:
  - 1. Refer to design documents.

**3.05 EQUIPMENT INSTALLATION**

- A. Equipment to be wired and installed per manufacturer's instructions.

- B. Wall mounted VoIP ~~Telephone~~-Phone sets are to have a data drops to be installed inside flush single-gang back box at the location shown on the design documents (typically to the righthand side of the teaching wall).
- C. Desktop VoIP ~~Telephone~~-Phone sets are to plugged into an appropriate location standard data connection.

### 3.06 CONFIGURATION

- A. VoIP ~~Telephone~~-Phone sets are to are to be programmed by the District. Coordinate the delivery and return from the District the install ready VoIP ~~Telephone~~-Phone sets. Provide a letter of transmittal.

### 3.10 FIELD QUALITY CONTROL AND TESTING

- A. Upon reaching substantial completion, perform a complete test and inspection of the system. If found to be installed and operating properly, notify District of your readiness to perform the formal Test & Inspection of the complete system.
- B. Submit the Record Drawings (as-builts) to District for review prior to inspection.
- C. During the formal Test & Inspection (Commissioning) of the system, the Contractor shall have personnel available with tools and equipment to inspect wiring, devices, and system operation.
- D. If corrections are needed, the Contractor will be provided with a Punch-List of all discrepancies. Perform the needed corrections in a timely fashion.
- E. Notify the District when ready to perform a re-inspection of the installation.
- F. District or its representative to provide final sign-off for acceptance.

### 3.11 AS-BUILT DRAWINGS

- A. See section 27 00 00 for requirements.

## APPENDIX A – Pre-Approved Materials

| DESCRIPTION                                                       | MFG                    | PART NUMBER                                                                             |
|-------------------------------------------------------------------|------------------------|-----------------------------------------------------------------------------------------|
| <a href="#">Standard VoIP Telephone sets</a>                      | <a href="#">Cisco</a>  | <del>xxx</del> <a href="#">CP-7841</a><br><a href="#">w/ Wall Mount Kit CP-7800-WMK</a> |
| <a href="#">Advanced VoIP Telephone sets</a>                      | <a href="#">Cisco</a>  | <del>xxx</del> <a href="#">CP-8841</a>                                                  |
| <a href="#">Standard IP Phone</a>                                 | <a href="#">Cisco</a>  | <a href="#">DP-9841-K9=</a>                                                             |
| <a href="#">Advanced IP Phone</a>                                 | <a href="#">Cisco</a>  | <a href="#">DP-9861-K9=</a>                                                             |
| <a href="#">Wall Mount Kit for Cisco 9800 Series IP Phones</a>    | <a href="#">Cisco</a>  | <a href="#">DP-9800-WMK=</a>                                                            |
| <a href="#">Conference Room IP Phone</a>                          | <a href="#">Cisco</a>  | <a href="#">CP-7832-3PCC-K9=</a>                                                        |
| <a href="#">Analog to IP Adapter (ATA)</a>                        | <a href="#">Cisco</a>  | <a href="#">ATA192-3PW-K9</a>                                                           |
| <a href="#">Cisco ATA North American Power Adapter Clip</a>       | <a href="#">Cisco</a>  | <a href="#">ATA191-CLIP-NA</a>                                                          |
| <a href="#">5G Cellular Gateway (Internal Antenna)</a>            | <a href="#">Meraki</a> | <a href="#">MG52-HW</a>                                                                 |
| <a href="#">5G Cellular Gateway (External Antenna)</a>            | <a href="#">Meraki</a> | <a href="#">MG52E-HW</a>                                                                |
| <a href="#">5G Cellular Gateway External Antenna</a>              | <a href="#">Meraki</a> | <a href="#">MA-ANT-DUAL-C3</a>                                                          |
| <a href="#">3-Year Enterprise License for 5G Cellular Gateway</a> | <a href="#">Meraki</a> | <a href="#">LIC-MG52-ENT-3Y</a>                                                         |
| <a href="#">VoIP Gateway</a>                                      | <a href="#">Cisco</a>  | <del>xxx</del> <a href="#">C8300-2N2S-4T2X w/ NIM-4FXO, NIM-4FXS cards</a>              |

END OF APPENDIX [A](#)

END OF SECTION

SECTION 27 41 00  
AUDIO-VISUAL SYSTEMS

REVISION SUMMARY

All Users and Designers! This page is for your information only to provide information on the latest update to this specification so that you don't have to traipse line by line looking for the last edit. Please delete this page prior to issuance.

09/30/2022 – Initial Section creation/edits

02/28/2023 – Edits from meetings with District

10/19/2023 – Appendix A Updates

DISTRICT DESIGN STANDARDS

All Users and Designers! The information shown below are provided by the District to convey the District's thought process on manufacturers, products, procedures, etc. These items are to assist the design team with understanding what to use as part of the design along with those items that the District does not want to be installed or used on their school sites. Please delete this page prior to issuance.

09/30/2022 – Designer to evaluate:

1. Existing system capacity

1/31/2025 – Annual update:

1. District standard control system (MP room, gyms, etc.) is Extron.
2. Standard school AV systems (MP room, gyms, etc.) shall not utilize AVoIP (including Dante) as a basis of design. Standard point-to-point transmission systems (analog, HDBaseT, etc.) shall be utilized. Any use of AVoIP in a system design must receive prior approval from the Electronics shop and will only be allowed for special purpose facilities.
3. AV systems shall have their own dedicated rack/enclosure and shall not be co-located in an IDF rack.

SECTION 27 41 00  
AUDIO-VISUAL SYSTEMS

**PART I - GENERAL****1.01 SUMMARY**

- A. This section specifies equipment, accessories, materials, wire, installation, configuration, and testing requirements for a complete and operable audio-visual system. This system shall provide multi-media presentation capabilities for education and instructional purposes.

**1.02 SCOPE**

- A. The work will include but not be limited to the following objectives:
1. Labor and Materials: The Contractor shall provide and pay for all labor, supervision, materials, accessories, components, equipment, tools, transportation, and other facilities and services necessary for the proper installation of turn-key audio-visual systems to the District.
  2. The Contractor shall be responsible for all programming, commissioning, and activation of the Audio-Visual System.
  3. The contractor will coordinate with the District in writing for any needed information (i.e. IP addresses, etc.) At least 2 weeks prior to date the information is needed.
- B. The District has standardized on 86" interactive flat panel display for standard classroom teaching A-V. The interactive display shall be integrated with the Assistive Listening System, see Section 27 51 26 for requirements.
- C. Multi-purpose rooms shall be equipped with an integrated audio-visual system consisting of a video projector, rear-projection screen, video switcher, audio DSP, speakers, and related components, as indicated on the project documents. The audio-visual system shall be integrated with the Assistive Listening System, see Section 27 51 26 for requirements.
- D. Gymnasiums shall be equipped with an audio system consisting of an audio DSP, speakers, and related components, as indicated on the project documents. The audio system shall be integrated with the Assistive Listening System, see Section 27 51 26 for requirements.
- D. The Contractor is responsible for user/operator training (1-2 hours per system type).
- E. The Contractor shall complete all required project closeout documentation in a timely fashion.



**1.03 RELATED REQUIREMENTS**

- A. Division 01 – General Requirements
- B. Section 27 00 00 - Communications
- C. Section 27 05 00 – Common Work Results for Communication Systems.
- D. Section 27 10 00 – Structured Cabling

**1.04 REFERENCES**

- A. See section 27 00 00 for requirements.

**1.05 DEFINITIONS**

- A. See section 27 00 00 for requirements.

**1.06 SYSTEM REQUIREMENTS**

- A. Not used.

**1.07 SUBMITTALS**

- A. Products Material Submittal:
  - 1. See Section 27 00 00 for Contractor Product Submittal requirements.
- B. Touch Screen Interface Submittal
  - 1. The contractor shall provide a submittal including all touch-screen interface programming including each menu, submenu, and popup, for review and approval by the District.
- C. Post construction submittals
  - 1. Provide as-built documentation in accordance with Section 3.
  - 2. Submit owner’s manual binders of all equipment documentation.
  - 3. Provide a laminated simple operational sheet for end-users of system.
  - 4. Provide backup copies of all A/V system programming files, including “uncompiled” copies of all Extron programming and backups of the Audio DSP programming.
  - 5. See Section 27 00 00 for requirements.

**1.08 CONTRACTOR “SHOP DRAWINGS” DESIGN REQUIREMENTS**

- A. See section 27 00 00 for requirements.
- B. Shop drawings are required for this section.

**1.09 QUALIFICATIONS**

- A. The Contractor shall be located within 50 miles or less from the project site to support 2-hour response time.
- B. The Contractor shall have five (5) years' experience installing Assistive Listening/AV equipment systems.
- C. The Contractor shall possess a California a C7 or C10 license.
- D. The Contractor or Subcontractor shall be AV equipment manufacturer authorized to provide and install equipment with 5 years documented experience.

**1.10 CERTIFICATIONS**

- A. The Contractor's installers shall be manufacturer certified.

**1.11 WORKMANSHIP**

- A. Quality workmanship is a high priority for the District and the Contractor shall be held to a high-level of professional workmanship.
- B. The District's Project or Construction Manager will have the authority to reject Work which does not conform to the Drawings and Specifications.
- C. The Contractor shall comply with highest industry standards, except when specified requirements indicate more rigid standards or more precise workmanship.
- D. The Contractor shall perform the work with persons experienced and qualified to produce workmanship specified.
- E. The Contractor shall maintain quality control over suppliers and Subcontractors.
- F. The Contractor shall be responsible for scheduling Subcontractors in a timely fashion.

**1.12 WARRANTY**

- A. Refer to Division 01 Warranty section.

B. See section 27 00 00 for additional requirements.

**1.13 CLOSEOUT DOCUMENTS**

A. See section 27 00 00 for requirements.

**PART 2 - PRODUCTS****2.01 GENERAL**

- A. The approved manufacturers for the project are:
  - 1. A-V Control unit and related accessories: Extron
  - 2. Interactive flat panel display: Newline
  - 3. See Appendix A for additional pre-approved equipment/materials.
- B. All products shall be new, unused and without blemishes and shall be of manufacturer's current and standard production.
- C. Drawings and Specifications indicate major system components, and may not show every component, connector, module, or accessory that may be required to support the operation specified. The Contractor shall provide all components needed for complete and satisfactory installation and operation.
- D. Product Availability
  - 1. Contractor, prior to submitting a proposal, shall determine product availability and delivery time, and shall include such considerations into his proposed Contract Time.
  - 2. Subject to compliance with these specifications, products and systems included in this section are to be installed as specified by the manufacturer of the system or engineer approved equal.

**2.02 EQUIPMENT**

- A. See Appendix A at the end of this document for pre-approved materials.
- B. Substitutions require proof of equivalence and prior approval by District and/or it's representative before ordering.

**2.03 CABLE**

- A. HDBaseT cable shall be manufacturer-specified shielded twisted pair specialty cable including manufacturer-specified terminations. For example, Extron systems shall utilize Extron-branded DTP cable and terminations.

**PART 3 - EXECUTION**

**3.01 ACCEPTABLE INSTALLERS**

- A. The equipment shall only be installed by Contractors who are qualified and certified by the manufacturer to install and maintain the system.
- B. The Contractor (or subcontractor listed at time of bid) must have at least five (5) years' experience installing educational A-V equipment before the Bid Opening Date.

**3.02 EXAMINATION**

- A. The Contractor shall be required to visit the installation site(s) prior to bidding the job. The Contractor acknowledges that the failure to visit the site(s) will not relieve the Contractor of the responsibility for observing and considering those conditions which a Contractor would have observed and considered during a site visit, estimating properly the difficulty and cost of successfully performing the Work or proceeding to perform the Work without additional cost to District.
- B. The Contractor shall report any discrepancies between the Specifications, Drawings, and Site Examination prior to the Bid Opening Date.

**3.03 PREPARATION**

- A. The Contractor shall verify materials are readily available prior to submitting product submittals and notify the District's Project Manager of long lead time items.
- B. The Contractor shall order all required parts and equipment only after receipt of approved product submittals from the District's Project Manager.
- C. Submit and receive approval of shop drawings prior to work commencement.

**3.04 PATHWAY INSTALLATION**

- A. See Division 26 and Section 27 05 00 for requirements and more information.

**3.05 EQUIPMENT INSTALLATION**

- A. Equipment to be wired and installed per the manufacturer's instructions.
- B. The Contractor shall coordinate with the District's IT Department if connecting to their network.

- C. Installation shall be in accordance with applicable codes (i.e. NEC, NFPA 72) local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.
- D. Perform all Work as indicated on the approved Shop Drawings, Design Documents and Specifications.
- E. All low voltage cables shall be kept away from power circuits.
- F. Contractor shall provide programming and configuration each audio-visual system.
- G. Cables/wire shall be installed in a neat and orderly manner. Loose cables/wires shall be bundled and wrapped with Velcro.

### 3.06 LABELING/SCHEDULES

- A. All labels are to be machine generated black letters on white adhesive label stock that is appropriate for the installation environment (interior/exterior).
- B. Cables shall be identified with a machine-printed tag identifying the system type, source or head end location, and destination location in all access points (i.e. junction boxes, ground boxes, MDF, IDF, etc.) and as they enter or exit and conduit pathway.

### 3.07 CONFIGURATION

- A. All equipment needs to be fully configured and tested for functionality prior to testing.

### 3.08 FIELD QUALITY CONTROL AND TESTING

- A. The installation contractor will fine tune and test the systems for optimal audio and visual performance.
- B. Multi Purpose Room Audio System:
  - 1. Frequency Response:  $\pm 3$  dB per octave band, 125 Hz to 10,000 Hz. 3dB per octave roll off below 125 Hz and above 10 kHz.
  - 2. Total Acoustical Harmonic Distortion: Less than 2% at 85 dBC (1kHz reference) at four feet (1,220mm) above finished floor in the middle of the room.
  - 3. Adjust the gain structure for all audio system components (mixer input to amplifier output) to achieve the highest signal-to-noise ratio, 75 dB from 50 Hz to 15 kHz minimum.
  - 4. Ensure that the audio frequency response of the electronics system with equalizers bypassed varies less than  $\pm 1$  dB from 50 Hz to 12 kHz.

5. The electronic system audio distortion shall be less than 0.5% at 1 kHz at the equipment's rated input signal level.
  6. Sound Output Capability: Provide program levels of not less than 95 dB and speech reinforcement levels of not less than 85dB in the seating area without objectionable distortion, rattles, or buzzes, employing as test signals several different samples of recorded music and microphones applied at each system input.
  7. Hum and Noise: Hum and noise shall be inaudible (below the background noise level of the space) under normal operation and as observed in normal seat locations.
  8. Manufacturer-provided speaker tuning and limiting presets shall be utilized in the programming of the amplifier.
- G. Upon reaching substantial completion, perform a complete test and inspection of the system. If found to be installed and operating properly, notify District of your readiness to perform the formal Test & Inspection of the complete system.
- H. Submit the Record Drawings (as-builts) to District for review prior to inspection.
- I. During the formal Test & Inspection (Commissioning) of the system, have personnel available with tools and equipment to inspect wiring, devices, and system operation.
- J. If corrections are needed, the Contractor will be provided with a Punch-List of all discrepancies. Perform the needed corrections in a timely fashion.
- K. Notify the District when ready to perform a re-inspection of the installation.
- L. District or its representative to provide final sign-off for acceptance.

### 3.09 AS-BUILT DRAWINGS

- A. See section 27 00 00 for requirements.
- B. As-built drawings shall be provided for this section.

### 3.10 TRAINING

- A. The Contractor shall create quick start guides customized to the specific system being installed at each location. Quick start guides shall be prepared in advance of all training sessions so they can be distributed and reviewed with staff at time of initial training. All quick start guides shall be laminated.

- B. The contractor shall make a video recording of all training sessions and export to digital medium (USB Drive) for district archive.
- C. The Contractor shall provide 1-2 hours per system type (classroom, office, MP room).



## APPENDIX A – Pre-Approved Materials

| DESCRIPTION                                                                                                                                                                   | MANUFACTURER                                    | PART NUMBER                                                                                   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|-----------------------------------------------------------------------------------------------|
| <b>Classrooms</b>                                                                                                                                                             |                                                 |                                                                                               |
| Touch Displays, 65", for offices and smaller conf. rooms:<br>i. Display<br>ii. Display monitor wall bracket                                                                   | i. Newline<br>ii. Peerless                      | i. TT-6521Q<br>ii. PA762                                                                      |
| Touch Displays, 75", for larger conf. rooms:<br>i. Display<br>ii. Display monitor wall bracket                                                                                | i. Newline<br>ii. Peerless                      | i. TT-7521Q<br>ii. PA762                                                                      |
| Touch Displays, 86", for classrooms:<br>i. Display<br>ii. Mobile Cart<br>iii. Mobile Cart Required<br>Accessories<br>iv. Assistive Listening Components, see Section 27 51 26 | i. Newline<br>ii. BalanceBox<br>iii. BalanceBox | i. TT-8621Q (with Wi-Fi module)<br>ii. eBox II (487A11011)<br>iii. 481A70<br>481A89<br>481A92 |
| <b>Multipurpose Rooms / Gymnasiums</b>                                                                                                                                        |                                                 |                                                                                               |
| <b>Rack, Wall Swing</b>                                                                                                                                                       | <b>Middle Atlantic</b>                          | <b>SR-40-28</b>                                                                               |
| <b>Rack Drawer</b>                                                                                                                                                            | <b>Middle Atlantic</b>                          | <b>D3</b>                                                                                     |
| <b>Video Switcher</b>                                                                                                                                                         | <b>Extron</b>                                   | <b>60-1570-12</b>                                                                             |
| <b>10" Wall Mount Touch Screen</b>                                                                                                                                            | <b>Extron</b>                                   | <b>60-1566-02</b>                                                                             |
| <b>HDMI over Catx Transmitter (Decora)</b>                                                                                                                                    | <b>Extron</b>                                   | <b>60-1741-52</b>                                                                             |
| <b>Projector</b>                                                                                                                                                              | <b>Epson</b>                                    | <b>EB-PU2213B</b>                                                                             |
| <b>Projector wall mount with cage</b>                                                                                                                                         | <b>BMS</b>                                      | <b>CTAWA-PROJ PRO COMBO</b>                                                                   |
| <b>Projector Screen</b>                                                                                                                                                       | <b>Da-Lite</b>                                  | <b>70239</b>                                                                                  |
| <b>4K Blu-Ray Player</b>                                                                                                                                                      | <b>Tascam</b>                                   | <b>BD-MP4K</b>                                                                                |
| <b>Audio DSP</b>                                                                                                                                                              | <b>Allen Heath</b>                              | <b>AHM-64</b>                                                                                 |
| <b>Amplifier</b>                                                                                                                                                              | <b>Powersoft</b>                                | <b>Quattrocanali 4804 DSP</b>                                                                 |
| <b>PA Speaker</b>                                                                                                                                                             | <b>Fulcrum</b>                                  | <b>DX1295</b>                                                                                 |
| <b>Wireless Microphone Receiver</b>                                                                                                                                           | <b>Shure</b>                                    | <b>ULXD4D</b>                                                                                 |
| <b>Wireless Microphone Transmitter</b>                                                                                                                                        | <b>Shure</b>                                    | <b>ULXD2/B87A</b>                                                                             |
| <b>Wireless Microphone Antenna</b>                                                                                                                                            | <b>Shure</b>                                    | <b>UA864US</b>                                                                                |

|                                       |                             |                 |
|---------------------------------------|-----------------------------|-----------------|
| <b>Power Sequencer</b>                | <b>Furman</b>               | <b>CN-2400S</b> |
| <b>XLR Female Decora</b>              | <b>RDL</b>                  | <b>D-XLR3F</b>  |
| <b>XLR Dual Female Decora</b>         | <b>RDL</b>                  | <b>D-XLR2F</b>  |
| <b>XLRF and 3.5MM Decora</b>          | <b>RDL</b>                  | <b>D-J3M</b>    |
| <b>XLR Male Decora</b>                | <b>RDL</b>                  | <b>D-XLR3M</b>  |
| <b>Assistive Listening Components</b> | <b>See Section 27 51 26</b> |                 |

END OF SECTION

SECTION 27 51 23.50  
EDUCATIONAL INTERCOM SYSTEMS

REVISION SUMMARY

All Users and Designers! This page is for your information only to provide information on the latest update to this specification so that you don't have to traipse line by line looking for the last edit. Please delete this page prior to issuance.

09/30/2022 – Initial Section creation/edits

02/20/2023 – updated Appendix A

06/20/2023 – updated Appendix A

01/31/2025 – annual update

DISTRICT DESIGN STANDARDS

All Users and Designers! The information shown below is provided by the District to convey the District's thought process on manufacturers, products, procedures, etc. These items are to assist the design team with understanding what to use as part of the design along with those items that the District does not want to be installed or used on their school sites. Please delete this page prior to issuance.

Designer to evaluate:

1. Existing system capacity
2. POE available on existing switches

**Rauland Telecenter U Installation Project – District Design Guidelines**

The purpose of this document is to give general guidelines for Rauland Telecenter U communication systems installed in Sacramento City Unified School District.

- 1) **MINIMUM EQUIPMENT:** Each installation shall have the following equipment at a minimum:
  - 1 each TCC2000 Campus Controller (unless otherwise noted by District)
  - 1 each TCC2045 Administrative Console Phone
  - 1 each TCC2055 Program Line Input Module
  - 1 each TCC2033 Auxiliary I/O Module
- 2) **ANCILLARY EQUIPMENT:** Each installation will have varying quantities of the following equipment, depending on campus size and system layout:
  - TCC2011A Classroom Module (one for each classroom speaker)
  - TCC2022 Zone Page Module (one for each auxiliary amplifier channel needed)
  - TCC3022 Zone Page Amplifier (one for each speaker zone needed)
  - TCC3011S Small Message Board (one at each clock location, installed with speaker and TCC2011A)
  - TCC3012L Large Message Board (Middle and High Schools; standalone installation for large areas)

Powersoft Mezzo 322A dual-channel audio amplifier, 160W / channel, (installed with TCC2022 module(s) )

3) GENERAL DESIGN: Systems shall be designed using the following guidelines:

- a) Speaker placement outside the buildings and inside large spaces (Cafeterias, Auditoriums, Gymnasiums, interior hallways): Shall be placed and designed so that no single speaker needs to be driven above the 2-watt level to provide sufficient audio volume during voice announcements.
- b) Multiple speakers within the same physical space may be constant-voltage type driven by a TCC3022 zone page amplifier (up to 25 watts total load) or TCC2022 zone page module(s) and Powersoft Mezzo 322A amplifier (up to 125 watts total load per channel). All speakers so connected shall utilize the 25-volt primary taps.
- c) Outdoor speakers shall be installed in vandal-resistant enclosures. The speakers shall be moisture-resistant and the enclosures shall have all unused mounting holes covered or blocked to prevent entry by flying insects.
- d) If paging horns are used a low-frequency protection (a high-pass filter) shall be installed to prevent voice coil damage. The high-pass filter can be installed at the amplifier output or at the individual speaker locations.

4) ZONING: Systems shall be designed to allow separate audio zones using the following guidelines. Note that individual speakers driven by TCC2011 modules inherently have this capability.

- a) Gymnasium interior, including locker rooms and activity rooms, shall be a unique zone
- .c) Cafeteria interior shall be a unique zone.
- d) Auditorium interior shall be a unique zone.
- e) Other performing arts spaces (black box, little theater) shall be unique zones.
- f) Outside speakers facing off-campus toward neighboring properties shall be zoned separately from outside speakers facing within the campus.
- g) Administration building interior speakers shall be a unique zone.
- h) Special program buildings (Preschools, Student Support Centers, etc) shall be a unique zone.
- i) K-8 or multiple-grade schools may require additional outside speaker zones to accommodate differing bell schedules.

5) NETWORK DEVICES AND WIRING:

IP Clocks and Speakers shall be powered by the POE switch at the nearest IDF. Add new POE switches as required, See 27 21 00.

UPS shall be provided at each IDF to power the switch(es) and shall be sized for a 30-minute runtime See 27 21 00.

Cabling/Patch Cords: See 27 10 00

Existing network wiring pathways may be utilized when capacity permits; otherwise, contractor shall provide sufficient-capacity pathways for the additional clock/speaker network drops.

Wiremold 2300/5400 surface raceway may be used within interior rooms if the existing wiring pathway does not have sufficient capacity See 27 05 00.

6) OTHER CONSIDERATIONS:

The type of device mounting will depend on existing site conditions. In most cases unless directed otherwise, the new clock or clock/speaker assembly will be mounted at the existing clock location so as to minimize the need for blanking plates and touch-up painting. Wiremold 2300/5400 surface raceway may be used if the existing wiring pathway is inaccessible. In the case of a new clock or clock/speaker assembly installed where none previously exists, mounting shall be done in such a way as to keep all device wiring hidden.

## SECTION 27 51 23.50

## EDUCATIONAL INTERCOM SYSTEMS

**PART I - GENERAL****1.01 SUMMARY**

- A. This section specifies equipment, accessories, materials, wire, installation, configuration, and testing requirements for a complete and operable Intercom/Public Address/Bell system. This system shall provide the ability to bi-directionally communicate with an individual room, broadcast to defined speaker zone(s) and ring bell tones on a predefined schedule. For sites that utilize the small message board, this section will supplant the use of section 27 53 13 Clock Systems.

**1.02 SCOPE**

- A. The work will include but not be limited to the following objectives:
1. Labor and Materials: The Contractor shall provide and pay for all labor, supervision, materials, accessories, components, equipment, tools, transportation, and other facilities and services necessary for the proper installation of a turn-key Assistive Listening system to the District.
  2. The contractor will coordinate with the District in writing for any needed information (i.e. IP addresses, etc.) 10 business days prior to the date the information is needed.
- B. The District has standardized on Rauland Telecenter U equipment and the installing Contractor shall be Rauland Telecenter authorized.
- C. For existing construction – provide and install all components and accessories to modify the existing system while maintaining code compliance and to seamlessly integrate the new components into the existing campus' system. Prior to beginning any work, the Contractor is responsible for identifying any existing system errors or faults and bring these issues to the attention of the District Project Manager.
- D. The Contractor shall be responsible for programming the Rauland Telecenter Intercom System.
- E. The Contractor shall coordinate with site staff for Bell schedule programming requirements.
- F. The Contractor shall review the proposed final system programming, functionality and expectations with the project manager, Architect/Engineer/Designer and District prior to final programming.

- G. After completion of the installation and pretest of the system a satisfactory final test of the entire system shall be made in the presence of the inspector of record (IOR) and District or the District's representative.
- H. The Contractor shall adjust any speaker levels to the appropriate level as determined in system testing.
- I. Existing systems shall remain operable until the new system is accepted and approved by the District or the District's representative.
- J. The Contractor is responsible for user/operator training (maximum 2 hours).
- K. The Contractor shall complete all required project closeout documentation in a timely fashion.

1.03 RELATED REQUIREMENTS

- A. Division 01 – General Requirements
- B. Section 27 00 00 - Communications
- C. Section 27 05 00 – Common Work Results for Communication Systems.
- E. Section 27 10 00 – Structured Cabling

1.04 REFERENCES

- A. See section 27 00 00 for requirements.

1.05 DEFINITIONS

- A. See section 27 00 00 for requirements.

1.06 SYSTEM REQUIREMENTS

- A. Any new installations or existing system modifications shall seamlessly integrate into the site's existing intercom system when applicable.

1.07 SUBMITTALS

- A. See section 27 00 00 for requirements.

1.08 CONTRACTOR "SHOP DRAWINGS" DESIGN REQUIREMENTS

- A. See section 27 00 00 for requirements.
- B. Shop drawings are required for this section.

1.09 QUALIFICATIONS

- B. The Contractor shall be located within 50 miles or less from the project site to support 2-hour response time.
- B. Five (5) years' experience installing Rauland Telecenter equipment.
- C. The contractor shall possess a California a C7 or C10 license.
- D. The Contractor or Subcontractor shall be Rauland Telecenter authorized to provide and install equipment with 5 years documented experience.

1.10 CERTIFICATIONS

- A. Installers shall be manufacturer certified..

1.11 WORKMANSHIP

- A. Quality workmanship is a high priority for the District and the Contractor shall be held to a high-level of professional workmanship.
- B. The District's Project or Construction Manager will have the authority to reject Work which does not conform to the Drawings and Specifications.
- C. Comply with highest industry standards, except when specified requirements indicate more rigid standards or more precise workmanship.
- D. Perform Work with persons experienced and qualified to produce workmanship specified.
- E. Maintain quality control over suppliers and Subcontractors.
- F. Contractor shall be responsible for scheduling Subcontractors in a timely fashion.

1.12 WARRANTY

- A. Refer to Division 01 Warranty section.
- B. See section 27 00 00 for additional requirements.

1.13 CLOSEOUT DOCUMENTS

- A. See section 27 00 00 for requirements.



**PART 2 – PRODUCTS****2.01 GENERAL**

- A. The approved manufacturers for the project are:
  - 1. Control unit and related accessories: Rauland Telecenter U
  - 2. Speakers: See Appendix A for different installation types
  - 3. Wire, cable, and accessories: See Appendix A.
- B. All products shall be new, unused and without blemishes and shall be of manufacturer's current and standard production.
- C. Drawings and Specifications indicate major system components, and may not show every component, connector, module, or accessory that may be required to support the operation specified. The Contractor shall provide all components needed for complete and satisfactory installation and operation.
- D. Product Availability
  - 1. The Contractor, prior to submitting a proposal, shall determine product availability and delivery time, and shall include such considerations into his proposed Contract Time.
  - 2. Subject to compliance with these specifications, products and systems included in this section are to be installed as specified by the manufacturer of the system or engineer approved equal.

**2.02 EQUIPMENT**

- A. See Appendix A at the end of this document for pre-approved materials.
- B. Substitutions require proof of equivalence and prior approval by District and/or its representative before ordering.
- C. Main system components:
  - 1. Rauland Telecenter U IP Campus Controller and software
  - 2. Rauland Telecenter U Auxilliary Input/Output Module
  - 4. Rauland Telecenter U IP Classroom Module
  - 5. Rauland Telecenter U Administrative Console
  - 6. Rauland Telecenter U Program Line Input Module

**PART 3 - EXECUTION****3.01 ACCEPTABLE INSTALLERS**

- A. The equipment shall only be installed by Contractors who are qualified and certified by the manufacturer to install and maintain the system.
- B. The Contractor (or subcontractor listed at time of bid) must have at least five (5) years' experience installing educational intercom equipment before the Bid Opening Date.

**3.02 EXAMINATION**

- A. The Contractor shall be required to visit the installation site(s) prior to bidding the job. The Contractor acknowledges that the failure to visit the site(s) will not relieve the Contractor of the responsibility for observing and considering those conditions which a Contractor would have observed and considered during a site visit, estimating properly the difficulty and cost of successfully performing the Work or proceeding to perform the Work without additional cost to District.
- B. The Contractor shall report any discrepancies between the Specifications, Drawings, and Site Examination prior to the Bid Opening Date.

**3.03 PREPARATION**

- A. The Contractor shall verify materials are readily available prior to submitting product submittals and notify the District's Project Manager of long lead time items.
- B. The Contractor shall order all required parts and equipment only after receipt of approved product submittals from the District's Project Manager.
- C. Submit and receive approval for shop drawings prior to work commencement.

**3.04 PATHWAY INSTALLATION**

- A. See Division 26 and Section 27 05 00 for requirements and more information.
- B. Existing Construction:
  - 1. Refer to design documents.
  - 2. Surface raceway and components shall be Wiremold 2300.

**3.05 EQUIPMENT INSTALLATION**

- A. Equipment to be wired and installed per manufacturer's instructions.

- B. The Contractor shall coordinate with the District's IT Department if connecting to their network. The Contractor shall provide a spreadsheet of all device MAC addresses indexed by device location to the District IT department to facilitate programming of reserved IP addresses for each device.
- C. Installation shall be in accordance with applicable codes (i.e. NEC, NFPA 72) local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.
- D. Perform all Work as indicated in the Drawings and Specifications.
- E. All low voltage cables shall be kept away from power circuits.
- F. Contractor shall provide programming and configuration of the Educational Intercom system for full functionality.
- G. Contractor shall maintain a complete, up-to-date backup of the system configuration. Backup shall be maintained throughout the programming period until final Acceptance by District. Submit back-ups to District upon Final Acceptance.

### 3.06 LABELING/SCHEDULES

- A. All labels are to be machine generated black letters on white adhesive label stock that is appropriate for the installation environment (interior/exterior).
- B. Label all standard speaker cables with port ID.
- C. Label all speakers with speaker ID.
- D. Label all IP speakers with MDF/IDF, patch panel and jack numbers.

### 3.09 CONFIGURATION

- A. All equipment to be fully configured and tested for functionality prior to testing.

### 3.10 FIELD QUALITY CONTROL AND TESTING

- A. Upon reaching substantial completion, perform a complete test and inspection of the system. If found to be installed and operating properly, notify District of your readiness to perform the formal Test & Inspection of the complete system.
- B. Submit the Record Drawings (as-builts) to District for review prior to inspection.

- C. During the formal Test & Inspection (Commissioning) of the system the Contractor shall have personnel available with tools and equipment to inspect wiring, devices, and system operation.
- D. If corrections are needed, the Contractor will be provided with a Punch-List of all discrepancies. Perform the needed corrections in a timely fashion.
- E. Notify the District when ready to perform a re-inspection of the installation.
- F. District or its representative to provide final sign-off for acceptance.

**3.11 AS-BUILT DRAWINGS**

- A. See section 27 00 00 for requirements.
- B. As-built riser diagram showing all access control components for site.

**3.12 TRAINING**

- A. For new systems provide 8-hrs end-user training.
- B. For existing system upgrades provide 2-hrs end-user training.

## APPENDIX A – Pre-Approved Materials

| DESCRIPTION                                                            | MFG                                 | PART NUMBER                                                                                                                                                                     |
|------------------------------------------------------------------------|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| IP Campus Controller and software/licenses                             | Rauland Telecenter U                | TCC2000                                                                                                                                                                         |
| Administrative Console                                                 | Rauland Telecenter U                | TCC2045                                                                                                                                                                         |
| Auxiliary Input/Output Module                                          | Rauland Telecenter U                | TCC2033                                                                                                                                                                         |
| Universal Rack Mounting Kit                                            | Rauland Telecenter U                | TCC2099                                                                                                                                                                         |
| Program Line Input Module                                              | Rauland Telecenter U                | TCC2055                                                                                                                                                                         |
| Zone page amplifier (25V, 14W/35W)                                     | Rauland Telecenter U                | Amplifier: TCC3022<br>Power Supply (over 14W): TCC3022PS                                                                                                                        |
| IP Classroom Module                                                    | Rauland Telecenter U                | TCC2011B                                                                                                                                                                        |
| Zone Page Module (used with external audio amplifier)                  | Rauland Telecenter U                | TCC2022                                                                                                                                                                         |
| Audio Power Amplifier (25V, 2x160W)                                    | Powersoft                           | MEZZO 322A                                                                                                                                                                      |
| 8-Ohm 2'x2' Lay-in Ceiling Speaker, RJ-45 (common areas / hallways)    | Rauland                             | BAFKIT2X2L8RJ<br>Add: IP Classroom module                                                                                                                                       |
| 8-Ohm 8" Speaker assembly surface (retrofit)                           | Rauland                             | <ul style="list-style-type: none"> <li>- Speaker USO880</li> <li>- Backbox ACC1112</li> <li>- Baffle ACC1003</li> <li>- Add: IP Classroom module</li> </ul>                     |
| 8-Ohm 8" Speaker assembly flush (new construction)                     | Rauland                             | <ul style="list-style-type: none"> <li>- Baffle w/speaker ACC1480</li> <li>- Backbox ACC1000</li> <li>- Add: IP Classroom module</li> </ul>                                     |
| 25V 8" Speaker assembly flush (new construction restrooms)             | Rauland                             | <ul style="list-style-type: none"> <li>- Baffle w/speaker ACC1400</li> <li>- Backbox ACC1100</li> </ul>                                                                         |
| Clock/Speaker surface combo (standard classroom/office retrofit)       | Rauland                             | <ul style="list-style-type: none"> <li>- Baffle w/ Speaker ACC3011S</li> <li>- Backbox ACC3011SBB</li> <li>- Message Board TCC3011S</li> </ul> Add: IP Classroom module         |
| Clock/Speaker flush combo (standard classroom/office new construction) | Rauland                             | <ul style="list-style-type: none"> <li>- Backbox ACC3011FBB</li> <li>- Baffle w/speaker ACC3011S</li> <li>- Message Board TCC3011S</li> </ul> Add: IP Classroom module          |
| Exterior Speaker (retrofit)                                            | Rauland<br>Lowell<br>Rauland<br>FSR | Backbox: ACC1113<br>Baffle: ACC1012<br>Speaker: 8C10MRB<br>Interior Backbox SMWB-4G-WHT<br><ul style="list-style-type: none"> <li>- Add: IP Classroom Module (single</li> </ul> |

**EDUCATIONAL INTERCOM SYSTEMS****27 51 23.50 - 12**

|                                     |                                     |                                                                                                                                                                                                      |
|-------------------------------------|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                     |                                     | speaker up to 2W)<br>Add: Wire breakout 603101 (when IP module used)                                                                                                                                 |
| Exterior Speaker (new construction) | Lowell<br>Rauland<br>Rauland<br>FSR | Speaker 8C10MRB<br>Baffle ACC1012<br>Backbox ACC1105<br>Interior Backbox 4-gang generic<br>- Add: IP Classroom Module (single speaker up to 2W)<br>- Add: Wire breakout 603101 (when IP module used) |
| Large Message Board (Clock)         | Rauland                             | TCC3012L                                                                                                                                                                                             |
| Wire Guard for Large Message Board  | American Time                       | G2055OF-28                                                                                                                                                                                           |
| Speaker, Exterior (25V)             | Lowell                              | Speaker: 8C10MRB-T72                                                                                                                                                                                 |
| UPS (Telecenter Head End)           | N1C                                 | N1C.L1500                                                                                                                                                                                            |
| 25V Speaker Cable                   | West Penn                           | 292                                                                                                                                                                                                  |

END OF APPENDIX  
END OF SECTION

SECTION 27 51 26  
ASSISTIVE LISTENING SYSTEMS

REVISION SUMMARY

All Users and Designers! This page is for your information only to provide information on the latest update to this specification so that you don't have to traipse line by line looking for the last edit. Please delete this page prior to issuance.

09/30/2022 – Initial Section creation/edits

02/28/2023 – Edits from meetings with District

11/07/2023 – Edits to clarify integration with TV cart

01/31/2025 – Annual review

DISTRICT DESIGN STANDARDS

All Users and Designers! The information shown below is provided by the District to convey the District's thought process on manufacturers, products, procedures, etc. These items are to assist the design team with understanding what to use as part of the design along with those items that the District does not want to be installed or used on their school sites. Please delete this page prior to issuance.

09/30/2022 – Designer to evaluate:

1. Occupancy levels to require Assistive Listening systems

SECTION 27 51 26  
ASSISTIVE LISTENING SYSTEMS

**PART I - GENERAL****1.01 SUMMARY**

- A. This section specifies equipment, accessories, materials, wire, installation, configuration, and testing requirements for a complete and operable Assistive Listening system. The system shall be provided in each assembly area, including conference and meeting rooms, in accordance with ADA Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010 section(s) 216.10, 219, 706, and CBC section(s) 11B-216.10, 11B-219, 11B-706.

**1.02 SCOPE**

- A. The work will include but not be limited to the following objectives:
1. Labor and Materials: The Contractor shall provide and pay for all labor, supervision, materials, accessories, components, equipment, tools, transportation, and other facilities and services necessary for the proper installation of a turn-key Assistive Listening system to the District.
  2. The contractor will coordinate with the District in writing for any needed information (i.e. IP addresses, etc.) at least 2 weeks prior to date the information is needed.
- B. The Assistive Listening System shall be FM (72 MHz) for large venue systems, and IR for classroom and portable systems.
- C. Assistive Listening equipment: Includes, but is not limited to:
- a. Transmitters
  - b. Receivers
  - c. Earpiece/Neck loops
  - d. Chargers
  - e. Signs
- D. Typical installation includes a transmitter with audio source input or microphone and portable rechargeable receivers with either neck loops or earpieces.
- E. Permanently installed assistive-listening systems are required in areas if (1) they accommodate at least 50 persons or if they have audio-amplification systems, and (2) they have fixed seating. If portable assistive-listening systems are used for conference or meeting rooms, the system may serve more than one room. An adequate number of electrical outlets or other supplementary wiring necessary to support a portable assistive-listening system shall be provided.



- F. The minimum number of receivers to be provided shall be equal to 4 percent of the total number of seats, but in no case less than two. Twenty-five percent minimum of receivers provided, but no fewer than two, shall be hearing aid compatible.
- G. Receivers required to be hearing-aid compatible shall interface with telecoils in hearing aids through the provision of neck loops.
- E. Classroom assistive listening systems shall be fully integrated with the classroom audio-visual system or mobile TV cart such that program audio is provided via the assistive listening system.

#### 1.03 RELATED REQUIREMENTS

- A. Division 01 – General Requirements
- B. Section 27 00 00 - Communications
- C. Section 27 05 00 – Common Work Results for Communication Systems.
- D. Section 27 10 00 – Structured Cabling

#### 1.04 REFERENCES

- A. See section 27 00 00 for requirements.

#### 1.05 DEFINITIONS

- A. See section 27 00 00 for requirements.

#### 1.06 SYSTEM REQUIREMENTS

- A. Any new installations or existing system modifications shall seamlessly integrate into the site's existing A-V system

#### 1.07 SUBMITTALS

- A. See section 27 00 00 for requirements.

#### 1.08 CONTRACTOR "SHOP DRAWINGS" DESIGN REQUIREMENTS

- A. See section 27 00 00 for requirements.
- B. Shop drawings are required for this section.

**1.09 QUALIFICATIONS**

- A. Contractor shall be located within 50 miles or less from the project site to support 2-hour response time.
- B. Five (5) years' experience installing Assistive Listening/AV equipment systems.

**1.10 CERTIFICATIONS**

- A. See section 27 00 00 for requirements.

**1.11 WORKMANSHIP**

- A. Quality workmanship is a high priority for the District and the Contractor shall be held to a high-level of professional workmanship.
- B. The District's Project or Construction Manager will have the authority to reject Work which does not conform to the Drawings and Specifications.
- C. Comply with highest industry standards, except when specified requirements indicate more rigid standards or more precise workmanship.
- D. Perform Work with persons experienced and qualified to produce workmanship specified.
- E. Maintain quality control over suppliers and Subcontractors.
- F. Contractor shall be responsible for scheduling Subcontractors in a timely fashion.

**1.12 WARRANTY**

- A. Refer to Division 01 Warranty section.
- B. See section 27 00 00 for additional requirements.

**1.13 CLOSEOUT DOCUMENTS**

- A. See section 27 00 00 for requirements.

**PART 2 - PRODUCTS****2.01 GENERAL**

- A. Manufacturers – The District has standardized on Listen Technologies.
- B. All products shall be new, unused and without blemishes and shall be of manufacturer's current and standard production.
- C. Drawings and Specifications indicate major system components, and may not show every component, connector, module, or accessory that may be required to support the operation specified. The contractor shall provide all components needed for complete and satisfactory installation and operation.
- D. Product Availability
  - 1. Contractor, prior to submitting a proposal, shall determine product availability and delivery time, and shall include such considerations into his proposed Contract Time.
  - 2. Subject to compliance with these specifications, products and systems included in this section are to be installed as specified by the manufacturer of the system or engineer approved equal.

**2.02 EQUIPMENT**

- A. See Appendix A at the end of this document for pre-approved materials.
- B. Substitutions require proof of equivalence and prior approval by District and/or its representative before ordering.

**PART 3 - EXECUTION****3.01 ACCEPTABLE INSTALLERS**

- A. The equipment shall only be installed by Contractors who are qualified to install and maintain the system.
- B. The Contractor (or subcontractor listed at time of bid) must have at least five (5) years' experience installing electronic assistive listening equipment before the Bid Opening Date.

**3.02 EXAMINATION**

- A. The Contractor shall be required to visit the installation site(s) prior to bidding the job. The Contractor acknowledges that the failure to visit the site(s) will not relieve the Contractor of the responsibility for observing and considering those conditions which a Contractor would have observed and considered during a site visit, estimating properly the difficulty and cost of successfully performing the Work or proceeding to perform the Work without additional cost to District.
- B. The Contractor shall report any discrepancies between the Specifications, Drawings, and Site Examination prior to the Bid Opening Date.

**3.03 PREPARATION**

- A. The Contractor shall verify materials are readily available prior to submitting product submittals and notify the District's Project Manager of long lead time items.
- B. The Contractor shall order all required parts and equipment only after receipt of approved product submittals from the District's Project Manager.
- C. Submit and receive approval for shop drawings prior to work commencement.

**3.04 PATHWAY INSTALLATION**

- A. See Division 26 and Section 27 05 00 for requirements and more information.
- B. Existing Construction:
  - 1. Refer to design documents.
  - 2. Surface raceway and components shall be Wiremold 2300.

**3.05 EQUIPMENT INSTALLATION**

- A. Equipment to be wired and installed per manufacturer's instructions.

- B. BASE TRANSMITTER (provide 1 for each permanent sound system).
  - 1. Provide base transmitter with rack mount kit. Install where specified in the sound equipment rack and connect to content source.
  - 2. Install antenna where specified and cabling from the Base Transmitter to the antenna location.
  - 3. Program the transmitter to an interference-free transmit frequency in coordination with any adjacent systems
- C. RECEIVERS (provide a quantity equal to or greater than 4% of the total number of seats, but in no case less than 2)
  - 1. Install rechargeable batteries, if applicable
  - 2. Program receivers to the broadcast frequency of the Base Transmitter
- D. SIGN
  - 1. Provide Assistive Listening System sign per ADA requirements to indicate equipment available for the hearing impaired. Verify location with the architect prior to installation. Submit sample for approval. The sign shall include wording that states "Assistive-Listening System Available" and shall be posted in a prominent place at or near the assembly area entrance, or ticket booth window as applicable. Verify location with architect prior to installation. Assistive listening signs shall include the International Symbol of Access for Hearing Loss.
- E. PORTABLE SYSTEMS
  - 1. Contractor shall provide programming and configuration for each Assistive Listening System portable system to ensure interference-free operation between adjacent systems.

### 3.06 LABELING/SCHEDULES

- A. All labels are to be machine generated black letters on white adhesive label stock that is appropriate for the installation environment (interior/exterior).
- B. Cables shall be identified with a machine-printed tag identifying the system type, source or head end location, and destination location in all access points (i.e. junction boxes, ground boxes, MDF, IDF, etc.) and as they enter or exit and conduit pathway.

### 3.09 CONFIGURATION

- A. All equipment to be fully configured and tested for functionality prior to testing.

**3.10 FIELD QUALITY CONTROL AND TESTING**

- A. Upon reaching substantial completion, perform a complete test and inspection of the system. If found to be installed and operating properly, notify District of your readiness to perform the formal Test & Inspection of the complete system.
- B. Submit the Record Drawings (as-builts) to District for review prior to inspection.
- C. During the formal Test & Inspection (Commissioning) of the system, the Contractor shall have personnel available with tools and equipment to inspect wiring, devices, and system operation.
- D. If corrections are needed, the Contractor will be provided with a Punch-List of all discrepancies. Perform the needed corrections in a timely fashion.
- E. Notify the District when ready to perform a re-inspection of the installation.
- F. The District or its representative to provide final sign-off for acceptance.

**3.11 AS-BUILT DRAWINGS**

- A. See section 27 00 00 for requirements.

## APPENDIX A – Pre-Approved Materials

| DESCRIPTION                                  | MFG                 | PART NUMBER   |
|----------------------------------------------|---------------------|---------------|
| Portable ListenIR System                     | Listen Technologies | LS-88-01      |
| <b>Multi Purpose Room Components:</b>        |                     |               |
| Assistive Listening Base Transmitter (72MHz) | Listen Technologies | LS-800-072-01 |
| Receivers (72 MHz)                           | Listen Technologies | LR-4200-072   |
| Ear Speaker                                  | Listen Technologies | LA-401        |
| Neck Loop                                    | Listen Technologies | LA-430        |
| Universal Antenna Kit                        | Listen Technologies | LA-122        |
| Universal Rack Mounting Kit                  | Listen Technologies | LA-326        |
| Assistive Listening Notification Signage Kit | Listen Technologies | LA-304        |
| RG-8 50 ohm Coaxial Cable                    | Listen Technologies | LA-113        |
| RG-8 BNC connector                           | Listen Technologies | LA-128        |
| 12 unit charging tray                        | Listen Technologies | LA-381        |
| 3U rack drawer                               | Middle Atlantic     | D3            |
| <b>TV Cart Components:</b>                   |                     |               |
| Assistive Listening Base Transmitter (IR)    | Listen Technologies | LT-82         |
| Assistive Listening IR Radiator              | Listen Technologies | LA-140        |
| Assistive Listening Receiver (IR)            | Listen Technologies | LP-41-IR      |
| Wireless Microphone Receiver                 | Shure               | SLXD4         |
| Wireless Microphone Transmitter              | Shure               | SLXD4         |
| Lavalier Microphone                          | Shure               | WL185         |
| Rechargeable Lithium Ion Battery             | Shure               | SB903         |
| Lithium-Ion Battery Charger                  | Shure               | SBC10-903     |

END OF APPENDIX

END OF SECTION



**REVISION SUMMARY**

All Users and Designers! This page is for your information only to provide information on the latest update to this specification so that you don't have to traipse line by line looking for the last edit. Please delete this page prior to issuance.

09/30/2022 – Initial Section creation/edits

02/28/2023 – Edits from meetings with District

03/17/2023 – Updated Appendix A

06/30/2023 – Updated Appendix A

10/19/2023 – Updated Appendix A

03/13/2024 – Updated Appendix A with Cards P/N 8543 per Troy M/SCUSD

09/11/2024 – Corrected P/N in appendix A

12/03/2024 – updated for door hardware

01/31/2025 – Annual update

**DISTRICT DESIGN STANDARDS**

All Users and Designers! The information shown below is provided by the District to convey the District's thought process on manufacturers, products, procedures, etc. These items are to assist the design team with understanding what to use as part of the design along with those items that the District does not want to be installed or used on their school sites. Please delete this page prior to issuance.

06/30/2023 – Designer to evaluate:

1. Existing door hardware for compatibility and/or replacement.
2. Existing low-voltage pathway and provide upgrades if required.
3. MDF/IDF locations for rack and/or wall space for proposed equipment.
4. MDF/IDF locations for available electrical.
5. Network switch power over ethernet (PoE) available capacity and provide upgrades if required.

06/30/2023 – Designer to include access control for all doors of new construction projects.

01/31/2025 – Designer to evaluate:

1. Designer to coordinate with District for determining whether the design is for 100% doors with access control or selected doors only. Typical intent is any door that a teacher would access shall have access control other doors may not (i.e. custodial, electrical, student rest rooms, etc.)
2. Request to exit functionality shall be integrated into the lockset or panic hardware.
3. Video Intercom shall be provided at public facing main entrance (front door and/or front gate).
4. Gates with access control shall utilize a 4"x6" fixed post at the strike side for video intercom, card reader and surface electric strike mounting when required.
5. Bollards/pedestals are acceptable for the mounting of video intercom and/or card readers.



SECTION 28 10 00  
ACCESS CONTROL SYSTEM

**PART I - GENERAL****1.01 SUMMARY**

- A. This section specifies equipment, accessories, materials, installation, configuration, and testing requirements for a complete and operable electronic ~~a~~Access ~~c~~Control system. The system shall provide electronic access to secure doorways to authorized ~~persons~~people at ~~an~~ authorized time of day.

**1.02 SCOPE**

- A. The work will include but not be limited to the following objectives:
1. Labor and Materials: The Contractor shall provide and pay for all labor, supervision, materials, accessories, components, equipment, tools, transportation, and other facilities and services necessary for the proper installation of a turn-key Access Control system to the District.
  2. The contractor will coordinate with the District in writing for any needed information (i.e. IP addresses, etc.) at least 2 weeks prior to the date the information is needed.
  3. Access Control software and equipment: Includes, but is not limited to:
    - a. Software based system for user authentication and system control
    - b. RFID cards/fobs
    - c. RFID readers
    - d. Door controllers
    - e. Power supplies
    - f. Electrified door hardware/latches/strikes
    - g. Door position switches
    - h. Power transfer hinges/armored loops
    - i. Request to exit (REX) devices (typically integrated into the door hardware)
    - j. RFID badge printer (optional)
  4. Typical installation includes software, door controller, card reader, door sensor, request to exit (REX)-~~sensor~~ and electrified door hardware~~a-surface-mounted-electric-strike designed-to-accommodate-existing-panic-hardware. Typical installations require bored doors and power transfer~~ ~~For doors with electrified lockset have bored doors and electric power transfer hinges see section-~~(see 08 71 00 – Door Hardware for more information).

5. All installations with network connectivity shall utilize District's network and be managed by the District's Avigilon ACM Enterprise system.
6. Access control hardware shall continue to fully function in the event of communication loss to the central server.
7. Power to control panels shall be hardwired in conduit.
8. All door controllers shall have battery backup.

### 1.03 RELATED REQUIREMENTS

- A. Division 01 – General Requirements
- B. Section 08 71 00 – Door Hardware
- C. Section 27 00 00 - Communications
- D. Section 27 05 00 – Common Work Results for Communication Systems.
- E. Section 27 10 00 – Structured Cabling
- F. Americans with Disability Act (ADA)

### 1.04 REFERENCES

- A. See section 27 00 00 for requirements.

### 1.05 DEFINITIONS

- A. See section 27 00 00 for requirements.

### 1.06 SYSTEM REQUIREMENTS

- A. Any new installations or existing system modifications shall seamlessly integrate into the site's existing Access Control systems and integrate into the Districts Avigilon ACM Enterprise installation.

### 1.07 SUBMITTALS

- A. See section 27 00 00 for requirements.

### 1.08 CONTRACTOR "SHOP DRAWINGS" DESIGN REQUIREMENTS

- A. See section 27 00 00 for requirements.
- B. Shop drawings are required for this section.

#### 1.09 QUALIFICATIONS

- A. Contractor shall be located within 50 miles or less from the project site to support 2-hour response time.
- B. Five (5) years' experience installing communications equipment systems.

#### 1.10 CERTIFICATIONS

- A. See section 27 00 00 for requirements.

#### 1.11 WORKMANSHIP

- A. Quality workmanship is a high priority for the District and the Contractor shall be held to a high-level of professional workmanship.
- B. The District's Project or Construction Manager will have the authority to reject Work which does not conform to the Drawings and Specifications.
- C. The Contractor shall c~~C~~omply with highest industry standards, except when specified requirements indicate more rigid standards or more precise workmanship.
- D. The Contractor shall p~~P~~erform the w~~W~~ork with persons experienced and qualified to produce workmanship specified.
- E. The Contractor shall m~~M~~aintain quality control over suppliers and Subcontractors.
- F. The Contractor shall be responsible for scheduling Subcontractors in a timely fashion.

#### 1.12 WARRANTY

- A. Refer to Division 01 Warranty section.
- B. See section 27 00 00 for additional requirements.

#### 1.13 CLOSEOUT DOCUMENTS

- A. See section 27 00 00 for requirements.

**PART 2 - PRODUCTS****2.01 GENERAL**

- A. Manufacturers - See Appendix A at the end of this document for pre-approved materials.
- B. All products shall be new, unused and without blemishes and shall be of manufacturer's current and standard production.
- C. Drawings and Specifications indicate major system components, and may not show every component, connector, module, or accessory that may be required to support the operation specified. The Contractor shall provide all components needed for complete and satisfactory installation and operation.
- D. Product Availability
  - 1. The Contractor, prior to submitting a proposal, shall determine product availability and delivery time, and shall include such considerations into his proposed Contract Time.
  - 2. Subject to compliance with these specifications, products and systems included in this section are to be installed as specified by the manufacturer of the system or engineer approved equal.

**2.02 EQUIPMENT**

- A. See Appendix A at the end of this document for pre-approved materials.
- B. Substitutions require proof of equivalence and prior approval by District and/or ~~it's~~sits representative before ordering.
- C. Whenever possible and required the request to exit functionality shall be integrated into the door hardware.
- D. Electrified latch hardware shall be compatible with panic hardware and be "rim" style.
- E. Panel cabinets shall have key locks.
- F. The contractor shall furnish at least 100 RFID cards serialized per the District's standards. Middle Schools and High Schools to receive 200 RFID cards.

2.03 EXTRA STOCK

A. For each increment of 100 controlled doors furnish:

1. Quantity 5 of current model door controller.
2. Quantity 57 of current model card reader.



**PART 3 - EXECUTION****3.01 ACCEPTABLE INSTALLERS**

- A. The equipment shall only be installed by Contractors who are qualified to install and maintain the system.
- B. The Contractor (or subcontractor listed at time of bid) must have at least five (5) years' experience installing electronic access control equipment before the Bid Opening Date.

**3.02 EXAMINATION**

- A. The Contractor shall be required to visit the installation site(s) prior to bidding the job. The Contractor acknowledges that the failure to visit the site(s) will not relieve the Contractor of the responsibility for observing and considering those conditions which a Contractor would have observed and considered during a site visit, estimating properly the difficulty and cost of successfully performing the Work or proceeding to perform the Work without additional cost to District.
- B. The Contractor shall report any discrepancies between the Specifications, Drawings, and Site Examination prior to the Bid Opening Date.

**3.03 PREPARATION**

- A. The Contractor shall verify materials are readily available prior to submitting product submittals and notify the District's Project Manager of long lead time items.
- B. The Contractor shall order all required parts and equipment only after receipt of approved product submittals from the District's Project Manager.
- C. Submit and receive ~~approval~~approval of shop drawings prior to work commencement.

**3.04 PATHWAY INSTALLATION**

- A. New Construction:
  - 1. Install 3/4" EMT in wall from hollow door frame to double-gang mud-ring and deep 4" Sq. back box on interior latch side above door frame at 96" AFF to top of box to accessible ceiling space or continuous conduit to nearest IDF.
  - 2. Install on the exterior latch side of the door a single-gang mud-ring and back box for exterior card reader at 48" AFF to top of box. Route EMT conduit to above door 4"-Sq. j-box.
- B. Existing Construction:
  - 1. Refer to design documents.

2. Surface raceway and components shall be Wiremold 2300.

### 3.05 EQUIPMENT INSTALLATION

- A. Power supplies and electric strike to use 24VDC and 16AWG wire.
- B. Power supplies shall be centrally located in the nearest MDF/IDF.
- C. Equipment to be wired and installed per the manufacturer's instructions.
- D. Door controllers to be installed in nearest MDF/IDF unless noted otherwise on design documents.
- E. Devices requiring POE power shall be connected to a POE switch in the nearest MDF/IDF data rack – verify with Electronics/Lock Shop for available PoE.
- F. All wiring in enclosure shall have 12" minimum service loop for troubleshooting/repairs.
- G. All shielded wiring to have shields grounded at the upstream end only. Floating shields is strictly prohibited.
- H. Data drops to be installed inside the controller panel cabinet.

### 3.06 LABELING/SCHEDULES

- A. All labels are to be machine generated black letters on white adhesive label stock that is appropriate for the installation environment (interior/exterior).
- B. Device ID Labels are to be 1/4" lettering for mounting heights 10' AFF or less, 1/2" black lettering on white labels for mounting heights greater than 10' AFF.
- C. Access Control Panel/Cabinet label – Panel ID on exterior top right of panel door.
- D. Battery label – Install date.
- E. Wiring label – Panel ID-Panel Schedule-Door ID.
- F. Network Information label – MAC and IP address on interior top right of panel door.
- G. Network Cable Termination label - MDF/IDF-port number.
- H. Reader/Door schedule – A reader/door schedule and location drawing shall be printed and installed in a plastic sleeve inside the panel cover door.

### 3.09 CONFIGURATION

- A. Program all network equipment with network IP address information obtained from Electronics/Lock Shop.
- B. All equipment to be fully configured and tested for functionality prior to testing.

### 3.10 FIELD QUALITY CONTROL AND TESTING

- A. Upon reaching substantial completion, perform a complete test and inspection of the system. ~~If it is~~ found to be installed and operating properly, notify District of your readiness to perform the formal Test & Inspection of the complete system.
- B. Submit the Record Drawings (as-builts) to District for review prior to inspection.
- C. During the formal Test & Inspection (Commissioning) of the system the Contractor shall have personnel available with tools and equipment to inspect wiring, devices, and system operation.
- D. If corrections are needed, the Contractor will be provided with a Punch-List of all discrepancies. Perform the needed corrections in a timely fashion.
- E. Notify the District when ready to perform a re-inspection of the installation.
- F. The District or its representative to provide final sign-off for acceptance.

### 3.11 AS-BUILT DRAWINGS

- A. See section 27 00 00 for requirements.
- B. As-built riser diagram showing all access control components for site.

## APPENDIX A – Pre-Approved Materials

| DESCRIPTION                                         | MFG                                            | PART NUMBER                                                      |
|-----------------------------------------------------|------------------------------------------------|------------------------------------------------------------------|
| Door Controller (1-door)                            | Avigilon/ <u>Mercury</u>                       | AC-MER-CONT-LP1501/ <u>LP1501</u>                                |
| Door Controller (2-door)                            | Avigilon/ <u>Mercury</u>                       | AC-MER-CONT-LP1502/ <u>LP1502</u>                                |
| Door Controller (1-door/slave PoE )                 | Avigilon/ <u>Mercury</u>                       | AC-MER-CON-MR62E/ <u>MR62e</u>                                   |
| 2-Reader Interface Module                           | Avigilon/ <u>Mercury</u>                       | AC-MER-CON-MR52/ <u>MR52-S3</u>                                  |
| Card Reader, (OSDP version)                         | Schlage                                        | MT15, (MT15-485)                                                 |
| Card Reader/Mullion, (OSDP version)                 | Schlage                                        | MT11, (MT11-485)                                                 |
| Power Supply/Cabinet (2 Door)                       | Avigilon/ <u>LifeSafety Power</u>              | AC-LSP-2DR-MER-LCK                                               |
| Power Supply/Cabinet (8 Door)                       | Avigilon/ <u>LifeSafety Power</u>              | AC-LSP-8DR-MER-LCK                                               |
| <u>Power Supply/Cabinet (16 Door)</u>               | <u>Avigilon/LifeSafety Power</u>               | <u>AC-LSP-16DR-MER-LCK</u>                                       |
| Video Intercom                                      | Avigilon                                       | 3.0C-H4VI-RO1-IR                                                 |
| Electronic Surface Strike (Rim Style)               | Assa Abloy/HES                                 | 9600                                                             |
| Electronic Strike (Door Frame)                      | Assa Abloy/HES                                 | 8000C-630<br>805 Faceplate (Wood Frames)                         |
| Electronic Latch Set (Cylindrical)                  | Schlage                                        | ND96EUPD                                                         |
| Latch Retraction Motor (Von Duprin) <u>with REX</u> | Von Duprin                                     | QEL-RX                                                           |
| Power Transfer                                      | Von Duprin                                     | EPT-10                                                           |
| Door Position Switch                                | George Risk Industries, Inc.<br><u>Resideo</u> | 195-12WG<br><u>7939WG-BR</u>                                     |
| Battery 12VDC, 8AH                                  | ELK, Powersonic                                | ELK-1280, PS-1280                                                |
| Proximity Cards                                     | Schlage                                        | 8543 - Serialized per District Requirements Via Schlage CardTrax |
| Armored Door Loop                                   | SECO-LARM                                      | SD-969-M15Q/S                                                    |

END OF SECTION

## SECTION 28 20 00

## VIDEO SURVEILLANCE

All Users and Designers! This page is for your information only to provide information on the latest update to this specification so that you don't ~~have~~ to traipse line by line looking for the last edit. Please delete this page prior to issuance.

09/30/2022 – Initial Section creation/edits

01/09/2023 – Appendix A updates

02/28/2023 – Edits from meetings with District

04/04/2023 – Update Camera P/N

06/20/2023 – Updated Camera P/N

11/12/2024 – add 2-sensor camera

01/31/2025 – Updates to Appendix A

## DISTRICT DESIGN STANDARDS

All Users and Designers! The information shown below ~~are~~ provided by the District to convey the District's thought process on manufacturers, products, procedures, etc. These items are to assist the design team with understanding what to use as part of the design along with those items that the District does not want to be installed or used on their school sites. Please delete this page prior to issuance.

Designer to evaluate:

1. Existing analog camera ~~install~~ installation for potential replacement with IP cameras.
2. Existing network video recorder (NVR) available capacity and provide upgrades if required.
3. Network switch power over ethernet (PoE) available capacity and provide upgrades if required.
4. Lighting at proposed camera location for modification/add coordination with Electrical.
5. Existing low-voltage pathway and provide upgrades if required.

## SECTION 28 20 00

## VIDEO SURVEILLANCE

**PART I - GENERAL****1.01 SUMMARY**

- A. This section specifies software, equipment, accessories, wire, materials, installation, configuration, and testing requirements for a complete and operable Video Surveillance system. The system shall provide electronic recording/playback and monitoring of digital cameras installed at the site.

**1.02 SCOPE**

- A. The work will include but not be limited to the following objectives:
  - 1. Labor and Materials: The Contractor shall provide and pay for all labor, supervision, materials, accessories, wire, components, equipment, tools, transportation, and other facilities and services necessary for the proper installation of a turn-key Video Surveillance system to District.
- A. The CCTV system shall have the following minimum requirements.
  - 1. Cameras
    - a. Weather resistant IP67 or greater (exterior only)
    - b. Network/IP based
    - c. PoE powered
    - d. 5MP or 4K resolution
    - e. H.265 video compression
    - f. Day/night with IR illumination
    - g. Motion detection
    - h. ONVIF
  - 2. Network Video Recorder
    - a. Network/IP based
    - b. H.265 video compression
    - c. RAID 5 or greater
    - d. Record on motion detection
    - e. 30+ day recording
  - C. Software
    - a. PC and Mobile viewing
    - b. View live and recorded video
    - c. Search
    - d. Save video to MP4 format
    - e. Notifications

### 1.03 RELATED REQUIREMENTS

- A. Division 01 - General Requirements
- B. Section 27 00 00 - Communications
- C. Section 27 05 00 - Common Work Results for Communication Systems.
- C. Section 27 10 00 - Structured Cabling

### 1.04 QUALIFICATIONS

- A. Contractor shall be located within 50 miles or less from the project site to support 2-hour response time.
- B. Five years' experience installing Video Surveillance equipment systems.

### 1.05 SYSTEM REQUIREMENTS

- A. Any new installations or existing system modifications shall seamlessly integrate into the site's existing Video Surveillance system.

### 1.06 CONTRACTOR "SHOP DRAWINGS" DESIGN REQUIREMENTS

- A. See section 27 00 00 for requirements.
- B. Shop drawings are required for this section

### 1.07 SUBMITTALS

- A. See section 27 00 00 for requirements.

### 1.08 WARRANTY

- A. Refer to Division 01 Warranty section.
- B. See section 27 00 00 for additional requirements.

### 1.09 CLOSEOUT DOCUMENTS

- A. See section 27 00 00 for requirements.

**PART 2 - PRODUCTS****2.01 GENERAL**

- A. See Appendix A at the end of this document for pre-approved materials.
- B. All products shall be new, unused and without blemishes and shall be of manufacturer's current and standard production.
- C. Drawings and Specifications indicate major system components, and may not show every component, connector, module, or accessory that may be required to support the operation specified. Contractor shall provide all components needed for complete and satisfactory installation/operation.
- D. Product Availability
  - 1. Contractor, prior to submitting a proposal, shall determine product availability and delivery time, and shall include such considerations into his proposed Contract Time.
  - 2. Subject to compliance with these specifications, products and systems included in this section are to be installed as specified by the manufacturer of the system or engineer approved equal.

**2.02 EQUIPMENT**

- A. The District's preferred manufacturer for CCTV equipment is i-Pro (formally Panasonic) for cameras and network video recorders (NVR).
- B. The District's preferred manufacturer for video intercom is Avigilon.
- C. Substitutions require proof of equivalence and approval by District and/or its representative.
- D. All exterior cameras to be IP67 rated or better.



**PART 3 - EXECUTION****3.01 ACCEPTABLE INSTALLERS**

- A. The equipment shall only be installed by Contractors who are qualified to install and maintain the system.
- B. The Contractor (or subcontractor listed at time of bid) must have at least five (5) years' experience installing Video Surveillance equipment before the Bid Opening Date.

**3.02 EXAMINATION**

- A. The Contractor shall be required to visit the installation site(s) prior to job bidding. The Contractor acknowledges that the failure to visit the site(s) will not relieve the Contractor of the responsibility for observing and considering those conditions which a Contractor would have observed and considered during a site visit, estimating properly the difficulty and cost of successfully performing the Work or proceeding to perform the Work without additional cost to District.
- B. The Contractor shall report any discrepancies between the Specifications, Drawings, and Site Examination prior to the Bid Opening Date.

**3.03 PREPARATION**

- A. The Contractor shall verify materials are readily available prior to submitting product submittals and notify the Project Manager of long lead time items.
- B. The Contractor shall order all required parts and equipment only after receipt of approved product submittals from the Project Manager.
- C. The Contractor shall coordinate with the District's Technology Services department for needed IP addresses at least 2 weeks prior to configuration/installation.

**3.04 SHOP DRAWINGS**

- A. The Contractor shall create "Shop Drawings" per section 27 00 00.

**3.05 WORKMANSHIP**

- A. Quality workmanship is a high priority for the District and the Contractor shall be held to a high-level of professional workmanship.
- B. The District's Project or Construction Manager will have the authority to reject Work which does not conform to the Drawings and Specifications.

- C. Comply with highest industry standards, except when specified requirements indicate more rigid standards or more precise workmanship.
- D. Perform Work with persons experienced and qualified to produce workmanship specified.
- E. Maintain quality control over suppliers and Subcontractors.

### 3.06 PATHWAY AND EQUIPMENT INSTALLATION

- A. Install all conduit and pathway per design documents. Refer to 27 05 00 for additional information/requirements.
- B. Install all Cat6/6A cables per design documents. Refer to Section 27 105 00 for additional information/requirements.
- B. Equipment to be installed per manufacturer's instructions.
- C. Devices requiring PoE power shall be connected to a PoE switch in the MDF/IDF data rack – verify with Technology Services for adequate PoE power capacity for available PoE power.

### 3.07 CONFIGURATION

- A. Program cameras and/or NVR with network IP address using the following scheme.  
Note: x=site octet, contact District Electronics shop for site information.
  - 1. Cameras: 10.x.253.101 = Camera 1, 10.x.253.102 = Camera 2...
  - 2. NVR: 10.x.253.54
  - 3. POE Switch: 10.x.253.10 = 1<sup>st</sup> switch, 10.x.253.11 = 2nd switch...
  - 4. Gateway: 10.x.0.1
  - 5. Subnet Mask: 255.255.0.0
- B. All equipment to be fully configured and tested for functionality prior to District acceptance testing.

### 3.08 CAMERA VIEW

- A. Adjust view aim, zoom and focus camera to show intended view from design documents.

### 3.09 FIELD QUALITY CONTROL AND TESTING

- A. Upon completion of network programming and initial view setting, notify District of your readiness to perform the formal camera view review with District or its representative. Make all adjustments required from District review.
- B. Submit the Record Drawings (as-builts) to District for review prior to inspection.

- C. During the formal Test & Inspection (Commissioning) of the system, Contractor to have personnel available with tools and equipment to inspect wiring, devices, and system operation.
- D. If corrections are needed, the Contractor will be provided with a Punch-List of all discrepancies. Perform the needed corrections in a timely fashion.
- E. Notify the District when ready to perform a re-inspection of the installation.

### 3.10 AS-BUILT DRAWINGS

- A. See section 27 00 00 for requirements.

APPENDIX A – Pre-Approved Materials

## VIDEO SURVEILLANCE:

| DESCRIPTION                                                                                                                           | MFG.        | PART NUMBER          |
|---------------------------------------------------------------------------------------------------------------------------------------|-------------|----------------------|
| Network Video Recorder 48TB                                                                                                           | i-PRO       | NVR-RL-2-48TB-V3     |
| NVR license                                                                                                                           | i-PRO       | ASM-300              |
| Network Dome Camera, Outdoor, Vandal-Resistant, 5MP with Base Bracket                                                                 | i-PRO       | WV-S25500-V3LG2552L  |
| Network Dome Camera, Indoor, 5MP with Base Bracket                                                                                    | i-PRO       | WV-S22500-V3L        |
| Network Multi-Directional Camera, Outdoor (3x4MP Sensors)                                                                             | i-PRO       | WV-S8543LG           |
| Network Multi-Directional Camera, Outdoor (4x4MP Sensors) Network Camera, Outdoor 360-degree, Vandal Resistant, 5MP with Base Bracket | i-PRO i-PRO | WV-S4551L WV-S8544LG |
| Pendant Wall Mount Kit                                                                                                                | i-PRO       | PWM485S              |
| Pendant Corner Mount Kit                                                                                                              | i-PRO       | PCM485S              |
| Pendant Pole Mount Kit                                                                                                                | i-PRO       | PPM485S              |
| Wall Mount Bracket                                                                                                                    | i-PRO       | WV-QWL500-W          |
| Back Box                                                                                                                              | i-PRO       | WV-QJB500-W          |
| Corner Bracket                                                                                                                        | i-PRO       | WV-QCN500-W          |
| Sunshade                                                                                                                              | i-PRO       | WV-QSR500-W          |
| Dome Cover                                                                                                                            | i-PRO       | WV-CW7SN             |
| 2 RU Din Rack Mount Adapter                                                                                                           | Antaira     | DIN-Rack-2U          |
| 240W Power Supply                                                                                                                     | Antaira     | NDR-240              |
| 960W Power Supply                                                                                                                     | Antaira     | SDR-960-48           |
| 10-Port Industrial Gigabit PoE+ Managed Ethernet Switch                                                                               | Antaira     | LMP-1002G-SFP        |
| 20-Port Industrial Gigabit PoE+ Managed Ethernet Switch                                                                               | Antaira     | LMP-2004G-SFP        |
| 28-Port Industrial Gigabit PoE+ Switch 1RU                                                                                            | Antaira     | LNP-2804GN-SFP-T     |
| Gigabit Ethernet Single Mode Transceiver                                                                                              | Antaira     | SFP-S10-T            |
| Video Intercom                                                                                                                        | Avigilon    | 3-0C-H4VI-RO1-IR     |
| DESCRIPTION                                                                                                                           | MFG.        | PART NUMBER          |
| Network Video Recorder (96TB)                                                                                                         | i-PRO       | NVR-RL-2-96TB-V4     |
| NVR License (i-PRO Management Software)                                                                                               | i-PRO       | WV-ASM300            |
| Network Dome Camera, Indoor, 5MP                                                                                                      | i-PRO       | WV-S22500-V3L        |
| Network Multi-Directional Camera Dual Sensor, Outdoor (2x4MP Sensors)                                                                 | i-PRO       | WV-U85402-V2L        |
| Network Dome Camera, Outdoor, Vandal Resistant, 5MP                                                                                   | i-PRO       | WV-S25500-V3L        |
| Wall Mount Bracket for Dome Camera (Outdoor)                                                                                          | i-PRO       | WV-QJB501-W          |
| Ceiling Mount Bracket for Dome Camera (Outdoor)                                                                                       | i-PRO       | WV-QJB504-W          |
| Sunshade for Dome Camera (Outdoor)                                                                                                    | i-PRO       | WV-QSR505-W          |
| Smoked Dome Cover for Dome Camera (Outdoor)                                                                                           | i-PRO       | WV-CW7SN             |
| Network Dual Sensor Camera, Outdoor (2x4MP Sensors)                                                                                   | i-PRO       | WV-U85402-V2L        |
| Network Multi-Directional Camera, Outdoor (3x4MP Sensors)                                                                             | i-PRO       | WV-S8543L            |
| Network Multi-Directional Camera, Outdoor (4x4MP Sensors)                                                                             | i-PRO       | WV-S8544L            |
| Wall Mount Bracket for Dual Sensor and Multi-Directional Cameras                                                                      | i-PRO       | WV-QWL501-W          |
| Wall Mount Bracket Adapter for Dual Sensor Camera                                                                                     | i-PRO       | WV-QSR507-W          |
| Wall Mount Bracket Adapter for Multi-Directional Cameras                                                                              | i-PRO       | WV-QSR503-W          |

|                                                                                  |                          |                                  |
|----------------------------------------------------------------------------------|--------------------------|----------------------------------|
| <a href="#">Ceiling Mount Bracket for Multi-Directional Camera</a>               | <a href="#">i-PRO</a>    | <a href="#">WV-QJB503-W</a>      |
| <a href="#">Pole Mount Bracket for Cameras</a>                                   | <a href="#">i-PRO</a>    | <a href="#">WV-QPL500-W</a>      |
| <a href="#">Corner Mount Bracket for Cameras</a>                                 | <a href="#">i-PRO</a>    | <a href="#">WV-QCN500-W</a>      |
| <a href="#">24-port SFP+ Managed Aggregation Network Switch</a>                  | <a href="#">Aruba</a>    | <a href="#">JL658A</a>           |
| <a href="#">250W Power Supply for Aruba Network Switch (JL658A)</a>              | <a href="#">Aruba</a>    | <a href="#">JL085A</a>           |
| <a href="#">24-Port Gigabit PoE+ Managed Network Switch</a>                      | <a href="#">Aruba</a>    | <a href="#">R8Q68A</a>           |
| <a href="#">1050W Power Supply for Aruba Network Switch (R8Q68A)</a>             | <a href="#">Aruba</a>    | <a href="#">JL087A</a>           |
| <a href="#">10G SFP+ LC-LR SMF Transceiver for Aruba Network Switches</a>        | <a href="#">Aruba</a>    | <a href="#">J9151E</a>           |
| <a href="#">10GBASE-T SFP+ RJ45 Cat6A Transceiver for Aruba Network Switches</a> | <a href="#">Aruba</a>    | <a href="#">JL563B</a>           |
| <a href="#">2 RU Din Rack Mount Adapter</a>                                      | <a href="#">Antaira</a>  | <a href="#">DIN-Rack-2U</a>      |
| <a href="#">35mm Steel DIN-Rail Track (10")</a>                                  | <a href="#">Antaira</a>  | <a href="#">DIN-RAIL-10</a>      |
| <a href="#">35mm Steel DIN-Rail Track (20")</a>                                  | <a href="#">Antaira</a>  | <a href="#">DIN-RAIL-20</a>      |
| <a href="#">240W Power Supply</a>                                                | <a href="#">Antaira</a>  | <a href="#">NDR-240</a>          |
| <a href="#">480W Power Supply</a>                                                | <a href="#">Antaira</a>  | <a href="#">SDR-480-48</a>       |
| <a href="#">10-Port Industrial Gigabit PoE+ Managed Ethernet Switch</a>          | <a href="#">Antaira</a>  | <a href="#">LMP-1002G-SFP</a>    |
| <a href="#">20-Port Industrial Gigabit PoE+ Managed Ethernet Switch</a>          | <a href="#">Antaira</a>  | <a href="#">LMP-2004G-SFP</a>    |
| <a href="#">28-Port Industrial Gigabit PoE+ Switch 1RU</a>                       | <a href="#">Antaira</a>  | <a href="#">LNP-2804GN-SFP-T</a> |
| <a href="#">Gigabit Ethernet-Single Mode Transceiver</a>                         | <a href="#">Antaira</a>  | <a href="#">SFP-S10-T</a>        |
| <a href="#">Video Intercom</a>                                                   | <a href="#">Avigilon</a> | <a href="#">3.0C-H4VI-RO1-IR</a> |

END OF APPENDIX A

END OF SECTION

SECTION 28 31 00  
INTRUSION DETECTION

REVISION SUMMARY

All Users and Designers! This page is for your information only to provide information on the latest update to this specification so that you don't have to traipse line by line looking for the last edit. Please delete this page prior to issuance.

09/30/2022 – Initial Section creation/edits

06/20/2023 – Updates to Appendix A

10/24/2023 – Update Honeywell to Resideo

2/29/2024 – update Appendix A for wire

01/31/2025 – annual update. Update Appendix A for IP communicator

DISTRICT DESIGN STANDARDS

All Users and Designers! The information shown below is provided by the District to convey the District's thought process on manufacturers, products, procedures, etc. These items are to assist the design team with understanding what to use as part of the design along with those items that the District does not want to be installed or used on their school sites. Please delete this page prior to issuance.

09/30/2022 – Designer to evaluate:

1. Existing system capacity

01/31/2025 – Designer to evaluate:

1. District is evaluating Bosch as an approved product line – confirm with District for product selection.

SECTION 28 31 00  
INTRUSION DETECTION

**PART I - GENERAL****1.01 SUMMARY**

- A. This section specifies equipment, accessories, materials, wire, installation, configuration, and testing requirements for a complete and operable electronic Intrusion Detection system. The system shall provide intrusion alarm notification, monitoring, command and control and be connected to the District's existing UL listed monitoring station.

**1.02 SCOPE**

- A. The work will include but not be limited to the following objectives:
1. Labor and Materials: The Contractor shall provide and pay for all labor, supervision, materials, accessories, components, equipment, tools, transportation, and other facilities and services necessary for the proper installation of a turn-key Intrusion Detection system to the District.
  2. The contractor will coordinate with the District in writing for any needed information (i.e. IP addresses, etc.) at least 2 weeks prior to date the information is needed.
  3. Intrusion detection equipment: Includes, but is not limited to:
    - a. Control panels
    - b. Keypads
    - c. Motion detectors
    - d. Door contacts
    - e. Glass break detectors
    - f. Monitor modules
    - g. Wire
  4. Typical installation includes a central control panel and keypad with distributed motion detection and/or door contacts for rooms requiring intrusion detection.
  5. All installations with network connectivity shall utilize District's network.
  6. All control panels shall have battery backup.

**1.03 RELATED REQUIREMENTS**

- A. Division 01 – General Requirements

B. Section 27 00 00 - Communications

C. Section 27 05 00 – Common Work Results for Communication Systems.

D. Section 27 10 00 – Structured Cabling

**1.04 REFERENCES**

A. See section 27 00 00 for requirements.

**1.05 DEFINITIONS**

A. See section 27 00 00 for requirements.

**1.06 SYSTEM REQUIREMENTS**

A. Any new installations or existing system modifications shall seamlessly integrate into the site's existing Intrusion Detection system.

**1.07 SUBMITTALS**

A. See section 27 00 00 for requirements.

**1.08 CONTRACTOR "SHOP DRAWINGS" DESIGN REQUIREMENTS**

A. See section 27 00 00 for requirements.

**1.09 QUALIFICATIONS**

A. Contractor shall be located within 50 miles or less from the project site to support 2-hour response time.

B. Five (5) years' experience installing communications equipment systems.

**1.10 CERTIFICATIONS**

A. See section 27 00 00 for requirements.

**1.11 WORKMANSHIP**

A. Quality workmanship is a high priority for the District and the Contractor shall be held to a high-level of professional workmanship.



- B. The District's Project or Construction Manager will have the authority to reject Work which does not conform to the Drawings and Specifications.
- C. The Contractor shall comply with highest industry standards, except when specified requirements indicate more rigid standards or more precise workmanship.
- D. The Contractor shall perform the work with persons experienced and qualified to produce workmanship specified.
- E. The Contractor shall maintain quality control over suppliers and Subcontractors.
- F. The Contractor shall be responsible for scheduling Subcontractors in a timely fashion.

**1.12 WARRANTY**

- A. Refer to Division 01 Warranty section.
- B. See section 27 00 00 for additional requirements.

**1.13 CLOSEOUT DOCUMENTS**

- A. See section 27 00 00 for requirements.

**PART 2 - PRODUCTS****2.01 GENERAL**

- A. Manufacturers - See Appendix A at the end of this document for pre-approved materials.
- B. All products shall be new, unused and without blemishes and shall be of manufacturer's current and standard production.
- C. Drawings and Specifications indicate major system components, and may not show every component, connector, module, or accessory that may be required to support the operation specified. The Contractor shall provide all components needed for complete and satisfactory installation and operation.
- D. Product Availability
  - 1. Contractor, prior to submitting a proposal, shall determine product availability and delivery time, and shall include such considerations into his proposed Contract Time.
  - 2. Subject to compliance with these specifications, products and systems included in this section are to be installed as specified by the manufacturer of the system or engineer approved equal.

**2.02 EQUIPMENT**

- A. See Appendix A at the end of this document for pre-approved materials.
- B. Substitutions require proof of equivalence and prior approval by District and/or its representative before ordering.
- C. The control panel cabinet shall have a key lock.
- D. The control panel cabinet shall have backup batteries.

**PART 3 - EXECUTION****3.01 ACCEPTABLE INSTALLERS**

- A. The equipment shall only be installed by Contractors who are qualified to install and maintain the system.
- B. The Contractor (or subcontractor listed at time of bid) must have at least five (5) years' experience installing electronic intrusion detection equipment before the Bid Opening Date.

**3.02 EXAMINATION**

- A. The Contractor shall be required to visit the installation site(s) prior to bidding the job. The Contractor acknowledges that the failure to visit the site(s) will not relieve the Contractor of the responsibility for observing and considering those conditions which a Contractor would have observed and considered during a site visit, estimating properly the difficulty and cost of successfully performing the Work or proceeding to perform the Work without additional cost to District.
- B. The Contractor shall report any discrepancies between the Specifications, Drawings, and Site Examination prior to the Bid Opening Date.

**3.03 PREPARATION**

- A. The Contractor shall verify materials are readily available prior to submitting product submittals and notify the District's Project Manager of long lead time items.
- B. The Contractor shall order all required parts and equipment only after receipt of approved product submittals from the District's Project Manager.
- C. The Contractor shall submit and receive approval for submitted shop drawings prior to work commencement.

**3.04 PATHWAY INSTALLATION**

- A. See Division 26 and Section 27 05 00 for requirements and more information.
- B. Existing Construction:
  - 1. Refer to design documents.
  - 2. Surface raceway and components shall be Wiremold 2300.

**3.05 EQUIPMENT INSTALLATION**

- A. Equipment to be wired and installed per the manufacturer's instructions.

- B. All wiring in enclosure shall have 12" minimum service loop for troubleshooting/repairs.
- C. All shielded wiring to have shields grounded at the upstream end only. Floating shields are strictly prohibited.
- D. Data drops to be installed inside the controller panel cabinet.

### **3.06 LABELING/SCHEDULES**

- A. All labels are to be machine generated black letters on white adhesive label stock that is appropriate for the installation environment (interior/exterior).
- B. Device ID Labels are to be 1/4" lettering for mounting heights 10' AFF or less, 1/2" black lettering on white labels for mounting heights greater than 10' AFF.
- C. Intrusion Control Panel/Cabinet label – Panel ID on exterior top right of panel door.
- D. Battery label – Install date.
- E. Wiring label – Panel, ID-Zone/Circuit.
- F. Network Information label – MAC and IP address on interior top right of panel door.
- G. Network Cable Termination label - MDF/IDF-port number.
- H. Zone schedule – A zone schedule and device location drawing shall be printed and installed in a plastic sleeve inside the panel cover door.

### **3.09 CONFIGURATION**

- A. Program all network equipment with network IP address information obtained from Technology Services.
- B. All equipment to be fully configured and tested for functionality prior to testing.

### **3.10 FIELD QUALITY CONTROL AND TESTING**

- A. Upon reaching substantial completion, the Contractor shall perform a complete test and inspection of the system. If found to be installed and operating properly, the Contractor shall notify District of your readiness to perform the formal Test & Inspection of the complete system.

- B. Submit the Record Drawings (as-builts) to District for review prior to inspection.
- C. During the formal Test & Inspection (Commissioning) of the system, the Contractor shall have personnel available with tools and equipment to inspect wiring, devices, and system operation.
- D. If corrections are needed, the Contractor will be provided with a Punch-List of all discrepancies. Perform the needed corrections in a timely fashion.
- E. The Contractor shall notify the District when ready to perform a re-inspection of the installation.
- F. The District or its representative to provide final sign-off for acceptance.

**3.11 AS-BUILT DRAWINGS**

- A. See section 27 00 00 for requirements.
- B. As-built riser diagram showing all components for project.

## APPENDIX A – Pre-Approved Materials

| DESCRIPTION                             | MFG                                     | PART NUMBER           |
|-----------------------------------------|-----------------------------------------|-----------------------|
| Intrusion Control Panel                 | Resideo                                 | Vista-250BPT          |
| Transformer                             | Ademco                                  | 1361                  |
| IP Enterprise Communicator              | Honeywell                               | 7847i-E               |
| Keypad                                  | Resideo                                 | 6160                  |
| Motion Detector (V-Plex)                | Resideo                                 | IS3050A-SN            |
| Monitor Module (V-Plex)                 | Resideo                                 | 4193SNP               |
| Glass-Break Sensor (V-Plex)             | Resideo                                 | 4FG1625SN             |
| Horn                                    | Resideo                                 | 748                   |
| Swivel                                  | DSC                                     | DM-W                  |
| Door Position Switch (metal door/frame) | George Risk Industries, Inc.<br>Resideo | 195-12WG<br>7939WG BR |
| Door Position Switch (surface)          | George Risk Industries, Inc.            | 29A                   |
| Roll-up Door Contact                    | George Risk Industries, Inc.            | 4532                  |
| Battery 12VDC, 8AH                      | ELK, Powersonic                         | ELK-1280, PS-1280     |
| Cable, 18-2, Interior, White            | West Penn                               | 224                   |
| Cable, 18-2, OSP                        | West Penn                               | AQ-224                |
| Cable, 18-4 Interior, Gray              | West Penn                               | 244                   |
| Cable, 18-2, OSP                        | West Penn                               | AQ-244                |

END OF SECTION

SECTION 28 46 00  
FIRE DETECTION AND ALARM

REVISION SUMMARY

All Users and Designers! This page is for your information only to provide information on the latest update to this specification so that you don't have to traipse line by line looking for the last edit. Please delete this page prior to issuance.

09/30/2022 – Initial Section creation/edits

01/09/2023 – Updated Appendix A

06/20/2023 – Updated Appendix A

01/31/2025 – Updated Appendix A, added Bosch B465

DISTRICT DESIGN STANDARDS

All Users and Designers! The information shown below is provided by the District to convey the District's thought process on manufacturers, products, procedures, etc. These items are to assist the design team with understanding what to use as part of the design along with those items that the District does not want to be installed or used on their school sites. Please delete this page prior to issuance.

09/30/2022 - Designer to evaluate:

1. Existing low-voltage pathway and provide upgrades if required.

09/30/2022 - Designer to include:

1. Emergency Voice/Alarm Evacuation for all new construction and altered areas (See DSA IR F-1 for exclusions).
2. CO detection and audible/visible notification for areas with fuel burning appliances (See DSA IR 9-2 for more information).
3. District does not allow Beam Smoke detectors – use only spot type smoke detectors.

## SECTION 28 46 00

## FIRE DETECTION AND ALARM

**PART 1 – GENERAL****1.01 SUMMARY**

- A. This section specifies equipment, accessories, wire, materials, installation, configuration and testing requirements for a complete and operable Fire Detection and Alarm system. The system shall provide fire alarm detection, notification, monitoring, command, and control and be connected to the District's existing UL listed monitoring station. New construction shall be Emergency Voice Alarm Communication (EVAC) compliant.

**1.02 SCOPE**

- A. The installed Fire Alarm system shall comply with all requirements of currently adopted version of NFPA 72.
- B. Quality workmanship is a high priority for the District and the Contractor shall be held to a high-level of professional workmanship. Contractors unfamiliar with the District's standards shall familiarize themselves with the District's standards and requirements prior to beginning work.
- C. For new building construction on an existing campus – provide and install all components and accessories as outlined in the design documents for a complete and operable system that extends and seamlessly integrates into the existing campus' Fire Alarm system.
- D. For construction in existing buildings - provide and install all components and accessories as outlined in the design documents to modify the existing system while maintaining code compliance and to seamlessly integrate the new components into the existing campus' Fire Alarm system. Prior to beginning any work, the Contractor is responsible for identifying any existing system errors or faults and bring these issues to the attention of the District Project Manager.
- E. Labor and Materials: The Contractor shall provide and pay for all labor, materials, equipment, tools, utilities, construction equipment and machinery, transportation and other facilities and services necessary for the proper execution, operation, and completion of the Work
- F. Contractor shall furnish and install all new conduit/raceway and wire as indicated on the project drawings and/or as required to provide a turn-key system to the District.
- G. The Contractor shall be responsible for programming of all Fire Alarm Control Panel(s) (FACP) site wide.



- H. With one-week notice the Contractor shall coordinate with the District staff for monitoring connectivity.
- I. Prior to final programming the contractor shall review the proposed final system programming, functionality and expectations with the District project manager, and/or Designer/Engineer. If the system is programmed without approval, all subsequent requested programming changes by the District will be at the Contractor's expense.
- J. After completion of the installation and 100% pretest of the system, a satisfactory final test (compliant with NFPA 72 requirements) of the entire system shall be made in the presence of the inspector of record (IOR) and District or the District's representative.
- K. Provide District an electronic copy of final test results.
- L. Existing system shall remain operable until new system is accepted and approved by the IOR and the District or its representative.
- M. The Contractor is responsible for user/operator training (2 hours).
- N. The Contractor shall complete all required project closeout documentation in a timely fashion.
- O. A single speaker/strobe notification appliance may be used for both Fire alarm and CO detection notification. However, the device shall NOT have the word "FIRE" and requires a distinct temporal (3 or 4) coding with distinct voice notification (see DSA IR 9-2 for more information).

#### 1.03 RELATED REQUIREMENTS:

- A. Division 01 – General Requirements
- B. Division 26 – Electrical
- C. Section 27 00 00 – Communications
- D. Section 27 05 00 – Common Work Results for Communication Systems

#### 1.05 CODES AND STANDARDS:

- A. The installed system shall conform to all California State Codes
  - 1. 2022 California Building Code (CBC)

2. 2022 California Electrical Code (CEC)
  3. 2022 California Fire Code (CFC)
  4. All equipment shall have California State Fire Marshall listing(s)
  5. DSA IR 9-1 Emergency Voice/Alarm Communication Systems
  6. DSA IR 9-2 Carbon Monoxide Detection Requirements for Group E Classrooms and Group I-4 Occupancies
- B. National Fire Protection Association (NFPA) - USA:
1. 2020 NFPA 70 - National Electric Code (NEC)
  2. 2022 NFPA 72 - National Fire Alarm Code (NFPA 72)
  3. 2021 NFPA 101 - Life Safety Code (NFPA 101)
  4. Americans with Disabilities Act (ADA)
- C. Local building codes
- D. All requirements of the Authority Having Jurisdiction (AHJ)

#### 1.06 UNDERWRITERS LABORATORY (UL) LISTING

- A. All equipment shall be UL listed for its intended purpose.
- B. Any modification that voids the equipment's UL listing is strictly prohibited (i.e. relocated or oversize knock-outs).
- C. Any modified new equipment that voids the UL listing shall be replaced by the Contactor (parts and labor) at their expense.

#### 1.07 QUALIFICATIONS:

- A. The Contractor shall possess a California C10 license.
- B. The installing Contractor or Subcontractor shall be FACP manufacturer authorized to provide and install equipment with 5 years of documented experience.
- C. The programming technician shall possess a valid manufacturer's programming certification.
- D. The Contractor shall have at least one NICET certified in Fire Alarm Technology, level II (or greater) personnel as the on-site supervising technician who is always on site when Fire Alarm activities are taking place.
- E. The installation company and its subcontractors shall have an office located within 50 miles of the project site.

#### 1.07 REFERENCES

- A. See Section 27 00 00

#### 1.08 SYSTEM REQUIREMENTS

- A. Site Compatibility

1. Any new installations or modifications to an existing system shall seamlessly integrate into the site's existing Fire Alarm system.

#### 1.09 CONTRACTOR "SHOP DRAWINGS" DESIGN REQUIREMENTS

- A. See Section 27 00 00 for requirements.

#### 1.10 SUBMITTALS

- A. See Section 27 00 00 for requirements.
- B. Provide copies of certificates listed in the QUALIFICATIONS section above.

#### 1.11 WARRANTY

- A. Refer to Division 01 Warranty section.
- B. After the satisfactory completion letter has been received, a continuous and fault free thirty (30) day "burn-in" period shall begin. Any fault shall reset the "burn-in" period to zero (0). Warranty shall commence at day 31 of a successful and continuous "burn-in" period.

**PART 2 – PRODUCTS****2.01 EQUIPMENT AND MATERIAL, GENERAL:**

- A. The District preferred fire alarm control panel manufacturers are FireLite for Elementary and Notifier for Middle and High Schools.
- B. See Appendix A for pre-approved equipment listings.
- C. All products shall be new and unused and shall be of manufacturer's current and standard production.
- D. Where two or more equipment items of the same kind are provided, all shall be identical and provided by the same manufacturer.
- E. Drawings and Specifications indicate major system components, and may not show every component, connector, module, or accessory that may be required to support the operation specified. The Contractor shall provide all components needed for complete and satisfactory system operation.
- F. Product availability:
  - 1. Contractor, prior to submitting a proposal, shall determine product availability and delivery time, and shall include such considerations into his proposed Contract Time.
  - 2. Certain products specified may only be available through factory authorized dealers and distributors. The Contractor shall verify his ability to procure the products specified prior to submitting a proposal.
- G. In compliance with DSA IR 9-2 for CO Detection, in areas where CO detection is needed EVAC notification appliances will be utilized for Fire Alarm and Carbon Monoxide alerts, promoting a building wide evacuation. For this reason, interior notification appliances (Speaker/Strobes) shall not have the word "FIRE" on the device.

**2.02 CONDUIT AND RACEWAY**

- A. See Section 27 05 00 for conduit and raceway requirements.

**2.03 WIRE AND CABLE**

- A. Provide all new wire and cable required to install systems as indicated on design documents or approved shop drawings.

- B. Approved wire and cable manufacturer is West Penn, substitutions require prior approval.
- C. All cable shall be jacketed, and jacket color shall be red (OSP cable excluded). No THHN/THWN allowed.
- D. All cables shall be specifically designed for their intended use and install requirements (FPL, plenum, direct burial, aerial, etc.).
- E. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG solid for initiating device circuits and signaling line circuits, 12 AWG stranded for notification appliance circuits and 14 AWG stranded for emergency voice communication circuits. (Coordinate with wire schedule)

## 2.05 BATTERIES

- A. Shall be new 12-volt, sealed lead-acid type.
- B. Battery shall be sized according to calculations on design drawings.
- C. Approved battery manufacturer: Powersonic or approved equal

## 2.06 EXTRA STOCK:

- A. For projects with less than 10 new Fire Alarm devices – no extra stock required.
- B. For projects with 11 – 50 new Fire Alarm devices – provide extra stock of 1 (ea.) Smoke detector (current model), 1 (ea.) Heat detector (current model) and 1 (ea.) Pull station (current model)
- C. For projects over 50 new Fire Alarm devices – provide extra stock of 2 (ea.) Smoke detector (current model), 1 (ea.) CO detector (current model), 1 (ea.) Wall speaker/strobe (current model) and 1 (ea.) Ceiling speaker strobe (current model) per 100 Fire Alarm device increments.
- D. For projects over 300 new Fire Alarm devices – provide devices listed in sections C (above) plus 1 (ea.) Power Booster (current model)

**PART 3 – EXECUTION****3.01 INSTALLATION:**

- A. The installing company shall employ a minimum of one National Institute for the Certification in Engineering Technologies (NICET) Fire Alarm Systems, level II technician. To ensure system integrity, the NICET level II technician shall be on site during all fire system related work to guide the installation of conduit, back-boxes, device placement, device installation, programming, pre-testing, and final testing of the system.
- B. The District, Inspector of Record (IOR), Construction Manager or an agent of the District shall have the authority to stop work until the certified personnel requirement is met. The Contractor shall be held accountable for meeting completion dates.
- C. Installation shall be in accordance with the CBC, CEC, CFC, NFPA 72, local and national codes.
- D. Fire Alarm cables shall not be installed in decking flutes as pathway. Any conduit that needs to be located in decking flutes needs to be rigid.
- E. All Fire Alarm cables shall be run unexposed (not observable from occupiable space) throughout the entire cable path – either in conduit, on ladder racking, on j-hooks above ceilings or below flooring. Cable runs on j-hooks shall be perpendicular/parallel to building structure – no diagonal runs.
- F. All fire devices and panels shall be mounted at the height as indicated on the design plans and shall comply with local, CBC, CEC, CFC, and NFPA 72 codes and standards. Any code discrepancies shall be brought to the Designer/Engineer and Project Manager's attention.
- G. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place with fasteners and supports in accordance with drawings and specifications.
- H. Signal line circuits (SLC) for initiating devices shall be wired Class B.
- I. Notification appliance circuits (NAC) shall be wired Class B.
- J. CO detection to initiate a building wide evacuation in accordance with DSA IR 9-2.
- K. Smoke detectors shall remain covered until operational. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and/or physical damage and may require additional testing and/or replacement.
- L. All addressable smoke or heat devices shall have trim skirts.

- M. All modules with indicator lights (i.e., Monitor Modules & etc.) shall be mounted where the indicator lights are observable from the occupiable space.
- N. Smoke relief hatches are to have door contacts installed and monitored with a monitoring module. The opening of the hatch shall produce a Supervisory event notification. Monitoring module height is to be 10' AFF or less.
- O. Fire alarm circuits shall have a red breaker lock on device per NFPA 72 requirements.
- P. All modifications to electrical power shall be made by a licensed electrician.
- Q. Headend FACP and associated equipment layout per design documents. If no layout exists Contractor to notify and receive guidance from District or District's representative prior to install.
- R. All Duct Smoke Detector / Fire Smoke Damper shutdown to be coordinated with Div 23.

### 3.02 LABELING

- A. All labels are to be machine generated black letters on white adhesive label stock that is appropriate for the installation environment (interior/exterior).
- B. Device ID Labels are to be 1/4" lettering for mounting heights 10' AFF or less, 1/2" black lettering on white labels for mounting heights greater than 10' AFF.
- C. All panels and power supplies shall be labeled indicating AC electrical power panel and circuit breaker number and panel location.
- D. All panels and power supplies shall be identified per design plans.
- E. All smoke and heat detectors shall be labeled with Point ID affixed to the trim skirt. Labels are to be visible when approaching the device from the room entry.
- F. All modules are to be labeled with Point ID and function and/or associated equipment (i.e., FAN SHUTDOWN, HVAC UNIT XX, ATTIC HEAT, etc.)
- G. All notification devices shall be labeled with NAC Point ID.
- H. All cables in cabinets shall be labeled with function and circuit ID.
- I. All end-of-line devices shall have a "EOL" label.

3.03 PANEL PROGRAMMING/SOFTWARE MODIFICATION

- A. The contractor shall review the proposed system programming, functionality, expectations with the District or its representative 10 days prior to final programming.
- B. The Contractor shall provide the services of a factory trained, and authorized technician to perform all system software modifications, upgrades, or changes on site. No remote programming is allowed.
- C. The Contractor shall provide all hardware, software, programming tools and documentation necessary to modify the fire alarm system.
- D. Programming syntax shall be consistent with the existing site for label text and numbering scheme.

3.04 PRE-TESTING

- A. The entire system shall be checked and pre-tested by the Contractor and shall test free of all faults prior to calling for a final test.
- B. Before energizing the cables and wires, check for correct connections and test for open circuits, short circuits, ground faults, continuity, and any physical damage to the cable/wire insulation that may have occurred during installation.

3.05 TESTING AND GUARANTEE

- A. Upon completion of the installation of the system, a test consisting of 100% of all newly installed and 10% of existing relevant system components shall be performed to confirm operation and function. This test shall be done in the presence of the Inspector of Record (IOR) and the District or its representative.
- B. Provide the Project Manager with 7 days in advance written notice of system readiness for Final Testing and Inspection. The system shall be 100% pre-tested and fully operable with no trouble conditions prior to final test.
- C. Provide the service of a NICET level II technician to supervise and participate in all of the adjustments and/or testing of the system.
- D. Testing and adjustments
  - 1. Verify that all devices operate per Design documents matrix (matrices.)
  - 2. Verify the Point IDs and descriptions as indicated on the updated (redlined) Design Documents Floor Plan.



3. Verify the candela settings of all NAC devices with strobes.
4. Verify the intelligibility for all EVAC notification appliance speakers.
5. Verify and document that sound levels at all EVAC notification appliance speakers meet or exceeds the minimum sound levels as indicated in the design drawings for expected average ambient or maximum sound levels. Testing to be conducted using dBA setting, 5' above finished floor and 10' from speaker with a stand-alone meter (Galaxy Check Mate series or equal).
6. Contractor to adjust speaker wattage settings as required to meet sound levels required after testing.
7. Verify proper alarm and trouble of all sprinkler system flow valve(s).
8. Verify that an open circuit on the initiating device circuit activates a trouble signal locally for all circuits.
9. Verify that an open or a short circuit on the signaling line circuit activates a trouble signal locally for all circuits.
10. Verify that an open or short circuit on the notification appliance circuit activates a trouble signal locally for all circuits.
11. Verify that a ground condition on an initiating device circuit activates a trouble signal locally for all circuits.
12. Verify that a ground condition on a signaling line circuits activates a trouble signal locally for all circuits.
13. Verify that a ground condition on a notification appliance circuit activates a trouble signal locally for all circuits.

### 3.06 DEMOLITION

- A. See section 27 05 00, for requirements

### 3.07 FINAL DOCUMENT SUBMITTALS

- A. See section 27 00 00, for additional requirements
- B. Submit completed NFPA certification forms as found in NFPA 72. Forms shall be submitted in typewritten format.

- C. Provide District an electronic copy of final test results.
- D. Contractor “red-line as-built” drawings shall also include the following: The drawings shall depict, at a minimum, the following conditions:
  - 1. The device exact installed location.
  - 2. Device updated labeling ID(s), which shall match the physical label at the device.
  - 3. Revised risers to match record set point to point installation and
  - 4. Updated battery calculation with quantity of device changes.
  - 5. New pathways, conduit, ground boxes, junction boxes, raceway, power-poles and floor-monuments.
  - 6. Any other new conditions.
- E. The Contractor shall submit “red-line as-built” drawings as indicated on project schedule.
- F. Warranty:
  - 1. Refer to Division 01 Warranty section.
  - 2. After the satisfactory completion letter has been received, a continuous and fault free thirty (30) day “burn-in” period shall begin. Any fault shall reset the “burn-in” period to zero (0). Warranty shall commence at day 31 of a successful and continuous “burn-in” period.

## APPENDIX A – Pre-Approved Materials

| DESCRIPTION                     | MFG                      | PART NUMBER     |
|---------------------------------|--------------------------|-----------------|
| Fire Alarm Control Panel        | Fire-Lite                | ES-1000X 954-PT |
| Voice EVAC Control Panel        | Fire-Lite                | ECC-50/100      |
| Remote Fire Annunciator         | Fire-Lite                | LCD-80F         |
| Smoke Detector                  | Fire-Lite                | SD365           |
| Heat Detector (Rate of Rise)    | Fire-Lite                | H365R           |
| Heat Detector (Non-addressable) | System Sensor            | 5602            |
| CO Detector                     | Fire-Lite                | SD355CO         |
| Pull Station                    | Fire-Lite                | BG-12LX         |
| Monitor Module (Single)         | Fire-Lite                | MMF-300         |
| Monitor Module (Dual)           | Fire-Lite                | MDF-300         |
| Monitor Module (Mini)           | Fire-Lite                | MMF-301         |
| DACT                            | Fire-Lite                | DACT-UD2        |
| Remote Amplifier                | Fire-Lite                | ECC-50DA        |
| Remote Microphone               | Fire-Lite                | ECC-RM          |
| Booster Power Supply            | Fire-Lite                | FCPS-24FS6      |
| Horn/Strobe (Wall)              | System Sensor            | P2RL            |
| Horn/Strobe (Ceiling)           | System Sensor            | PC2RL           |
| Horn (Outdoor)                  | System Sensor            | HRK             |
| Speaker/Strobe (Wall)           | System Sensor            | SPSRL           |
| Speaker/Strobe (Ceiling)        | System Sensor            | SPSCRL          |
| Speaker (Outdoor)               | System Sensor            | SPRK            |
| Duct Smoke Detector             | System Sensor            | D4120           |
| Test Switch                     | System Sensor            | RTS-151-KEY     |
| Terminal/Barrier Strip          | Ideal Industries         | 89-608          |
| Dry Contact Input Relay         | Functional Devices, Inc. | RIB01BDC        |
| Fire Alarm Control Panel        | Notifier                 | NFS2-3030       |
| Voice EVAC Control Panel        | Notifier                 | NFC-50/100      |
| Smoke Detector                  | Notifier                 | FSP-951         |

|                                                        |                      |                 |
|--------------------------------------------------------|----------------------|-----------------|
| <b>Heat Detector (Rate of Rise)</b>                    | <b>Notifier</b>      | <b>FST-951</b>  |
| <b>CO Detector</b>                                     | <b>Notifier</b>      | <b>FSCO-951</b> |
| <b>Smoke/CO Detector</b>                               | <b>Notifier</b>      | <b>FCO-951</b>  |
| <b>Pull Station</b>                                    | <b>Notifier</b>      | <b>NBG-12LX</b> |
| <b>Monitor Module</b>                                  | <b>Notifier</b>      | <b>FMM-1</b>    |
| <b>Monitor Module (Mini)</b>                           | <b>Notifier</b>      | <b>FMM-101</b>  |
| <b>Control Relay</b>                                   | <b>Notifier</b>      | <b>FRM-1</b>    |
| <b>Isolator Module</b>                                 | <b>Notifier</b>      | <b>ISO-X</b>    |
| <b>Remote Power Supply</b>                             | <b>Notifier</b>      | <b>PSE-6</b>    |
| <b>Heat Detector (194°/Rate of rise, Conventional)</b> | <b>System Sensor</b> | <b>5602</b>     |
| <b>Universal Dual Path Communicator</b>                | <b>Bosch</b>         | <b>B465</b>     |

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- This specification section shall be tailored to meet the recommendations as set forth in the Geotechnical Report.
- Provide Engineered Fill Plan showing limits of subgrade prep/fill requirements.
- Specify earthwork requirements for all types of paving and building pad in this specification.
- Provide Soil Stabilization specification section 313200 if lime and/or cement treatment is required.

SECTION 31 00 00

EARTHWORK

**PART 1 - GENERAL**

1.01 SUMMARY

A. RELATED SECTIONS

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 01 50 00, Construction Facilities and Temporary Controls.
3. Section 01 57 13, Erosion Control
4. Section 31 23 33, Trenching and Backfilling.
5. Section 32 12 00, Asphalt Concrete Paving.
6. Section 32 16 00, Site Concrete.
7. Section 32 80 00, Irrigation.
8. Section 32 90 00, Landscaping.
9. Section 33 40 00, Site Drainage.
10. Section 31 32 00, Soil Stabilization

1.02 SUBMITTALS

- A. Refer to Section 01 33 00.
- B. Manufacturer's Data: Submit list and complete descriptive data of all products proposed for use. Include manufacturer's specifications, published warranty or guarantee, installation instructions, and maintenance instructions.

1.03 QUALITY ASSURANCE

- A. Use only new materials and products, unless existing materials or products are specifically shown otherwise on the Drawings to be salvaged and re-used.
- B. All materials, components, assemblies, workmanship and installation are to be observed by the Owner's Inspector of Record. Work not so inspected is subject to uncovering and replacement.
- C. The representatives of the Owner's testing lab will not act as supervisor of construction, nor will they

direct construction operations. Neither the presence of the Owner's testing lab representatives nor the testing by the Owner's testing lab shall excuse the contractors or subcontractors for defects discovered in their work during or following completion of the project. Correcting of inadequate compaction or moisture content is the sole responsibility of the contractor.

- D. Tests (See Part 3 for Compaction Testing).
- E. Contractor shall be solely responsible for all subgrades built. Failures resulting from inadequate compaction or moisture content are the responsibility of the contractor. Contractor shall be solely responsible for any and all repairs.

#### 1.04 WARRANTY

- A. Refer to General Conditions and Section 01 78 36.

#### 1.05 REFERENCES AND STANDARDS

- A. General: Site survey, included in the drawings, was prepared by \_\_\_\_\_, dated \_\_\_\_\_, and is the basis for data regarding current conditions. While the survey is deemed generally accurate, there exists discrepancies and variations due to elapsed time, weather, etc. Existing dirt grades may vary 0.2 ft. from that shown.
- B. Geotechnical Engineering Report was prepared by \_\_\_\_\_. Report is entitled \_\_\_\_\_, and is on file with Architect. Recommendations of the Geotechnical report were used to develop the contract plans and specifications. The Geotechnical report shall be used as a reference for the soil condition of the project site. The design information contained in the contract plans and specifications shall govern over the recommendation of the Geotechnical report.
- C. Site Visitation: All bidders interfacing with existing conditions shall visit the site prior to bid to verify general conditions of improvements. Discrepancies must be reported prior to the bid for clarification.
- D. ANSI/ASTM D698-e1 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)).
- E. ANSI/ASTM D1556-e1 - Test Method for Density of Soil in Place by the Sand-Cone Method.
- F. ANSI/ASTM 698-12e2 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
- G. ANSI/ASTM D 3017-05 Test Methods for Moisture Content of Soils and Soil-Aggregate Mixture by Nuclear Methods (Shallow Depth).
- H. ANSI/ASTM D 4318-10e1 Test Method for Liquid Limit, Plastic Limit, and Plasticity Limit.
- I. CALTRANS Standard Specifications Section 17.
- J. CAL-OSHA, Title 8, Section 1590 (e).

- K. Any work within the street, highway or right-of-way shall be performed in accordance with the requirement of the governmental agencies having jurisdiction, and shall not begin until all of those governing authorities have been notified.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Transport, store and handle in strict accord with the local jurisdiction.
- B. Make delivery to job when notified by Contractor verifying that the job is ready to receive the work of this Section and that arrangements have been made to properly store, handle and protect such materials and work.

1.07 PROJECT CONDITIONS

- A. Existing civil, mechanical and electrical improvements are shown on respective site plans to the extent known. Should the Contractor encounter any deviation between actual conditions and those shown, he is to immediately notify the Architect before continuing work.
- B. Excavation dewatering may be necessary. Contractor shall provide any and all tools, equipment and labor necessary for excavation dewatering no matter what the source. Dewatering shall be continuous until all site utilities are installed and backfilled.

- C. [Add following if Mehrten is noted in soils report] Mehrten Formations are present on site at varying depths. Contractor shall anticipate the use of earthmoving equipment capable of removing and processing Mehrten Formations. The use of a Cat D10N with single tooth ripper and an excavator CAT 330D L shall be anticipated for the grading and excavation operations of this project.

1.08 EXISTING SITE CONDITIONS

- A. Contractor shall acquaint himself with all site conditions. If unknown active utilities are encountered during work, notify Architect promptly for instructions. Failure to notify will make Contractor liable for damage to these utilities arising from Contractor's operations subsequent to discovery of such unknown active utilities.

1.09 [Use following if working on existing site] ON SITE UTILITY VERIFICATION AND REPAIR PROCEDURES

A. Ground-breaking requirements:

1. All underground work performed by a Contractor must be authorized by the District's Construction Manager or the Low Voltage Consultant prior to start of construction.
2. The Contractor is to obtain and keep the original School's construction utility site plans on site during all excavation operations. Contractor can contact the District's Construction Manager, Facilities Manager, or the Low Voltage Consultant to procure the drawings.

B. Underground Utility Locating:

1. The contractor shall hire an Underground Utility Locating Service to locate existing underground utility pathways in areas affected by the scope of work for excavation.



2. Contractor must use an underground utility locator service with a minimum of 3 years' experience. The equipment operator must have demonstrated experience.
3. The Underground Utility Locator Service must have the use of equipment with the ability to locate by means of inductive clamping, induction, inductive metal detection, conductive coupling, or TransOnde (Radio detection) to generate signals, passive locating (free scoping) for "hot" electric, and metal detector.
4. The Underground Utility Locator Service must be able to locate existing utilities at a depth of at least 72".
5. The Underground Utility Locator Service must be able to locate but are not limited to locating the following types of utility pathways:
  - a) All conduit pathways containing 110 volt or greater 50-60Hz electrical wire.
  - b) All conduit pathways containing an active cable TV system.
  - c) All conduit pathways containing wire or conductor in which a signal can be attached and generated without damaging or triggering the existing systems.
  - d) All empty conduit pathways or pipe in which a signal probe or sonde (miniature transmitter) can be inserted.
  - e) All conduit pathways containing non-conductive cables or wires in which a signal probe or sonde (miniature transmitter) can be inserted.
  - f) All plastic and other nonconductive water lines in which a TransOnde Radio detection) or other "transmitter" can be applied to create a low frequency pressure wave (signal) without damaging or triggering the existing systems.
  - g) All copper or steel waterlines and plastic or steel gas lines
6. All markings made by the Underground Utility Locator Service or other shall be clear and visible.
7. The contractor shall maintain all markings made by Underground Utility Locator Service or other throughout the entire length of the project.
8. The Underground Utility Locator Service shall provide the contractor with two sets of maps showing the location of utilities and average depth. They will be referenced to permanent buildings. Contractor will deliver one copy to the district at no additional charge.
9. Contractor is responsible to contact Underground Service Alert (U.S.A. 800/227-2600) and receive clearance prior to any excavation operations.
10. Contractor shall inform the (District's Construction Manager) (Architect) (Owner) no later than five (5) days prior to the date scheduled for the utility locator service to be on site.

#### 1.10 PROTECTION

- A. Adequate protection measures shall be provided to protect workmen and passers-by on and off the site. Adjacent property shall be fully protected throughout the operations. Blasting will not be permitted. Prevent damage to adjoining improvements and properties both above and below grade. Restore such improvements to original condition should damage occur. Replace trees and shrubs outside building area disturbed by operations.
- B. In accordance with generally accepted construction practices, the Contractor shall be solely and completely responsible for working conditions at the job site, including safety of all persons and property during performance of the work. This requirement shall apply continuously and shall not be limited to normal working hours.
- C. Any construction review of the Contractor's performance conducted by the Geotechnical Engineer is not intended to include review of the adequacy of the Contractor's safety measures, in, on, or near the

construction site.

- D. Provide shoring, sheeting, sheet piles and or bracing to prevent caving, erosion or gullyng of sides of excavation.
- E. Surface Drainage: Provide for surface drainage during period of construction in manner to avoid creating nuisance to adjacent areas. The contractor shall make a reasonable effort on a daily basis to keep all excavations and the site free from water during entire progress of work, regardless of cause, source, or nature of water.
- F. Adjacent streets and sidewalks shall be kept free of mud, dirt or similar nuisances resulting from earthwork operations.
- G. The site and adjacent influenced areas shall be watered as required to suppress dust nuisance. Dust control measures shall be in accordance with the local jurisdiction.

H. [Adjust the following to meet environmental requirements] ENVIRONMENTAL PROTECTION

1. No ground-disturbing activities shall be allowed outside of the project construction boundary. Construction fencing shall be placed at the boundary of the project site to clearly mark the limits of ground-disturbing activities.
2. All project-related traffic shall be restricted to designated access roads, routes, and construction areas within the project boundary. No vehicular or pedestrian traffic shall be allowed outside the designated project boundary.
3. Prior to initiation of any site preparation/construction activities, a USFWS-approved biologist will conduct an education and training session for all construction personnel. The training program will instruct workers on the life history and ecology of vernal pool crustaceans, requirements to avoid damaging the crustaceans and their habitat (vernal pools/seasonal wetlands), and the possible penalties for not complying with these requirements.
4. To prevent sediment, hazardous materials, and other pollutants from washing or running off into the vernal swale and vernal pools outside of the project site, the contractor shall implement best management practices as identified in a Storm Water Pollution Prevention Plan (SWPPP).
5. Dirt roadways or other areas of disturbed bare ground within 100 feet of elderberry shrubs will be watered at least twice a day to minimize dust emissions.
6. A worker awareness training program for construction personnel will be conducted by a qualified biologist prior to beginning construction activities. The program will inform all construction personnel about the life history and status of the beetle, requirements to avoid damaging the elderberry plants, and the possible penalties for not complying with these requirements. Written documentation of the training will be submitted to USFWS within 30 days of its completion.
7. Contractor to avoid and protect all protected species.

1.11 SEASONAL LIMITS

- A. No fill material shall be placed, spread or rolled during unfavorable weather conditions. When work is interrupted by rains, fill operations shall not be resumed until field tests indicate that moisture content and density of fill are satisfactory.
- B. Excessively wet fill material shall be bladed and aerated per section 3.08, B.

## 1.12 TESTING

- A. General: Refer to Section 01 45 00 – Quality Requirements.
- B. Geotechnical Engineer: Owner is retaining a Geotechnical Engineer to determine compliance of fill with Specifications, and to direct adjustments in fill operations. Costs of Geotechnical Engineer will be borne by Owner; except those costs incurred for re-tests or re-inspection will be paid by Owner and back charged to Contractor.
  - 1. If Contractor elects to process or mine onsite materials for use as Suitable Fill, Aggregate Sub Base, Aggregate Base, Rock, Crushed Rock or sand the cost of all testing of this material shall be paid for by the Contractor.
  - 2. Testing of import fill for compliance with Department of Toxic Substance Control (DTSC) shall be paid for by the Contractor.

## 1.13 ARCHEOLOGICAL AND CULTURAL RESOURCES

- A. If archeological or cultural resources are discovered during the Work, the Contractor must cease all construction operations in the vicinity of the discovery until a qualified archeologist can assess the value of these resources and make recommendations to the State Historic Preservation Officer. Archeological and cultural resources include artifacts, large amounts of bone, shell, or flaked stone, and other evidence of human activity. If the State Historic Preservation Officer or the Owner directs that work be temporarily ceased at the location of an archeological or cultural find, the Contractor must temporarily suspend work at the location.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Engineered Fill Materials: All fill shall be of approved local materials supplemented by imported fill if necessary. "Approved" local materials are defined as local soils tested and approved by Geotechnical Engineer free from debris, and concentrations of clay and organics; and contain rocks no larger than \_\_\_-inches in greatest dimension. The soil and rock should be thoroughly blended so that all rock is surrounded by soil. This may require mixing of the soil and rock with a dozer prior to placement and compaction. Clods, rocks, hard lumps or cobbles exceeding \_\_\_-inches in final size shall not be allowed in the upper \_\_\_ inches of any fill. Native clay or clayey soils will not be permitted within the upper \_\_\_ inches of building pad areas or paved areas.
- B. Imported Engineered Fill Material: Imported fill may be required to complete work. Proposed import fill material shall meet the above requirements; shall be similar to the native soils. Import fill shall meet the above requirements; shall have plasticity index of 12 or less; an Expansion Index of 20 or less; be free of particles greater than \_\_\_-inches in largest dimension; be free of contaminants and have corrosion characteristics within the acceptable limits. All import fill material shall be tested and approved by Soils Engineer prior to transportation to the site. Proposed fill material shall comply with DTSC guidelines to include Phase 1 environmental site assessment and related tests. Refer to the October 2001 DTSC Information Advisory for clean imported fill material.

1. DTSC TESTING: Site work contractor is to coordinate testing with an analytical lab, hired by the owner, licensed by the State of California for the DTSC testing. The costs associated with the testing will be paid by the contractor.
2. DTSC testing shall include documentation as to the previous land use, location, and history. Soils shall be analyzed for all compounds of concern to ensure the imported soil is uncontaminated and acceptable. Testing shall be performed per the recommendations included in DTSC Imported Fill Advisory ([http://www.dtsc.ca.gov/Schools/upload/SMP\\_FS\\_Cleanfill-Schools.pdf](http://www.dtsc.ca.gov/Schools/upload/SMP_FS_Cleanfill-Schools.pdf)). Soils shall be tested prior to import to the project site.  
Lab shall determine geographically which tests and analysis comparison will be appropriate for the testing. (CAM 17 / Title 22); (RWQCB) Regional Water Quality Control Board; or (OEHHA) Office of Environmental Health Hazard Assessment.
3. Frequency of testing shall be conducted in accordance with DTSC's Imported Fill Advisory as follows;

Fill Material Sampling Schedule

| Area of Individual Borrow Area | Sampling Requirements                                 |
|--------------------------------|-------------------------------------------------------|
| 2 Acres or less                | Minimum of 4 samples                                  |
| 2 to 4 Acres                   | Minimum of 1 sample every ½ Acre                      |
| 4 to 10 Acres                  | Minimum of 8 Samples                                  |
| Greater than 10 Acres          | Minimum of 8 locations with 4 subsamples per location |

Volume of Borrow Area Stockpile

|                                |                                                                                             |
|--------------------------------|---------------------------------------------------------------------------------------------|
| Up to 1,000 Cubic Yards        | 1 sample per 250 cubic yards                                                                |
| 1,000 to 5,000 Cubic Yards     | 4 samples for the first 1000 cubic Yards + 1 sample per each additional 500 cubic yards     |
| Greater than 5,000 Cubic Yards | 12 samples for the first 5,000 cubic yards + 1 sample per each additional 1,000 cubic yards |

4. Reports/ Documentation

- a. Results of the testing analysis shall be sent to the Owner; Architect; Project Inspector, Project Civil Engineer, DTSC, and DSA. Letter shall reference DSA file and application numbers.

C. Landscape Backfill Material:

1. The top \_\_\_\_" of native topsoil stripped from the site may be used for landscape backfill material provided it meets the requirements as specified in Section 329000.
2. Imported Topsoil may be required to complete work. See Section 329000 for requirements. Proposed Topsoil material shall comply with DTSC guidelines to include Phase 1 environmental site assessment and related tests. Refer to the October 2001 DTSC Information Advisory for clean imported fill material.

- D. Water: Furnish all required water for construction purposes, including compaction and dust control. Water shall be potable.

- E. Aggregate Base: Provide Class 2 3/4" Aggregate Base conforming to standard gradation as specified in Cal Trans Standard Specifications, Section 26,-1.02A.
- F. Decomposed Granite: Decomposed Granite shall be well graded mixture of fine to 1/8" particles in size with no clods. The material shall be free of vegetation, other soils, debris and rock. The material shall be reddish-tan to tan in color.
- G. Decomposed Granite Solidifier: PolyPavement or equal.

### **PART 3 – EXECUTION**

#### **3.01 INSPECTION LAYOUT AND PREPARATION**

- A. Prior to installation of the work of this Section, carefully inspect and verify by field measurements that installed work of all other trades is complete to the point where this installation may properly commence
- B. Layout all work, establish grades, locate existing underground utilities, set markers and stakes, setup and maintain barricades and protection facilities; all prior to beginning actual earthwork operations. Layout and staking shall be done by a licensed Land Surveyor or Professional Civil Engineer.
- C. Verify that specified items may be installed in accordance with the approved design.
- D. In event of discrepancy, immediately notify Owner and the Architect. Do not proceed in discrepant areas until discrepancies have been fully resolved.

#### **3.02 PERFORMANCE**

##### **A. GENERAL:**

- 1. General: Do all grading, excavating and cutting necessary to conform finish grade and contours as shown. All cuts shall be made to true surface of subgrade.
- 2. Archaeological Artifacts: Should any artifacts of possible historic interest be encountered during earthwork operations, halt all work in area of discovery and immediately contact the Architect for notification of appropriate authorities.
- 3. Degree of Compaction: Percentage of maximum density, hereinafter specified as degree of compaction required, means density equivalent to that percentage of maximum dry density determined by ASTM D1557 Compaction Test method, and such expressed percentage thereof will be minimum acceptable compaction for specified work.
- 4. Moisture Content: Moisture content shall be as noted below and as called for on the plans. Moisture content shall be maintained until subgrade is covered by surfacing materials.

#### **3.03 DEMOLITION, DISPOSAL AND DISPOSITION OF UNDESIRABLE MAN-MADE FEATURES**

- A. All other obstructions, such as abandoned utility lines, septic tanks, concrete foundations, and the like shall be removed from site. Excavations resulting from these removal activities shall be cleaned of all loose materials, dish shaped, and widened as necessary to permit access for compaction equipment.

Areas exposed by any required over-excavation should be scarified to a depth of \_\_\_\_", moisture-conditioned to (optimum) (2% above optimum) moisture content, and recompacted to at least \_\_\_\_% of the maximum dry density.

#### 3.04 TESTING AND OBSERVATION

- A. All grading and earthwork operations shall be observed by the Geotechnical Engineer or his representative, serving as the representative of the Owner.
- B. Field compaction tests shall be made by the Geotechnical Engineer or his representative. If moisture content and/or compaction are not satisfactory, Contractor will be required to change equipment or procedure or both, as required to obtain specified moisture or compaction. Notify Geotechnical Engineer at least 48 hours in advance of any filling operation.
- C. Earthwork shall not be performed without the notification or approval of the Geotechnical Engineer or his representative. The Contractor shall notify the Geotechnical Engineer at least two (2) working days prior to commencement of any aspect of the site earthwork.
- D. If the Contractor should fail to meet the compaction or design requirements embodied in this document and on the applicable plans, he shall make the necessary readjustments until all work is deemed satisfactory, as determined by the Geotechnical Engineer or Architect/Engineer.
- E. After each rain event Geotechnical Engineer shall test fill material for optimum moisture. Do not place any fill material until desired moisture is achieved.

#### 3.05 CLEARING AND GRUBBING

- A. Prior to grading, remove all debris off-site. Remove trees and brush including the root systems. Holes resulting from tree and brush removal should be prepared and backfilled in accordance with paragraphs 3.07, 3.08, 3.09, and 3.10. This may require deepening and/or widening the holes to adequately remove disturbed soil and provide room for compaction equipment. Strip the surface of all organics. Stripping's meeting the requirements of Section 32 90 00 may be used in landscape areas only.

#### 3.06 CUTTING

- A. Building pads that are located within a cut/fill transition area will have to be overexcavated to provide a semi-uniform fill beneath the building pad. The portions of building pads located in cut areas shall be overexcavated to provide no more than \_\_\_\_ foot difference in fill placed in the same building pad.
- B. Do all cutting necessary to bring finish grade to elevations shown on Drawings.
- C. When excavation through roots is necessary, cut roots by hand.
- D. Carefully excavate around existing utilities to avoid unnecessary damage. The contractor shall anticipate and perform hand work near existing utilities as shown on the survey, without additional claims or cost.

#### 3.07 STRUCTURAL EXCAVATION

- A. General: Excavate to bear on firm material at contract depth shown on Structural Drawings.
- B. Footings: All footing excavations shall be of sufficient width for installation of formwork, unless earth will retain its position during concreting. All portions of footings above grade must be formed.
- C. Unsuitable Ground: Any errors in structural excavation, soft ground, or clay soils found when excavating shall be reported to Architect. In no case shall work be built on any such soft or clayey unsuitable surface without direction from the Architect. Restore excavations to proper elevation with engineered fill material compacted to 90% of dry density.

### 3.08 SUBGRADE PREPARATION

- A. Grade compact and finish all subgrades within a tolerance of 0.10' of grades as indicated on Drawings and so as not to pool water. Subgrade within building pads and concrete walks shall be within 0.05' of grades indicated.
- B. After clearing, grubbing and cutting, subsurface shall be plowed or scarified to a depth of at least \_\_", until surface is free from ruts, hummocks or other uneven features and uniform and free from large clods. Moisture condition to (optimum) (2% above optimum) moisture content and recompact to at least \_\_\_\_% of the maximum dry density as determined by ASTM Test Method D1557. If the existing soils are at a water content higher than specified, the contractor shall provide multiple daily aerations by ripping, blading, and/or disking to dry the soils to a moisture content where the specified degree of compaction can be achieved. After seven consecutive working days of daily aerations, and the moisture content of the soil remains higher than specified, the contractor shall notify the architect. If the existing soils have a moisture content lower than specified, the contractor shall scarify, rip, water and blade existing soil to achieve specified moisture content. The contractor shall make proper allowance in schedule and methods to complete this work.
- C. Subgrade in areas to receive landscaping shall be compacted to 90%.
- D. Where Contractor over-excavates building pads through error, resulting excavation shall be recompacted as engineered fill at Contractor's expense.
- E. [May not be necessary for all sites. Review soils report.] In building pad areas with cut/fill transitions or building pad areas, which are entirely in cut, overexcavate a minimum of \_\_\_\_ feet so that differential fill thickness does not exceed \_\_\_\_ feet over a horizontal distance of \_\_\_\_ feet.

### 3.09 PLACING, SPREADING AND COMPACTING FILL MATERIAL IN BUILDING PAD AND PAVEMENT AREAS

- A. Selected fill material shall be placed in layers which, when compacted, shall not exceed 6 inches in compacted thickness. Each layer shall be spread evenly and thoroughly mixed to insure uniformity in moisture content. [The following must be confirmed by Geotechnical Engineer] Compaction of rocky fill materials should be achieved by at least successive passes with a compactor or an equivalent self-propelled sheepsfoot compactor. Compactive effort should be applied uniformly across the full width of the fill. Large rocks that cannot be properly incorporated into the engineered fill should be removed.
- B. Selected fill material shall be moisture-conditioned to specified moisture content. Selected fill material shall be unfrozen. When moisture content of fill material is below that specified, add water until proper

moisture content is achieved. When moisture content is above that specified, aerate by blading or other methods mentioned in 3.08 B until moisture content is satisfactory.

- C. After each layer has been placed, mixed and spread evenly, it shall be thoroughly compacted to a minimum of 90% as determined by the ASTM D1557 Compaction Test. Compact each layer over its entire area until desired density has been obtained.
- D. Recomposition of Fill in Trenches and Compaction of Fill Adjacent to Walls: Where trenches must be excavated, backfill with material excavated. Place in lifts that when compacted do not exceed 6", moisture conditioned to (optimum)(2% above optimum) moisture content, and compact to a minimum of 90% relative compaction in building pad and paved areas, and to 90% relative compaction in landscape areas.
- E. Jetting of fill materials will not be allowed.

### 3.10 FINAL SUBGRADE COMPACTION

- A. Building Pads: Upper \_\_\_\_" of all final building pad subgrades (including future buildings) shall be uniformly compacted at specified moisture content to at least \_\_\_\_% of maximum dry density, as determined by ASTM D1557 Compaction Test, regardless of whether final subgrade elevation is attained by filling, excavation, or is left at existing grade. After acceptance of final compaction test, contractor shall maintain the required moisture content of subgrade until concrete flatwork is placed.
  - 1. Exception; in lime /cement treated areas the upper \_\_\_\_" shall be compacted to \_\_\_\_% Compaction.
- B. Paved Areas: Upper \_\_\_\_" of all final subgrades supporting pavement sections and all other flatwork shall be brought to specified moisture content and shall be uniformly compacted to not less than \_\_\_\_% of maximum dry density, regardless of whether final subgrade elevation is attained by filling, excavation, or is left at existing grade. After acceptance of final compaction test, contractor shall maintain the required moisture content of subgrade until concrete flatwork is placed.
  - 1. Exception; in lime /cement treated areas the upper \_\_\_\_" shall be compacted to \_\_\_\_% Compaction.
- C. Other Fill and Backfill: Upper [Same depth as topsoil]" of all other final subgrades or finish grades shall be compacted to \_\_\_\_% of maximum dry density.
- D. Gravel Fill: Do not place compacted gravel fill until after underground work and foundations are in place. Compact gravel fill with vibratory plate or similar equipment to preclude settlement.

### 3.11 PLACING, SPREADING, AND COMPACTION OF LANDSCAPE BACKFILL MATERIALS

- A. All landscaped areas shall receive topsoil. After subgrade under landscape area has been scarified and brought to 90% maximum dry density, top soil shall be placed evenly to depth of \_\_\_\_" at 85% of maximum dry density.
- B. Project Inspector must verify that materials are uniformly spread to minimum depth specified.

### 3.12 DECOMPOSED GRANITE COMPACTION AND STABILIZATION



- A. Decomposed granite paving, paths or track shall be placed uniformly to the required depth and treated with PolyPavement or approved equal. Apply PolyPavement using Application Method 1 or a mixed application method.

### 3.13 SLOPE CONSTRUCTION

- A. Cut slopes shall be constructed to no steeper than \_\_\_\_:\_\_\_\_ (horizontal:vertical). Fill slopes shall be constructed to no steeper than \_\_\_\_:\_\_\_\_ (horizontal:vertical). Prior to placement of fill on an existing slope the existing slope shall be benched. The benches shall be in a ratio of \_\_\_\_horizontal to \_\_\_\_vertical. The face of the fill slopes shall be compacted as the fill is placed, or the slope may be overbuilt and then cut back to the design grade. Compaction by track walking will not be allowed.

### 3.14 FINISH GRADING

- A. At completion of project, site shall be finished graded, as indicated on Drawings. Finish grades shall be "flat graded" to grades shown on the drawing. Mounding of finish grades will not be allowed unless otherwise directed on the landscape drawings. Tolerances for finish grades in drainage swales shall be  $\pm 0.05'$ . Tie in new and existing finish grades. Leave all landscaped areas in finish condition for lawn seeding. Landscaped planters shall be graded uniformly from edge of planter to inlets. If sod is used for turf areas the finish grade on which it is placed shall be lowered to allow for sod thickness.
- B. All landscape areas shall be left free of rock or foreign material as specified in Section 32 90 00.
- C. All landscape areas shall be approved by Architect prior to any planting.

### 3.15 SURPLUS MATERIAL

- A. Excavated material not required for grading or backfill shall be removed from site at contractor's expense.

### 3.16 CLEANING

- A. Refer to Section 01 74 00.
- B. Remove from fill all vegetation, wood, form lumber, casual lumber, and shavings, in contact with ground; buried wood will not be permitted in any fill.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- None at this time.

SECTION 31 13 16

TREE PROTECTION

**PART 1 – GENERAL**

1.01 SUMMARY

A. Section Includes:

1. Tree protection complete as shown and as specified.

B. Related Sections:

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 00 00 00 – Site Demolition.
3. Section 32 80 00 – Irrigation.
4. Section 32 90 00 – LANDSCAPING.

1.02 SUBMITTALS

- A. Contractor shall submit Tree Protection Area plan to Architect outlining all trees and plants listed by number to be protected and their groupings. All trees and plants shall be grouped in their own Fenced Tree Protection Areas as shown in Drawings.
- B. Contractor shall submit to Landscape Architect in writing a schedule including any and all activity inside Fenced Tree Protection Areas. This schedule to include but not limited to the dates fences are initially installed, altered and dates of fence replacement. Intent of these provisions is that the Tree Protection Zone (TPZ) are fenced for the entire duration with only exceptions of short intervals or specifically defined construction activity needs. Revise schedule as directed by Architect.
- C. Provide a Mediation Plan to keep existing trees and planting irrigated during construction.

1.03 WARRANTY

- A. Guarantee all workmanship and materials hereunder against defective workmanship and materials, including damage by leaks and settlement of irrigation trenches, for the duration specified in Division 01 of these Specifications. (The Contractor is not responsible for vandalism or theft after date of final acceptance.)

**PART 2- PRODUCTS**

2.01 MATERIALS

- A. Use materials as specified; any deviation from the Specifications must first be approved by the

Owner's Representative in writing. All material containers or certificates shall be clearly marked by manufacturer as to contents for inspection.

B. Trunk Protection constructed of:

1. 20-foot long 2x6 wood boards or length needed to protect the trunk if tree trunk is shorter than 20'.
2. Metal wire. Gauge strong enough to tie the boards around the trunk of the tree.

C. Tree Protection Zone Fencing:

1. 4-foot-tall snow fencing or 6-foot-tall metal chain link construction fencing per the discretion of the Landscape Architect or District Representative.

D. Bark Mulch: Untreated, shredded cedar.

### **PART 3 – EXECUTION**

#### **3.01 PREPARATION**

A. Maintain pre-existing moisture levels.

B. Maintain areas inside the fenced tree protection area including lawn mowing, leaf removal, operation and repair of irrigation.

C. Protect root systems from flooding, erosion, excessive watering and drying resulting from dewatering or other operations:

D. Prohibitions - DO NOT:

1. Allow run off or spillage of damaging materials in vicinity of root systems,
2. Rinse tools or equipment under trees,
3. Store materials, stockpile soil, park or drive vehicles within drip lines or in areas with plants,
4. Cut, break skin or bark, bruise roots or branches,
5. Allow fires under and adjacent trees and plants,
6. Discharge exhaust under foliage,
7. Secure cable, chain, or rope to trees,
8. Change grade within drip line of trees without Landscape Architect's approval,
9. Lime shall not be used.

#### **3.02 INSTALLATION**

A. Tree Trunk Protection

1. Conform to requirements for trees and plants to be retained, per 3.01, above.

2. Install boards vertically around tree and bind together with wire to protect the bark 360 degrees around the entire tree prior to start of any demolition and construction. Boards are not to dig into bark.
3. Major scaffold limbs may require plastic fencing or straw waddles to be wrapped around them to protect them.

B. Tree Dripline Protection

1. The Tree Protection Zone (TPZ) is a restricted area around the base of the tree with a radius of one foot (1') for every inch of tree trunk diameter or ten feet, which is greater, enclosed by tree protection zone fencing.
2. Signage designating the protection zone and penalties for violations shall be secured in prominent location on each protection fence.

C. Requirements for Trees to be Protected

1. Duration: Tree protection shall be erected before demolition, grading, or any construction begins and remain in place until final inspection of the project.
2. Conform to requirements for trees and plants to be retained, per 3.01, above.
3. Architect shall give final review of Tree Protection before construction to begin. Revise schedule as directed by Architect.
4. Vehicle movement within the TPZ will only be allowed for construction equipment.
  - a. Within dripline, apply 10-inch layer of mulch over geotextile fabric.
5. Perform trenching operations within the TPZ of the tree so that:
  - a. Digging shall be by hand using narrow trenching shovel,
  - b. No roots larger than 2" diameter are cut and utilities are routed around or below them,
  - c. Roots smaller than 2" diameter are cut with sharp tools, saws, loppers- not torn, chopped or broken.
6. Where roots are exposed:
  - a. Do not allow the roots to dry out,
  - b. On the same day the excavation is made, provide temporary backfill to original grade at tree roots,
  - c. Or cover roots with 4 layers of wet untreated burlap, made wet each day, including weekends.
7. Roots larger than 3" in diameter are not to be cut without review and approval of Arborist.

3.03 REPAIR/RESTORATION:

- A. It shall be the responsibility of Contractor to repair or replace any damaged trees.
- B. Repair trees damaged by operations:
  1. within 24 hours of damage,

2. to satisfaction of Landscape Architect,
  3. to ISA Pruning Standards.
- C. Replace repaired trees where repair has not restored them to health or aesthetics:
1. within 6 months of request to replace,
  2. to the satisfaction of Landscape Architect,
  3. with replacement plants of a size and variety matching those that were removed
- D. Replaced trees and plants shall be the responsibility of Contractor to maintain in good health and aesthetics for the duration of the project from installation.
1. Contractor shall submit to Landscape Architect comprehensive maintenance plan for replacement tree, including but not limited to provisions for irrigation system independent of existing system.
- E. Where suitable replacement of trees and plants are not available:
1. Contractor shall provide affidavits to Landscape Architect that they are not available.
  2. Contractor shall provide compensation to the State at the following rates:
    - a. \$2000 for each caliper inch of any tree or plants removed under 12 inches.
    - b. \$4000 for each caliper inch of any tree or plants removed 12 inches or more.
    - c. Caliper of trees and plants measured at 6 inches above grade.
    - d. Caliper defined here as thickness of diameter, measured in inches.
- F. Soil Contamination:
1. Contractor shall remove soil that has been contaminated during the performance of the Work by oil, solvents, and other materials which could be harmful to trees and plants, and replace with good soil, at Contractor's expense.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- This specification section shall be tailored to meet the recommendations as set forth in the Geotechnical Report with regards to trench backfill.

SECTION 31 23 33

TRENCHING AND BACKFILLING

**PART 1 - GENERAL**

1.01 SUMMARY

A. RELATED SECTIONS

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 01 50 00, Construction Facilities and Temporary Controls.
3. Section 01 57 13, Erosion Control
4. Section 31 23 33, Trenching and Backfilling.
5. Section 32 12 00, Asphalt Concrete Paving.
6. Section 32 16 00, Site Concrete.
7. Section 32 80 00, Irrigation.
8. Section 32 90 00, Landscaping.
9. Section 33 40 00, Site Drainage.
10. Section 31 32 00, Soil Stabilization

1.02 QUALITY ASSURANCE

- A. Use only new materials and products, unless existing materials or products are specifically shown otherwise on the Drawings to be salvaged and re-used.
- B. All materials, components, assemblies, workmanship and installation are to be observed by the Owner's Inspector of Record. Work not so inspected is subject to uncovering and replacement.
- C. Contractor / Installer shall have been in business for five (5) years providing/finishing similar size projects and complexity.

1.03 SUBMITTALS

- A. Refer to Section 01 33 00.
- B. Submit Manufacturers data and shop drawings.

1.04 WARRANTY

- A. Submit fully executed warranty for work and materials in this section per 01 78 36.

1.05 REFERENCES AND STANDARDS

- A. California Building Code current edition.
- B. California Plumbing Code current edition.



#### 1.06 DELIVERY, STORAGE AND HANDLING

- A. Transport, store and handle in strict accord with the local jurisdiction.
- B. Make delivery to job when notified by Contractor verifying that the job is ready to receive the work of this Section and that arrangements have been made to properly store, handle and protect such materials and work.

#### 1.07 PROJECT CONDITIONS

- A. Contractor shall acquaint himself with all existing site conditions. If unknown active utilities are encountered during work, notify Architect promptly for instructions. Failure to notify will make Contractor liable for damage to these utilities arising from Contractor's operations subsequent to discovery of such unknown active utilities.
- B. Field verify that all components, backing, etc. by others are installed correctly to proceed with installation of products as herein specified.
- C. Trench dewatering may be necessary. Contractor shall provide any and all tools, equipment and labor necessary for trench dewatering no matter what the source. Dewatering shall be continuous until all site utilities are installed and backfilled.

#### 1.08 PROTECTION

- A. Adequate protection measures shall be provided to protect workers and passers-by on and off the site. Adjacent property shall be fully protected throughout the operations. Blasting will not be permitted. Prevent damage to adjoining improvements and properties both above and below grade. Restore such improvements to original condition should damage occur. Replace trees and shrubs outside building area disturbed by operations. Repair all trenches in grass areas with new sod (seeding not permitted) and "stake-off" for protection.
- B. Contractor shall be solely and completely responsible for working conditions at the job site, including safety of all persons and property during performance of the work. This requirement shall apply continuously and shall not be limited to normal working hours.
- C. Any construction review of the Contractor's performance conducted by the Architect or Owner is not intended to include review of the adequacy of the Contractor's safety measures, in, on or near the construction site.
- D. Provide shoring, sheeting, sheet piles and or bracing to prevent caving, erosion or gullyng of sides of excavation.
- E. Surface Drainage: Provide for surface drainage during period of construction in manner to avoid creating nuisance to adjacent areas. Keep all excavations free from water during entire progress of work, regardless of cause, source or nature of water.

- F. Adjacent streets and sidewalks shall be kept free of mud, dirt or similar nuisances resulting from earthwork operations.
- G. The site and adjacent influenced areas shall be watered as required to suppress dust nuisance.
- H. Trees: Carefully protect existing trees which are to remain.

#### 1.09 TRENCH SAFETY PROVISIONS

- A. General Contractor shall be solely responsible for safety design, construction and coordination with agencies having jurisdiction. If such plan varies from shoring system standards established by Construction Safety Orders, plan shall be prepared by registered civil or structural engineer.
- B. Nothing herein shall be deemed to allow use of shoring, sloping or protective system less effective than that required by Construction Safety Orders of California State Division of Industrial Safety.
- C. When trenching through paved surface, provide steel trench plates to cover open trenches daily until trenches are backfilled.

#### 1.10 SEASONAL LIMITS

- A. No backfill material shall be placed, spread or rolled during unfavorable weather conditions. When work is interrupted by heavy rains, full operations shall not be resumed until field tests indicate that moisture content and density of fill are satisfactory.
- B. Material above optimum moisture shall be processed per section 310000, 3.08, B.

#### 1.11 TESTING

- A. General: Refer to Section 01 45 00 – Quality Requirements.

### PART 2 – PRODUCTS

#### 2.01 MATERIALS

- A. Backfill materials: Pipeline and conduit trench backfill as shown on the plans and as specified below.
  - 1. ¾ inch crush rock.
  - 2. Native Materials: Soil native to Project Site, free of wood, organics, and other deleterious substances. Rocks shall not be greater than \_\_\_-inches.
  - 3. Sand: Fine granular material, free of organic matter, mica, loam or clay.
  - 4. Lean Mix Concrete/Controlled Density Backfill: 2 sacks cement slurry.
  - 5. Class 2 aggregate base, ¾" rock, per Caltrans section 26-1.02B
- B. Water: Furnish all required water for construction purposes, including compaction and dust control. Water shall be potable.

- C. Provide other bedding and backfill materials as described and specified in Section 31 00 00, Section 33 40 00 and Divisions 15 and 16.

### **PART 3 – EXECUTION**

#### **3.01 INSPECTION**

A. Verification of Conditions:

1. Examine areas and conditions under which work is to be performed.
2. Identify conditions detrimental to proper or timely completion of work and coordinate with General Contractor to rectify.

#### **3.02 COORDINATION**

- A. General Contractor shall coordinate work as herein specified, in accordance with drawings and as required to complete scope of work with all related trades.

#### **3.03 INSTALLATION**

- A. Perform work in accordance with pipe manufacturer's recommendations, as herein specified and in accordance with drawings.

#### **3.04 TRENCHING**

- A. Make all trenches open vertical construction with sufficient width to provide free working space at both sides of trench around installed item as required for caulking, joining, backfilling and compacting; not less than 12 inches wider than pipe or conduit diameter, unless otherwise noted.
- B. Carefully excavate around existing utilities to avoid unnecessary damage. The contractor shall anticipate and perform hand work near existing utilities as shown on the survey, without additional claims or cost.
- C. Trench straight and true to line and grade with bottom smooth and free of edges or rock points.
- D. Where depths are not shown on the plans, trench to sufficient depth to give minimum fill above top of installed item measured from finish grade above the utility as follows:
1. Sewer pipe: depth to vary
  2. Storm drain pipe: depth to vary
  3. Water pipe - Fire Supply: 36 inches
  4. Water pipe – Domestic Supply: 30 inches
- E. Where trench through existing pavement saw cut existing pavement in straight lines. Grind existing asphalt on each side of trench 3" wide x ½ the depth of the section. Apply tack coat to vertical surfaces before installing new asphalt. Replace asphalt and concrete pavement sections to matched existing conditions. In concrete pavement provide expansion and control joints to match existing joint layout.

### 3.05 BACKFILL

#### A. Pipe Trench Backfill is divided into three zones:

1. Bedding: Layer of material directly under the pipe upon which the pipe is laid.
2. Pipe Zone: Backfill from the top of the bedding to 6 inches (compacted) over the top of the pipe.
3. Upper Zone: Backfill between top of Pipe Zone and to surface of subgrade.

#### B. Bedding: Type of material and degree of compaction for bedding backfill shall be as defined in the Details and Specifications.

#### C. Pipe Zone and Upper Zone Backfill:

1. Type of material and degree of compaction Pipe Zone and Upper Zone Backfill shall be as required by Drawings, Details, & Specifications.
2. Upper Zone Backfill shall not be placed until conformance of Bedding and Pipe Zone Backfill with specified compaction test requirements has been confirmed.
3. Backfill shall be brought up at substantially the same rate on both sides of the pipe and care shall be taken so that the pipe is not floated or displaced. Material shall not be dropped directly on pipe.

#### D. Backfill Compaction:

1. Backfill shall be placed in layers which, when compacted shall not exceed 6 inches in thickness. Each layer shall be spread evenly and thoroughly mixed to insure uniformity. Do not backfill over, wet, frozen or soft subgrade surfaces. Employ a placement method that does not disturb or damage foundation walls, perimeter drainage, foundation damp-proofing, waterproofing or protective cover.
2. When moisture content of fill material is below that required to achieve specified density, add water until proper moisture content is achieved. When moisture content is above that required, aerate by blading or other methods until specified moisture content is met, see section 310000, 3.08, B.
3. After each layer has been placed, mixed and spread evenly, it shall be thoroughly compacted to \_\_\_\_% of maximum dry density while at specified moisture content. Compact each layer over its entire area until desired density has been obtained.
4. The top \_\_\_\_ inches of subgrade compaction under pavement or building shall be per Earthwork section 31 00 00.
5. Compaction: All backfill operations shall be observed by the Inspector of Record and/or Geotechnical Engineer. Field density tests shall be made to check compaction of fill material. If densities are not satisfactory, Contractor will be required to change equipment or procedure or both, as required to obtain specified densities. Notify Inspector and Architect at least 24 hours in advance of any operation.

#### E. Backfill in Areas Previously Lime or Cement Treated

1. If trenching is necessary in areas that have been previously lime treated the contractor shall backfill the trench with class 2 aggregate base, with minimum section equal to the lime treated section and compacted to 95%.

### 3.06 TRENCH AND SITE RESTORATION

- A. Finished surface of trenches shall be restored to a condition equal to, or better than the condition as existed prior to excavation work.

### 3.07 PROTECTION

- A. Protect existing surfaces, structures, and utilities from damage. Protect work by others from damage. In the event of damage, immediately repair or replace to satisfaction of Owner.
- B. Repair existing landscaped areas to as new condition. Replant trees, shrubs or groundcover with existing materials if not damaged or with new materials if required. Replace damaged lawn areas with sod, no seeding will be permitted.
- C. Replace damaged pavement with new compatible matching materials. Concrete walks to be removed to nearest expansion joint and entire panel replaced. Asphalt to be cut neatly and replaced with new materials.
- D. Any existing materials removed or damaged due to trenching to be returned to new condition.

### 3.08 SURPLUS MATERIAL

- A. Remove excess excavated material, unused materials, damaged or unsuitable materials from site.

### 3.09 CLEANING

- A. Refer to Section 01 74 00.
- B. Contractor will keep the work areas in a clean and safe condition so his rubbish, waste, and debris do not interfere with the work of others throughout the project and at the completion of work.
- C. After completion of work in this section, remove all equipment, materials, and debris. Leave entire area in a neat, clean, acceptable condition.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- This specification section shall be tailored to meet the recommendations as set forth in the Geotechnical Report.

SECTION 31 32 00

SOIL STABILIZATION

**(DESIGNER! FOR USE WITH LIME, LIME & CEMENT OR CEMENT)**

**PART 1 - GENERAL**

1.01 SUMMARY

A. SECTION INCLUDES:

1. Description: Provide Lime/**Cement** Stabilization Treatment, including spreading and mixing lime and water with in-place materials, and compacting the mixture to the lines, grades and dimensions shown on the plans and/or specified.

B. RELATED SECTIONS

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 01 50 00, Construction Facilities and Temporary Controls.
3. Section 31 23 33, Trenching and Backfilling.
4. Section 32 12 00, Asphalt Concrete Paving.
5. Section 32 16 00, Site Concrete.

1.02 SUBMITTALS

A. QUALITY ASSURANCE

1. Use only new materials and products, unless existing materials or products are specifically shown otherwise on the Drawings to be salvaged and re-used.
2. All materials, components, assemblies, workmanship and installation are to be observed by the Owner's Inspector of Record. Work not so inspected is subject to uncovering and replacement.
3. The representatives of the Owner's testing lab will not act as supervisor of construction, nor will they direct construction operations. Neither the presence of the Owner's testing lab representatives nor the testing by the Owner's testing lab shall excuse the contractors or subcontractors for defects discovered in their work during or following completion of the project. Correcting inadequate compaction is the sole responsibility of the contractor.
4. Tests (See Part 3 for Compaction Testing).
5. Contractor shall be solely responsible for all subgrades built. Any repairs resulting from inadequate

compaction are the responsibility of the contractor.

6. Failures due to the lack of continuous moisture control during the curing period will be the sole responsibility of the contractor.
7. Any trenching through the finished cured lime/cement section will result in the contractor having to backfill trench with class 2 aggregate base rock, or cement/sand slurry,

1.03 SUBMITTALS

- A. Refer to Section 01 33 00.

1.04 WARRANTY

- A. Refer to General Conditions and Section 01 78 36.

1.05 QUALITY ASSURANCE

- A. General: All Quality Assurance procedures specified on the drawings shall apply to this Section in addition to those shown below.
- B. Testing:
  0. Geotechnical Engineer: Owner is retaining a Geotechnical engineer to determine compliance of Lime/**Cement** Stabilization Treatment with Specifications, and to direct adjustments in fill operations. Costs of Geotechnical Engineer will be borne by Owner; except that costs incurred for re-tests or re-inspection will be paid by Owner and back charged to Contractor.
- C. Inspection: Work shall not be performed without the physical presence and approval of Geotechnical Engineer. The Contractor shall notify the Geotechnical Engineer at least two working days prior to commencement of any aspect of site earthwork.
- D. Field Density: Field density and phenolphthalein reaction tests shall be made by the Geotechnical Engineer after completion of compaction. Where compaction equipment has disturbed the surface to a depth of several inches, density tests shall be taken in the compacted material below the disturbed surface.

1.07 SUBMITTALS

- A. Weighmaster Certificates: Provide certificates as required in Section 2.01B.

**PART 2 - PRODUCTS**

2.01 MATERIALS

- A. Lime/ **Cement** Treated Engineered Fill: The materials to be treated shall consist of on-site soils or approved import material as described in Section 31 00 00.



- B. Lime/ **Cement**: Lime/ **Cement** in areas to be treated shall be lime **cement**. The percentage of lime shall be based on a soil weight of 100 pcf; hence, \_\_\_ pounds lime **cement** should be utilized per square foot. A certification of compliance shall be submitted to the Geotechnical Engineer with each delivery of lime **cement**.
- C. Water: Water shall be added during the preliminary mixing operations and, if necessary, during final mixing and to keep the cured material moist until curing is complete. The amount of water added shall be subject to the approval of the Geotechnical Engineer at all times.

### **PART 3 - EXECUTION**

#### **3.01 PREPARATION**

- A. General: Layout all work, establish grades, locate existing underground utilities, set markers and stakes, set up and maintain barricades and protection facilities; all prior to beginning actual earthwork operations.

#### **3.02 EQUIPMENT**

- A. Lime Spreader: The lime/**cement** shall be spread by equipment which shall uniformly distribute the required amount of lime/**cement**. The rate of spread per square foot of blanket shall not vary more than 5 percent from the designated rate, unless otherwise approved by the Geotechnical Engineer.
- B. Mixing Equipment: Mixing equipment shall be capable of mixing or remixing the materials to a uniform mixture free of streaks or pockets of lime/**cement** to the full required depth.

#### **3.03 START OF WORK UNDER THIS SECTION**

- A. General: Prior to starting physical work under this Section, the property line is to be clearly staked and identified. No lime treated materials shall be allowed to contaminate areas outside of the property.
- B. Utilities; Contractor is to engage with a licensed contractor specialized in the Utility Locating Business. The contractor shall locate any and all utilities and pothole the same. The frequency of potholing shall be enough to establish the elevations of all utilities located.

#### **3.04 LIME SPREADING**

- A. Engineered Fill: Provide lime/**cement** treatment in areas shown on plans and extending a minimum distance of \_\_\_ feet from outside edge of curb, building footing, wood header, and to a depth of at least \_\_\_-inches.
- B. Temperature: Lime shall not be spread while the atmospheric temperature is below 35 degrees Fahrenheit or when conditions indicate that the temperature may fall below 35 degrees Fahrenheit within 24 hours.

#### **3.05 MIXING**

- A. Lime/cement shall be added to the material to be treated at a rate of \_\_\_ pounds lime cement per square foot based on a soil unit weight of \_\_\_ pcf.
- B. Lime/cement shall be spread by equipment that will uniformly distribute the required amount of lime/cement for the full width of the prepared material. The rate of spread per linear foot of blanket shall not vary more than five percent (\_\_\_%) from the designated rate.
- C. The spread lime/cement shall be prevented from blowing by suitable means selected by the Contractor. Quicklime shall not be used to make lime slurry. The spreading operations shall be conducted in such a manner that a hazard is not present to construction personnel or the public. All lime spread shall be thoroughly mixed into the soil the same day lime spreading operations are performed.
- D. The distance which lime/cement may be spread upon the prepared material ahead of the mixing operation will be determined by the Geotechnical Engineer.
- E. No traffic other than the mixing equipment and water truck will be allowed to pass over the spread lime/cement until after the completion of mixing. After mixing, grading and compacting are completed, only the water truck is allowed on the treated area to maintain the optimum moisture for curing.
- F. Mixing equipment shall be equipped with a visual depth indicator showing mixing depth, an odometer or footmeter to indicate travel speed and a controllable water additive system for regulating water added to the mixture.
- G. Mixing equipment shall be of the type that can mix the full depth of the treatment specified and leave a relatively smooth bottom of the treated section. Mixing and re-mixing, regardless of equipment used, will continue until the material is uniformly mixed free of streaks, pockets, or clods of lime/cement, and moisture is at approximately two percent (2%) over optimum and the mixture complies with the following requirements:
 

| <u>Minimum<br/>Sieve Size</u> | <u>Percent Passing</u> |
|-------------------------------|------------------------|
| 1-1/2"                        | 100                    |
| 1"                            | 95                     |
| No. 4                         | 60                     |
- H. Non-uniformity of color reaction when the treated material, exclusive of one inch or larger clods, as tested with the standard phenolphthalein alcohol indicator, will be considered evidence of inadequate mixing.
- I. Lime/cement -treated material shall not be mixed or spread while the atmospheric temperature is below 35°F. The entire mixing operation shall be completed within seventy-two (72) hours of the initial spreading of lime, unless otherwise permitted by the Geotechnical Engineer.

### 3.06 SPREADING AND COMPACTING

- A. The treated mixture shall be spread to the required width, grade and cross-section. The maximum compacted thickness of a single layer may be determined by the Contractor provided he can demonstrate to the Geotechnical Engineer that his equipment and method of operation will provide uniform distribution of the lime/**cement** and the required compacted density throughout the layer. If the Contractor is unable to achieve uniformity and density throughout the thickness selected, he shall rework the affected area using thinner lifts until a satisfactory treated subgrade meeting the distribution and density requirements is attained, as determined by the Geotechnical Engineer, at no additional cost to the Owner.
- B. The finished thickness of the lime-treated material shall not vary more than five hundredths of a foot (0.05') from the planned thickness at any point.
- C. The lime/**cement** -treated soils shall be compacted to a relative compaction of not less than \_\_\_\_\_ percent (\_\_\_%) as determined by the ASTM D1557-01 Compaction Test.
- D. Initial compaction shall be performed by means of a sheepfoot type roller or a vibratory padfoot roller. Final rolling shall be by means of a smooth drum roller.
- E. Areas inaccessible to rollers shall be compacted to meet the minimum compaction requirement by other means satisfactory to the Geotechnical Engineer.
- F. Final compaction shall be completed within thirty-six (36) hours of final mixing. The surface of the finished lime/**cement** -treated material shall be the grading plane and at any point shall not vary more than five hundredths of a foot (0.05') foot above or below the grade established by the plans.
- G. Before final compaction, if the treated material is above the grade tolerance specified in this section, uncompacted excess material may be removed and used in areas inaccessible to mixing equipment. After final compaction and trimming, excess material shall be removed and disposed of off site. The trimmed and completed surface shall be rolled with steel or pneumatic-tired rollers. Minor indentations may remain in the surface of the finished materials so long as no loose material remains in the indentations.
- H. At the end of each day's work, a construction joint shall be made in thoroughly compacted material and with a vertical face. After a part-width section has been completed, the longitudinal joint against which additional material is to be placed shall be trimmed approximately three inches (3") into treated material, to the neat line of the section, with a vertical edge. The material so trimmed shall be incorporated into the adjacent material to be treated.
- I. An acceptable alternate to the above construction joints, if the treatment is performed with cross shaft rotary mixers, is to actually mix three inches (3") into the previous day's work to assure a good bond to the adjacent work.

### 3.07 FINAL GRADING

- A. Finish all lime/**cement** treated engineered fill grades to within a tolerance of 0.05' of grades shown for top of lime/cement stabilization treatment or as indicated by drawings and specifications.

- B. Leave all areas in suitable condition for subsequent work.
- C. Excess materials not needed for final grading operations shall be removed from the site.

### 3.07 CURING

- A. The surface of compacted and finish graded lime/**cement** treated soil shall be kept moist for at least 3 days after final trimming, rolling and compacting. No equipment or traffic shall be permitted on the lime treated material during the 3 day cure, except for the water truck to keep the treated area at or above the optimum moisture. After the 3 day cure apply aggregate base. Maintain moisture curing at optimum level until aggregate base is placed

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Slope hardcourts at 1.0%min and 1.8% max, typical all directions.
- Provide 3/8" HMA at hardcourts and 1/2" HMA at parking lots.
- Confirm with District if new asphalt paving is to receive seal coat.
- Spec section 321236 Pavement Sealer and Striping is not required if this section is used.
- It is recommended that existing utilities beneath pavement that is being removed be replaced with new. Confirm with District utilities to be replaced. Underground utility locating to be provided with topographic survey.
- At hardcourts, provide concrete flush curb at asphalt edges where abutting landscaping.
- Aggregate base thickness supporting asphalt paving shall meet recommendations as provided in Geotechnical Report.

- Hardcourt striping layout to be provided by Architect/Engineer. Site Principal will provide comments on layout as necessary.
- Accessible parking stalls shall consist of concrete paving, vehicular rated.

SECTION 32 12 00

ASPHALT CONCRETE PAVING

**PART 1 - GENERAL**

**1.01 SUMMARY**

**A. SECTION INCLUDES:**

1. Asphalt paving mix designs.
2. Aggregate Base Course.
3. Asphalt Overlay.
4. Seal Coat and Striping.

**B. RELATED SECTIONS**

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 01 50 00, Construction Facilities and Temporary Controls.
3. Section 310000, Earthwork.
4. Section 313200, Soil Stabilization.

**1.03 QUALITY ASSURANCE**

- A. Use only new materials and products, unless existing materials or products are specifically shown otherwise on the Drawings to be salvaged and re-used.
- B. All materials, components, assemblies, workmanship and installation are to be observed by the Owner's Inspector of Record. Work not so inspected is subject to uncovering and replacement.
- C. The representatives of the Owner's testing lab will not act as supervisor of construction, nor will they direct construction operations. Neither the presence of the Owner's testing lab representatives nor the testing by the Owner's testing lab shall excuse the contractors or subcontractors for defects discovered in their work during or following completion of the project. Correcting inadequate compaction is the sole responsibility of the contractor.
- D. Contractor shall provide verification that asphalt mix temperature meets the requirements of this specification at time of application.
- E. Contractor shall be solely responsible for all subgrades built. Any repairs resulting from inadequate compaction are the responsibility of the contractor.
- F. Sieve analysis from testing laboratories identifying rock/sand percentages within the asphalt mix shall have a testing date within 90 days of contract signing.
- G. Sieve analysis from a testing laboratory identifying rock/sand percentages within the class 2 aggregate base rock shall have a testing date within 90 days of contract signing.

#### 1.04 SUBMITTALS

- A. Refer to Section 01 33 00.
- B. Manufacturer's Data: Submit list and complete descriptive data of all products proposed for use. Include manufacturer's specifications, published warranty or guarantee, installation instructions, and maintenance instructions.

#### 1.05 WARRANTY

- A. Refer to General Conditions and Section 01 78 36.

#### 1.06 REFERENCES AND STANDARDS

- A. ANSI/ASTM D698-00 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.
- B. ANSI/ASTM D1556-00 - Test Method for Density of Soil in Place by the Sand-Cone Method.
- C. ANSI/ASTM D1557-02 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb. (4.54 Kg) Rammer and 18 inch (457 mm) Drop.
- D. ANSI/ASTM D 3017-05 Test Methods for Moisture Content of Soils and Soil-Aggregate Mixture by Nuclear Methods (Shallow Depth).
- E. ANSI/ASTM D 4318-05 Test Method for Liquid Limit, Plastic Limit, and Plasticity Limit.
- F. CALTRANS Standard Specifications.
- G. CAL-OSHA, Title 8, Section 1590 (e).
- H. Any work within the street, highway or right-of-way shall be performed in accordance with the requirement of the governmental agencies having jurisdiction, and shall not begin until all of those governing authorities have been notified.

#### 1.07 DELIVERY, STORAGE AND HANDLING

- A. Transport, store and handle in strict accord with the local jurisdiction.
- B. Make delivery to job when notified by Contractor verifying that the job is ready to receive the work of this Section and that arrangements have been made to properly store, handle and protect such materials and work.

#### 1.08 PROJECT CONDITIONS

- A. Environmental Requirements:



1. Base Course: Do not lay base course on muddy subgrade, during wet weather, or when atmospheric temperature is below 40 degrees F.
  2. Asphalt Surfacing: Do not apply asphaltic surfacing on wet base, during wet weather, or when atmospheric temperature is below 50 degrees F.
- B. Contractor shall acquaint himself with all site conditions. If unknown active utilities are encountered during work, notify Architect promptly for instructions. Failure to notify will make Contractor liable for damage to these utilities arising from Contractor's operations subsequent to discovery of such unknown active utilities.
- C. Adequate protection measures shall be provided to protect workmen and passers-by on and off the site. Adjacent property shall be fully protected throughout the operations. Blasting will not be permitted. Prevent damage to adjoining improvements and properties both above and below grade. Restore such improvements to original condition should damage occur. Replace trees and shrubs outside building area disturbed by operations.
- D. In accordance with generally accepted construction practices, the Contractor shall be solely and completely responsible for working conditions at the job site, including safety of all persons and property during performance of the work. This requirement shall apply continuously and shall not be limited to normal working hours.
- E. Any construction review of the Contractor's performance conducted by the owner's representative is not intended to include review of the adequacy of the Contractor's safety measures, in, on, or near the construction site.
- F. Surface Drainage: Provide for surface drainage during period of construction in manner to avoid creating nuisance to adjacent areas. The contractor shall make a reasonable effort on a daily basis to keep all excavations and the site free from water during entire progress of work, regardless of cause, source, or nature of water.
- G. Adjacent streets and sidewalks shall be kept free of mud, dirt or similar nuisances resulting from earthwork operations.
- H. The site and adjacent influenced areas shall be watered as required to suppress dust nuisance. Dust control measures shall be in accordance with the local jurisdiction.
- I. No fill material shall be placed, spread or rolled during unfavorable weather conditions. When work is interrupted by rains, fill operations shall not be resumed until field tests indicate that moisture content and density of fill are satisfactory.

#### 1.09 TESTING

- A. General: Refer to Section 01 40 00 – Quality Requirements.
- B. Geotechnical Engineer: Owner is retaining a Geotechnical Engineer to determine compliance of fill with Specifications, and to direct adjustments in fill operations. Costs of Geotechnical Engineer will be borne by Owner; except those costs incurred for re-tests or re-inspection will be paid by Owner and backcharged to Contractor.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Sterilant: Soil sterilizer shall be CIBA GEIGY's Pramitol 25-E or Thompson-Hayward Casoron.
  - 1. Soil sterilizer shall be applied in strict accordance with manufacturer's instructions.
- B. Base Course Aggregate: State Specifications, Section 26, Class 2 aggregate base (3/4" max.).
- C. Asphalt Binder: Steam-refined paving asphalt conforming to State Specifications, Section 92, viscosity grade PG 64-10. Asphalt binder additives for HMA per Caltrans approved list of manufacturer's.
- D. Liquid Asphalt Tack Coat: Per CALTRANS section 94.
- E. Surface Course Aggregate: Mineral aggregates for Type "B" asphalt concrete, conforming to State Specifications 39-2.02, Type B, 1/2" maximum, medium grading. 3/8" maximum grading at Playcourt.
- F. Seal Coat: shall be a pre-mixed asphalt emulsion blended with select fillers and fibers such as:
  - 1. "Park-Top No. 302", Western Colloid Products.
  - 2. "OverKote", Reed and Gram.
  - 3. "Drivewalk", Conoco Oil.
- G. Wood Headers and Stakes: Pressure treated.
- H. Pavement Marking: Colors as directed by Architect. Colors of painted traffic stripes and pavement markings must comply with ASTM D 6628.
  - 1. Waterborne traffic line - colors white, yellow and red, State specification PTWB-01R3.
  - 2. Waterborne traffic line for the international symbol of accessibility and other curb markings – blue, red and green, Federal specification TT-P-1952F.
- I. Precast Concrete Bumpers: 3000 psi at 28 day minimum strength; 48" length unless otherwise indicated; provide with steel dowel anchors and concrete epoxy.
- J. Pavement Epoxy; K-Lite; Ktepx-590; Ennis Epoxy HPS2 or an approved equal.
- K. Crack Filler;
  - 1. Cracks up to 1/2": QPR model CAR08, 10oz asphalt crack filler; Star STA-FLEX Trowel Grade crack filler or approved equal.
  - 2. Cracks 1/4" – 1": "Docal 1100 Viscolastic, distributed by Conoco, Inc., Elk Grove, CA, (916) 685-9253, or approved equal.
  - 3. Cracks greater than 1": Hot Mix, Topeka.
- L. Reclaimed Asphalt Pavingment (RAP). HMA Type A or Type B may be produced using RAP providing it

does not exceed 15% of the aggregate blend.

## 2.02 MIXES

- A. General: Plant mixed conforming to State Specifications, Section 39, Type B, ½" maximum, medium grading. 3/8" maximum grading shall be used at hardcourt.
- B. Temperature of Hot Mix Asphalt: Not less than 275 degrees F nor more than 325 degrees F when added to aggregate.
- C. Temperature of Hot Mix Aggregate: Not less than 250 degrees F nor more than 325 degrees F when asphalt is added.
- D. Temperature of Hot Mix Asphalt Concrete: Asphalt shall be not less than 285 degrees at time of application, nor more than 350 degrees. Asphalt not meeting the required temperature shall not be used.
- E. Temperature of Warm Mix Asphalt: Mixing and placement; Per the approved manufactures heat range recommendations for mixing and placement.

## PART 3 - EXECUTION

### 3.01 EXAMINATION OF CONDITIONS

- A. Conditions of Work in Place: Subsurfaces which are to receive materials specified under this Section shall be carefully examined before beginning work hereunder, and any defects therein shall be reported, in writing, to the Architect. Work shall not be started until such defects have been corrected. Starting of work shall imply acceptance of conditions as they exist.

### 3.02 PREPARATION

- A. Sub-Grade: Clean, shape and compact to hard surface free from elevations or depressions exceeding 0.05' in 10' from true plan. Compact per Section 31 00 00. Compaction and moisture content shall be verified immediately prior to placement of aggregate base. Proof roll subbase in presence of geotechnical engineer prior to placement of aggregate base.
- B. Cleaning: Existing surfaces and new surface shall be clean of all dirt, sand, oil or grease. All cracks shall be cleaned and free of all debris and vegetation. Hose down entire area with a strong jet of water to remove all debris.

### 3.03 INSTALLATION

- A. Headers:
  - 1. General: Install as edging to asphalt paving, except where adjoining existing pavement, concrete curbs, walks or building.
  - 2. Existing Headers: Remove existing headers where new paving will join existing. Saw cut existing asphalt to provide clean edge.
  - 3. Lines and Levels: Install true to line and grade. Cut off tops of stakes 2-inches below top of

header so they will not be visible on completion of job.

**B. Asphalt Paving:**

1. Base Course: Install in accord with State Specifications, Section 26. Compact to relative compaction of not less than 95%, ASTM D1557. The material shall be deposited on the subgrade in such a manner as to provide a uniform section of material within five percent tolerance of the predetermined required depth. Deposition will be by spreader box or bottom dump truck to prevent segregation of the material. The material so deposited on the subgrade shall have sufficient moisture which, in the opinion of the Architect is adequate to prevent excessive segregation. It shall then be immediately spread to its planned grade and cross section. Undue segregation of material, excessive drifting or spotting of material will not be permitted. If in the opinion of the site geotechnical engineer, the material is unsuitably segregated, it shall be removed or completely reworked to provide the desired uniformity of the material.
  - a. Moisture content and compaction of base material shall be tested immediately prior to placement of asphalt paving.
2. Sterilant: Apply specified material at manufacturer's recommended rate. Applicator of sterilant material shall be responsible for determining location of all planter areas. Apply specified material over entire base course area just prior to application of asphalt. Follow manufacturer's printed directions.
3. Liquid Asphalt Tack Coat: Apply as "tack coat" to all vertical surfaces of existing paving, curbs, walks, and construction joints in surfacing against which paving is to be placed.
4. Asphalt Concrete Surface Course:
  - a. Comply with State Specifications, 39-6 except as modified below.
    - 1) Final gradation shall be smooth, uniform and free of ruts, humps, depressions or irregularities, with a minimum density of 91% of the theoretical maximum specific gravity determined by California Test Method #309. Maximum variation 1/8 inch in 10' when measured with steel straightedge in any one direction. Test paved areas for proper drainage by applying water to cover area. Correct portions that do not drain properly by patching with plant mix. In no case shall accessible parking spaces or loading and unloading areas exceed 2% slope in any direction.
    - 2) Asphalt material shall be delivered to the project site in a covered condition to maintain acceptable temperature. Onsite inspector shall verify temperature of asphalt upon truck arrival to the site.
5. Placement and adjustment of Frames, Covers, Boxes and Grates: The Contractor shall set and adjust to finish grade all proposed and existing frames, covers, boxes, and grates of all manholes, drop inlets, drain boxes, valves, cleanouts, electrical boxes and other appurtenant structures prior to placement of asphaltic concrete.
6. Water Testing: All paved areas shall be water tested, to check drainage, in the presence of the project inspector prior to placement of seal coat. The surface of asphalt paving shall not vary more than 1/8 inch above or below the grade established on the plans. If variations in grade are present, they will be corrected by overlaying paving and/or pavement removal and replacement as directed by the Architect.
7. Patching: Cut existing paving square and plumb at all edges to be joined by new paving. In trenches; grind existing asphalt on each side of trench 3" wide x 1/2 the depth of the section. Apply tack coat to vertical surfaces before installing new work. Warp carefully to flush surface, with seal over joints, and feather edge. Sawcut, remove and patch existing paving where cutting is necessary

for installation of piping or conduits under Divisions 2, 15 and 16.

C. Seal Coat:

1. Seal coat shall be applied no sooner than 30 days from time of asphalt placement, no exceptions.
2. Surface Preparation: surface and cracks shall be clean of all dirt, sand, oil or grease. All cracks shall be filled to a level condition after curing. Make multiple fill applications until a level condition is achieved. Failure to do so will be the reason for rejection. Hose down entire area with a strong jet of water to remove all debris. Remove soft, loose, or otherwise damaged areas of asphalt concrete to full depth of damage and replace with compacted hot mix asphalt concrete as specified herein. Minor holes and imperfections may be patched using hot mix asphalt or mastic using sand/SS-1-H. Use wire brush for removal of oil and grease; prime with shellac or synthetic resin as recommended by manufacturer of pavement sealer material.
3. Seal Coat Seal Application: Thoroughly mix materials and apply in the presence of the onsite inspector. Failure to do so will be cause for rejection. Apply in accordance with manufacturer's written instructions.
  - a. The minimum application rate for each applied coat shall be 30gals per 1000 sq. ft. Two coats of sealcoat will be required.
  - b. Clean-Up and Precautions: As recommended by pavement sealer material manufacturer.

D. Asphalt Concrete Overlay Paving:

1. Comply with State Specifications, 39-6 except as modified below.
2. Grind or remove existing asphalt concrete paving at limits of overlay paving to provide a minimum 1 1/2" overlay thickness. Limits of grinding or removal shall be field verified to insure that finished paving surface will have a one percent minimum slope.
3. Thoroughly clean surface to remove vegetation, dirt, sand, gravel and water from surface and from cracks. Vegetation shall be treated 7 days prior to removal with an herbicide.
4. Cracks greater than 1 inch shall be filled with hot mix asphalt and rolled and compacted. Cracks less than one inch shall be filled with crack filler. Potholes shall be filled with hot-mix rolled and compacted. Contractor shall have Engineer approve crack and pothole repair prior to overlay. Provide leveling courses of hot mix asphalt as required to achieve finish grades shown on the drawings.
  - a. Cracks less than one inch in width shall be level after curing. Contractor shall make multiple filling applications as necessary to achieve a level condition.
5. Place overlay when ambient air temperature is 40 degrees F. and rising, and when pavement is dry.
6. An asphalt tack coat shall be applied to existing surface area at a rate of 0.20 gallons per square yard. Application width shall be width of fabric plus 2 to 6 inches.
7. Place, spread and compact asphalt overlay to provide a minimum density of 95% of maximum theoretical unit weight as determined by California Test Method #304. Maximum variation 1/8" in 10' when measured with steel straight edge in any one direction. Test paved areas for proper drainage by applying water to cover area. Correct portions that do not drain properly by patching with plant mix. Minimum compacted overlay thickness 1 1/2 inches.

[EDIT NOTE] USE ONLY FOR SITE THAT REQUIRE SANDSEAL MIX.

D. Sandseal application:

1. Coat No. 1 and 2: Add 300 lbs of #30 mesh sand and 1 gallon of SS-1 to 100 gallons of pavement

sealer. Apply at 2.0 gallons per 100 sq. ft.

2. Coat No. 3: Apply pavement sealer at minimum rate of 1.0 gallon per 100 sq. ft.

E. Pavement Marking: pavement markings shall be done only after the seal coat has thoroughly dried. Existing surfaces to be striped with traffic paint shall be cleaned of dust, dirt, grime, oil, rust or other contaminants which will impair the quality of work or interfere with proper bond of paint coats. Surfaces shall be thoroughly cleaned by whatever means necessary that will satisfactorily accomplish the purpose without damage to asphalt concrete. Provide measured layouts, temporary markings, templates, and other means necessary to provide required marking. Prepare and apply paint in accordance with manufacturer's instructions; paint shall be applied by spray and shall achieve complete coverage free from voids and thin spots. Where indicated on the Drawings, paint parking stall strips, lettering, arrows, accessible symbols, playfield markings, etc. on asphalt concrete paving. Paint strips shall be 4 inches wide (except otherwise indicated) and applied with two (2) coats of herein specified Traffic Line Paint; white (except as otherwise specified or indicated).

1. Paints shall be delivered to the site in unopened containers.
  - a. Paint shall not be diluted, or watered down.
  - b. Paint shall be applied in 10-12 wet mil thickness (4-6 mil dried). Each coat thickness shall be verified by the project inspector.
2. International Accessible Symbol: Symbol shall be white figures on a blue background. Blue shall be equal to PMS 293C. Lines and symbols shall be accurately formed and true to line and form; lines shall be straight and uniform in width. Painted edges shall be clean cut and free from raggedness, and corners shall be cut sharp and square. Tolerances: Apply striping within a tolerance 1/2 inch in 50 feet. Apply markings and striping to widths indicated with a tolerance of 1/4 inch on straight sections and 1/2 inch on curved sections.

F. Colors: As directed by Architect

G. Precast Concrete Bumpers: Install in location where shown, using steel rebar dowels, and epoxy.

### 3.04 DEFECTIVE ASPHALT; Defective asphalt is as described below.

- A. Exposed rock pockets on the finished surface that lack the # 8- #200 fines that is required per the sieve analysis.
- B. Asphalt not placed to the design grades.
- C. Asphalt that ponds water.
- D. Asphalt that was compacted below the minimum required temperature and is cracked.
- E. Asphalt that fails to meet the minimum compaction requirements.
- F. Asphalt that lacks the minimum thickness required per plan.
- G. New asphalt contaminated by a petroleum product, or spilled paint.

- H. Asphalt that has depressions, cracks, scored divits from dumpster wheels, heavy equipment use, heavy construction products,
- I. Asphalt placed on pumping, unstable sub-grades.

3.05 CLEANING

- A. Refer to Section 01 74 00.
- B. Upon completion of work of this Section promptly remove from the working area all scraps, debris and surplus material of this Section.
- C. Clean excess material from surface of all concrete walks and utility structures.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Use this specification when 32 12 00 Asphalt Concrete paving is not required.
- Two applications of seal coat are to be provided on asphalt paving.
- Crack fill required prior to placement of seal coat.
- Typical seal coat cure time is 30 days after placement.
- Two application of waterborne paint are required for all striping.
- Parking lots to be striped per CDE and MUTCD standards.
- Hardcourt striping layout to be provided by Architect/Engineer. Site Principal will provide comments on layout as necessary.



## SECTION 32 12 36

## PAVEMENT SEALER STRIPING AND SIGNAGE

**DESIGNER! DO NOT USE THIS SECTION IF ASPHALT CONCRETE SECTION IS USED****PART 1 - GENERAL****1.01 SUMMARY****A. SECTION INCLUDES:**

1. Asphalt Seal Coat and Striping.

**B. RELATED SECTIONS**

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 01 50 00, Construction Facilities and Temporary Controls.

**1.03 QUALITY ASSURANCE**

- A. Use only new materials and products, unless existing materials or products are specifically shown otherwise on the Drawings to be salvaged and re-used.
- B. All materials, components, assemblies, workmanship and installation are to be observed by the Owner's Inspector of Record. Work not so inspected is subject to uncovering and replacement.
- C. The representatives of the Owner's testing lab will not act as supervisor of construction, nor will they direct construction operations. Neither the presence of the Owner's testing lab representatives nor the testing by the Owner's testing lab shall excuse the contractors or subcontractors for defects discovered in their work during or following completion of the project. Correcting inadequate compaction is the sole responsibility of the contractor.
- D. Contractor shall provide verification that asphalt mix temperature meets the requirements of this specification at time of application.
- E. Contractor shall be solely responsible for all subgrades built. Any repairs resulting from inadequate compaction are the responsibility of the contractor.
- F. Sieve analysis from testing laboratories identifying rock/sand percentages within the asphalt mix shall have a testing date within 90 days of contract signing.
- G. Sieve analysis from a testing laboratory identifying rock/sand percentages within the class 2 aggregate base rock shall have a testing date within 90 days of contract signing.

**1.04 SUBMITTALS**

- A. Refer to Section 01 33 00.
- B. Manufacturer's Data: Submit list and complete descriptive data of all products proposed for use. Include manufacturer's specifications, published warranty or guarantee, installation instructions, and maintenance instructions.

#### 1.05 WARRANTY

- A. Refer to General Conditions and Section 017836.

#### 1.06 REFERENCES AND STANDARDS

- A. ANSI/ASTM D698-00 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.
- B. ANSI/ASTM D1556-00 - Test Method for Density of Soil in Place by the Sand-Cone Method.
- C. ANSI/ASTM D1557-02 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb. (4.54 Kg) Rammer and 18 inch (457 mm) Drop.
- D. ANSI/ASTM D 3017-05 Test Methods for Moisture Content of Soils and Soil-Aggregate Mixture by Nuclear Methods (Shallow Depth).
- E. ANSI/ASTM D 4318-05 Test Method for Liquid Limit, Plastic Limit, and Plasticity Limit.
- F. CALTRANS Standard Specifications.
- G. CAL-OSHA, Title 8, Section 1590 (e).
- H. Any work within the street, highway or right-of-way shall be performed in accordance with the requirement of the governmental agencies having jurisdiction, and shall not begin until all of those governing authorities have been notified.

#### 1.07 DELIVERY, STORAGE AND HANDLING

- A. Transport, store and handle in strict accord with the local jurisdiction.
- B. Make delivery to job when notified by Contractor verifying that the job is ready to receive the work of this Section and that arrangements have been made to properly store, handle and protect such materials and work.

#### 1.08 PROJECT CONDITIONS

- A. Environmental Requirements:
  - 1. Base Course: Do not lay base course on muddy subgrade, during wet weather, or when atmospheric temperature is below 40 degrees F.
  - 2. Asphalt Surfacing: Do not apply asphaltic surfacing on wet base, during wet weather, or

when atmospheric temperature is below 50 degrees F.

- B. Contractor shall acquaint himself with all site conditions. If unknown active utilities are encountered during work, notify Architect promptly for instructions. Failure to notify will make Contractor liable for damage to these utilities arising from Contractor's operations subsequent to discovery of such unknown active utilities.
- C. Adequate protection measures shall be provided to protect workmen and passers-by on and off the site. Adjacent property shall be fully protected throughout the operations. Blasting will not be permitted. Prevent damage to adjoining improvements and properties both above and below grade. Restore such improvements to original condition should damage occur. Replace trees and shrubs outside building area disturbed by operations.
- D. In accordance with generally accepted construction practices, the Contractor shall be solely and completely responsible for working conditions at the job site, including safety of all persons and property during performance of the work. This requirement shall apply continuously and shall not be limited to normal working hours.
- E. Any construction review of the Contractor's performance conducted by the owner's representative is not intended to include review of the adequacy of the Contractor's safety measures, in, on, or near the construction site.
- F. Surface Drainage: Provide for surface drainage during period of construction in manner to avoid creating nuisance to adjacent areas. The contractor shall make a reasonable effort on a daily basis to keep all excavations and the site free from water during entire progress of work, regardless of cause, source, or nature of water.
- G. Adjacent streets and sidewalks shall be kept free of mud, dirt or similar nuisances resulting from earthwork operations.
- H. The site and adjacent influenced areas shall be watered as required to suppress dust nuisance. Dust control measures shall be in accordance with the local jurisdiction.

#### 1.09 TESTING

- A. General: Refer to Section 01 40 00 – Quality Requirements.

### **PART 2 - PRODUCTS**

#### 2.01 MATERIALS

- A. Seal Coat: shall be an asphalt emulsion blended with select fillers and fibers such as:
  - 1. "Park-Top No. "327", a Western Colloid Product.
  - 2. "OverKote", Reed and Graham.
  - 3. "Park Top No. "302" with sand. (When specifically called for in the drawings).
- B. Precast Concrete Bumpers: 3000 psi at 28 day minimum strength; 48" length unless otherwise

indicated; provide with steel dowel anchors and concrete epoxy.

C. Crack Fill:

1. Cracks 1/8" – 1": "Docal 1100 Viscolastic, distributed by Conoco, Inc., Elk Grove, CA, (916) 685-9253, or an approved equal.
2. Cracks greater than 1": "Topeka" Hot Mix.

2.02 PAVEMENT MARKING PAINT

- A. Approved Manufacturers: TT-P-1952 F traffic paint.
- B. Colors: As directed by Architect and California Building Code

**PART 3 - EXECUTION**

3.01 INSPECTION

- A. Examine areas to receive asphalt sealcoat and verify following:
1. Absence of wet receiving surfaces or other conditions to adversely affect execution of his work.
  2. No foreseeable rain within 72 hrs. after application.
  3. Daytime temperatures of 50 degrees and rising.
- B. Do not start work until unsatisfactory conditions have been corrected and/or daytime temperatures are maintained above the minimum.

.3.02 PAVEMENT SEALER (Seal Coat)

- A. Surface Preparation: surface and cracks shall be clean of all dirt, vegetation, sand, oil or grease. Broom, blow and hose down entire area with a strong jet of water to remove all debris, dirt and sand.
1. Remove soft, loose, or otherwise damaged areas of asphalt concrete to full depth of damage and replace with compacted hot mix asphalt concrete as specified herein.
    - a. Minor holes and imperfections may be patched using hot mix asphalt or a mastic consisting of sand and SS-1-H.
  2. Fill all cracks with a mastic filler up to a level condition. Provide multiple fills on deeper cracks so the cured product is level. Any shrinkage within the cracks will be refilled until it cures level.
- B. Seal Coat Application: Thoroughly mix water with raw materials and apply in accordance with the following,
1. No more than 15% by volume of water can be added to the sealcoat raw mix.
  2. The water shall be added onsite to the raw mix in the presence of the project inspector.
    - a. Any deviation from this procedure will be cause for rejection and re-application at the contractor expense with no additional cost to the owner.
    - b. The contractor shall supply a measuring devise to accurately measure the added water and

be verifiable by the project inspector.

3. The contractor shall place 2 coats of seal coat.
  - a. The first coat shall be applied at a rate of 25 gals per 1000 sq. ft.
  - b. The second coat shall be applied at a rate of 15 gals. per 1000 sq. ft.
  - c. Both applications shall be applied in the presence of the project inspector. Failure to do so will be reason for rejection and reapplication by the contractor at his expense with no extra cost to the owner. The second coat of sealcoat shall not be applied until the first coat thoroughly dried.
  - d. Keep vehicles off the fresh coated surface for a minimum of 24 hrs. or longer in cooler climates.

C. Clean-Up and Precautions: As recommended by pavement sealer material manufacturer.

1. Remove all utility box lids, including drop inlet grates and clean seal coat from edges of lids so future removal is possible

### 3.03 PAVMENT MARKING

- A. Painted pavement markings shall be done only after the seal coat has thoroughly dried.
- B. Clean surfaces to be painted with traffic paint of dust, dirt, grime, oil, rust or other contaminants which will impair the quality of work or interfere with proper bond of paint coats. Surfaces shall be cleaned to the extent by whatever means necessary that will satisfactorily accomplish the purpose of cleaning the surface without damage to asphalt concrete.
- C. Provide measured layouts, temporary markings, templates, and other means necessary to provide required marking.
- D. Prepare and apply paint in accordance with manufacturer's instructions; paint shall be applied by spray and shall achieve complete coverage free from voids and thin spots.
  1. The each coat of paint shall be sprayed at a rate of 10-12 mils wet, 5-7 mils dry
  2. The first coat of paint shall thoroughly dry before the second coat is applied.
  3. Paint shall not be applied during any windy conditions or anticipated rain events.
- E. Where indicated on the Drawings, paint parking stall strips, lettering, arrows, accessible symbols, playfield markings, etc. on asphalt concrete paving. Paint stripes shall be 3 inches wide (except otherwise indicated) and applied with two (2) coats of herein specified Traffic Line Paint; white (except as otherwise specified or indicated on the drawings).
  1. International Accessible Symbol: Symbol shall be white figures on a blue background. Blue shall be equal to color No. 15080 in Fed. Std. 595a.
- F. Lines and symbols shall be accurately formed and true to line and form; lines shall be straight and uniform in width.
- G. Painted edges shall be clean cut and free from raggedness, and corners shall be cut sharp and square.

- H. Tolerances: Apply striping within a tolerance of 1/2 inch in 50 feet. Apply markings and striping to widths indicated with a tolerance of 1/4 inch on straight sections and 1/2 inch on curved sections.

### 3.04 SITE SIGNAGE

- A. Provide and erect site signage at the locations shown in the drawing and drawing detail(s)

1. Products;

- a. Sign Post; 1-1/2" (1.90" O.D.) Sch. 40 Galv. Pipe
- b. Post Cap; 1-1/2" (1.90" I.D.) Galv. Domed Cap
- c. Sign Brackets; U-Clamp steel plate bracket with bolts sized for 1-1/2" 1.90" O.D.) pipe. 2 per sign.
- d. Sign Post Sleeve; 2" (2.38" O.D.) Sch. 40 Galv. Pipe with 3/8 X3" bolt & Nut.
- e. Concrete Footing; 4 sack, 2500 psi
- f. "Stop" Sign; MUTCD; R1-1
- g. "Accessible Parking Sign" with \$250 Fine; MUTCD (Ca) R99C
- h. Accessible Parking Lot Entrance Sign; MUTCD (Ca) R100B
- i. "Van Accessible" Sign; MUTCD (Ca) R7-8b
- j. "Passenger Loading Zone Only" Sign; G-66 RA5
- k. Sign Sleeve Through Bolt; 3/8" zinc plated bolt, nut, and lock washer.

2. Installation

- a. Pier Footings shall be per diameter and depth shown in the drawing detail.
- b. Pier shall crown 1" higher in the center than the surrounding finish grade except when installing the post in a lawn area, the last 4" to the top of the pier shall be 12"X12" square. The top shall match the adjacent sidewalk elevation with a 1" crown higher in the center.
- c. Sleeves and posts shall be installed to within 1/8" of plumb in 80".
- d. Top of sleeves shall be placed no greater than 3" and no less than 2" above finish grade with a 7/16" hole for the through bolt.
- e. All sleeves and posts shall be placed so the post top is no greater than 3" but no less than 2" taller than the top of the highest mounted sign.
- f. All signage shall be mounted to 80" (6'-8") to the bottom of the sign(s) measured from finish grade. Exception; The parking lot accessible entrance signage shall be mounted no less than 36" and no greater than 40" when placed within a "Planter", other wise it shall be installed at 80" to the bottom of the sign.
- g. The accessible parking lot entrance sign shall have the name of the code enforcing agency along with the phone number. This information shall be an integral part of the sign when ordered.
- h. All posts shall have post caps installed and locked down by set screw. Glue on is not acceptable.

### 3.05 PROTECTION

- A. Provide barricades, warning signs and devices as required to protect sealcoat and Striping during application and drying period.

### 3.06 DEFECTIVE SEALCOAT

- A. The following description of sealcoat is considered defective and shall be corrected per the Engineers instructions.
  - 1. Sealcoat that's peeling, scaling, or blistering
  - 2. Sealcoat diluted greater than 15% the maximum dilution rate.
  - 3. Sealcoat that doesn't fill all of the crevasses within the asphalt up to a level and smooth surface.
  - 4. Sealcoat that lacks the minimum coverage rate as directed in specifications.
  - 5. Sealcoat applied over petroleum products such as diesel, oil, grease, etc.

### 3.07 CLEANING

- A. Refer to Section 01 74 00.
- B. Upon completion of work of this Section promptly remove from the working area all scraps, debris and surplus material of this Section.
- C. Clean excess material from surface of all concrete walks and utility structures.
- D. Clean all striping overspray from the asphalt, if necessary use blackout paint for made for asphalt.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Slope "courtyards" at 1.0%min and 1.8% max, typical all directions.
- Slope walkways at 1.8% max cross slope and 4.8% max in direction of travel.
- Accessible ramps shall be sloped at not more than 1:12. Design shall not exceed 8.0%
- Railing at ramps shall be hot dipped galvanized.
- Aggregate base thickness supporting concrete paving shall meet recommendations as provided in Geotechnical Report.
- All concrete flatwork shall be provided with reinforcing. #4 rebar at 24" o.c.e.w. typical.
- Minimum thickness of concrete paving shall be 5" for non-traffic rated and 6" for traffic rated concrete sections.
- Accessible parking stalls shall consist of concrete paving, vehicular rated.



SECTION 32 16 00

SITE CONCRETE

**PART 1 - GENERAL**

1.01 SUMMARY

A. SECTION INCLUDES:

1. The Section describes the requirements for providing portland cement concrete paving, including accessibility ramps, sidewalks, accessible routes of travel, vehicular travel, drain structures, sewer structures, thrust blocks and for other non-structural or non-vehicular applications.

B. RELATED SECTIONS

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 01 50 00, Construction Facilities and Temporary Controls.
3. Section 310000, Earthwork.
4. Section 313200, Soil Stabilization.

1.02 REFERENCES AND STANDARDS

- A. California Building Code, latest edition.
- B. ACI Standards, ACI 211.1, ACI 318-14, ACI 302, IR-04, ACI 301-16, ACI 305R-10, ACI 306R-16, ACI 308-16.
- C. ASTM C-94, Specification for Ready-Mixed Concrete.
- D. Concrete Reinforcing Steel Institute (CRSI) Manual of Standard Practice (latest edition).
- E. ASTM – American Society for Testing and Materials.

1.03 SUBMITTALS

- A. Refer to Section 01 33 00.
- B. Manufacturer's Data: Submit list and complete descriptive data of all products proposed for use. Include manufacturer's specifications, published warranty or guarantee, installation instructions, and maintenance instructions.

- C. Materials list: Submit to the Architect a complete list of all materials proposed to be used in this portion of the work. Submitted items should include but are not limited to sand, gravel, admixtures, surface treatments, coloring agents, sealers, fibers, cast-in-place accessories, forming and curing products and concrete mix designs.
- D. With concrete submittal, provide documented history of mix design performance.

1.04 QUALITY ASSURANCE

- A. Use only new materials and products.
- B. Use materials and products of one manufacturer whenever possible.
- C. All materials, components, assemblies, workmanship and installation are to be observed by the Owner's Inspector of Record. Work not so inspected is subject to uncovering and replacement.
- D. Sieve analysis from testing laboratories identifying rock/sand percentages within the concrete mix; or class 2 aggregate base shall have the current project name and project location identified on the report. Outdated analytical reports greater than 90 days old will not be accepted

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver undamaged products to job in manufacturer's sealed containers and/or original bundles with tags and labels intact.
- B. Store materials in protected, dry conditions off of ground and in areas so as to not interfere with the progress of the work.
- C. Transport, store and handle in strict accord with the manufacturer's written recommendations.
- D. Make delivery to job when notified by Contractor verifying that the job is ready to receive the work of this Section and that arrangements have been made to properly store, handle and protect such materials and work.
- E. Store cement in weather tight building, permitting easy inspection and identification. Protect from dampness. Lumpy or stale cement will be rejected.
- F. Aggregates: Prevent excessive segregation, or contamination with other materials or other sizes of aggregate. Use only one supply source for each aggregate stock pile.

1.06 WARRANTY

- A. Refer to General Conditions and Section 01 78 36.

1.07 TESTING

- A. General: Refer to Section 01 40 00 – Quality Requirements.
- B. Cement and Reinforcing shall be tested in accordance with CBC Section 1910A. Testing of reinforcing may be waived in accordance with Section 1910A.2 when approved by the Structural Engineer and DSA.

1.08 ADEQUACY AND INSPECTION

- A. Design, erect, support, brace and maintain formwork and shoring to safely support all vertical and lateral loads that might be applied until such loads can be carried by concrete.
- B. Notify Inspector, Architect and DSA at least 48 hours prior to placing of concrete.

1.09 PROTECTION

- A. Finish surfaces shall be protected at all times from concrete pour. Inspect forming against such work and establish tight leak-proof seal before concrete is poured. Finish work damaged, defaced or vandalized during the course of construction shall be replaced by contractor at contractor expense.

1.10 FIELD MEASUREMENTS

- A. Make and be responsible for all field dimensions necessary for proper fitting, slopes and completion of work. Report discrepancies to Architect before proceeding.

**PART 2 - PRODUCTS**

2.01 MATERIALS

- A. Cement: Portland cement, ASTM C150, Type II, per ACI 318-14 Section 26.4.
- B. Concrete Aggregates: Normal weight aggregates shall conform to ASTM C33, except as modified by this section. Combined grading shall meet limits of ASTM C33. Lightweight aggregate shall conform to ASTM C330, suitably processed, washed and screened, and shall consist of durable particles without adherent coatings.
- C. Water: Clean and free from deleterious amounts of acids, alkalis, scale, or organic materials and per ACI 318-14 Section 26.4.1.3.1.
- D. Fly Ash: Western Fly Ash, conforming to ASTM C618 for Class N or Class F materials (Class C is not permitted). Not more than 15% (by mass) may be substituted for portland cement.
- E. Water Reducing Admixture: Admixture to improve placing, reduce water cement ratio, and ultimate shrinkage may be used. Provide WRDA 64 by Grace Construction Products or approved equal. Admixture shall conform to ASTM C494 and ACI 318-14 Section 26.4.1.4.19(a). Such admixture must receive prior approval by the Architect, Structural Engineer, and the Testing Lab, and shall be included in original design mix.
- F. Air-entraining Admixture: Daravair 1000 by Grace Construction Products or approved equal. Admixture

must conform to ASTM C260 and ACI 318-14, section 26.4.1.4.

- G. Surface Retarder (for exposed aggregate finishes): Rugasol-S by Sika Corporation or approved equal.
- H. Form Coating: Material which will leave no residue on concrete surface that will interfere with surface coating, as approved by the Architect.
- I. Reinforcement Bars: New billet steel deformed bars conforming to requirements of ASTM A615 or ASTM A706; Grade 60. Dowels for installation through expansion joints or construction joints to existing sidewalks or concrete features shall be smooth or shall be sleeved on one end for slippage.
- J. Reinforcing supports: Galvanized metal chairs or spacers or metal hangers, accurately placed 3'-0" O.C.E.W. Staggered and each support securely fastened to steel reinforcement in place. Bottom bars in footings may be supported with 3" concrete blocks with embedded wire ties. Concrete supports without wire ties will not be allowed.
- K. Truncated Domes: Vitrified Polymer Composite (VPC), Cast-In-Place Detectable/Tactile Warning Surface Tiles; "Armor-Tile", "Access Tile Tactile Systems", or approved equal. Tiles shall comply with Americans with Disabilities Act and the California Code of Regulations (CCR) Title 24, Part 2, Chapter 11B (dome spacing shall be 2.35"). Install tiles as recommended by manufacturer. Color, federal yellow (FS 33538).
- L. Curing Compound (for exterior slabs only): Burke Aqua Resin Cure by Burke by Edoco, 1100 Clear by W.R. Meadows or accepted equal. Water based membrane-forming concrete curing compound meeting ASTM C 309 and C1315.
- M. Concrete Bonding Agent: Weld-Crete by Larson Products Corp., Daraweld C by Grace Construction Products or accepted equal.
- N. Patching Mortar: Meadow-Crete GPS, one-component, trowel applied, polymer enhanced, shrinkage-compensated, fiber reinforced, cementitious repair mortar for horizontal, vertical and overhead applications as manufactured by W.R. Meadows or accepted equal.
- O. Non-shrink Grout: Masterflow 713 Plus by Master Builders or approved equal. Premixed, non-metallic, no chlorides, non-staining and non-shrinking per CRD-C621, Corps of Engineers Specification and ASTM C 1107, Grades B and C.
- P. Aggregate Base: Class 2 AB per Caltrans specification section 26-1.02A.
- Q. Expansion Joint Material: Preformed 3/8" fiber material, full depth of concrete section, with bituminous binder manufactured for use as concrete expansion joint material, as accepted by the Architect.
- R. Joint sealant for expansion joints: Single component silicone sealant, Type S, ASTM D5893.
  - 1. Reference Standard: ASTM C920, Grade P, Class 25, Use T.
  - 2. Dow Corning 890-SL (self-leveling) Silicone, or accepted equal.
  - 3. Dow Corning 888-NS (non-sagging) Silicone, at slopes exceeding 5%. May not be used at asphalt surfaces.

- 4. Color: Custom color as selected by Architect.
- S. Pre- Formed plastic Expansion Joint; W.R. Meadows 3/8" "Snap Cap", Tex-Trude expansion joint cap, or an approved equal.
- T. Adhesive Anchoring (Epoxy): Hilty HIT-HY 200 Safe Set, or approved equal.

## 2.02 CONCRETE DESIGN AND CLASS

- A. Class "B": Concrete shall have 1" max. size aggregate, shall have 3000 psi min. at 28 day strength with a maximum water to cementitious ratio no greater than 0.50. Use for exterior slabs, including walks, vehicular paved surfaces, manhole bases, poured-in-place drop inlets, curbs, valley gutters, curb & gutter and other concrete of like nature.
- B. Slump Limits: Provide concrete, at point of final discharge, of proper consistency determined by Test Method ASTM C143 with a slumps of 4" plus or minus 1".
- C. Mix Design: All concrete used in this work will be designed for strength in accordance with provisions of ASI 318-14 Section 26.4. Should the Contractor desire to pump concrete, a modified mix design will need to be submitted for review. Fly ash may be used in concrete to improve workability in amounts up to 15% of the total cementitious weight.
- D. Air Entrainment; Per the Local Jurisdiction minimum requirements, or 3% minimum.

## 2.03 MIXING OF CONCRETE

- A. Conform to requirements of CBC, Chapter 19A.
- B. All concrete shall be mixed until there is uniform distribution of material and mass is uniform and homogenous; mixer must be discharged completely before the mixer is recharged.
- C. Concrete shall be Ready-mixed Concrete: Mix and deliver in accordance with the requirements set forth in ASTM C94 and ACI 301. Batch Plant inspection may be waived in accordance with CBC Section 1705A.3.3.1, when approved by Structural Engineer and DSA.
  - 1. Approved Testing Laboratory shall check the first batching at the start of the work and furnish mix proportions to the Licensed Weighmaster.
  - 2. Licensed Weighmaster to positively identify materials as to quantity and to certify to each load by ticket.
  - 3. Ticket shall be transmitted to Project Inspector by truck driver with load identified thereon. Project Inspector will not accept load without load ticket identifying mix and will keep daily record of pours, identifying each truck, its load and time of receipt and will transmit two copies of record to DSA.
  - 4. At end of project, Weighmaster shall furnish affidavit to DSA on form satisfactory to DSA, certifying that all concrete furnished conforms in every particular and to proportions established by mix designs.
  - 5. Placement of concrete shall occur as rapidly as possible after batching and in a manner which

will assure that the required quality of the concrete is maintained. In no case may concrete be placed more than 90 minutes from batch time.

6. Water may be added to the mix only if neither the maximum permissible water-cement ratio nor the maximum slump is exceeded. In no case shall more than 10 gallons of water shall be added to a full 9 yard load, or 1 gal. per yard on remaining concrete within the drum providing load tag indicates at time of mixing at plant will allow for additional water.

#### 2.04 MATERIALS TESTING

- A. Materials testing of concrete and continuous batch plant inspection may be waived in accordance CBC Sections 1704A.4.4 when approved by Structural Engineer and DSA.
- B. Testing of concrete shall be performed per article 3.12 of this specification.

#### 2.05 EQUIPMENT

- A. Handling and mixing of concrete: Project Inspector may order removal of any equipment which in his opinion is insufficient or in any way unsuitable.

### PART 3 - EXECUTION

#### 3.01 APPROVAL OF FORMS AND REINFORCEMENTS

- A. Forms and reinforcements are subject to approval by the Project Inspector, and notice of readiness to place first pour shall be given to DSA, Architect and Structural Engineer 48 hours prior to placement of concrete. Before placing concrete, clean tools, equipment and remove all debris from areas to receive concrete. Clean all reinforcing and other embedded items off all coatings oil, and mud that may impair bond with concrete.
- B. All reinforcing steel shall be adequately supported by approved devices on centers close enough to prevent any sagging.
- C. All reinforcing bar lap splices shall be staggered a minimum of 5 ft.
- D. Additional reinforcing steel shall be placed around all utility boxes, valve boxes, manhole frames and covers that are located within the concrete placements.
  1. The bars shall be placed so that there will be a minimum of 1 ½" clearance and a maximum of 3" clearance. The reinforcing steel shall be placed mid-depth of concrete slab.
- E. At all right angles or intersections of concrete walks, additional 2'x2' #5, 90 degree bars shall be added at all inside corners for additional crack control. The bars shall be placed 2" from concrete forms and supports at mid-depth of slab.

#### 3.02 PROTECTION

- A. Protect work and materials of this Section prior to and during installation, and protect the installed work

and materials of other trades.

- B. In the event of damage, make all repairs and replacements necessary to the approval of the Architect at no additional cost to the Owner.
- C. Sub-Grade in vehicular concrete paved areas: Subgrade shall be clean, shaped and compact to hard surface free from elevations or depressions exceeding 0.05' in 10' from true plan. Compact per Section 31 00 00. Compaction and moisture content shall be verified immediately prior to placement of concrete. Proof roll subbase in presence of geotechnical engineer prior to placement of aggregate base.

### 3.03 CLEANING

- A. Reinforcement and all other embedded items at time of placing concrete to be free of rust, dirt oil or any other coatings that would impair bond to concrete.
- B. Remove all wood chips, sawdust, dirt, loose concrete and other debris just before concrete is to be poured. Use compressed air for inaccessible areas. Remove all standing water from excavations.

### 3.04 FORMING

- A. Form material shall be straight, true, sound and able to withstand deformation due to loading and effects of moist curing. Materials which have warped or delaminated, or require more than minor patching of contact surfaces, shall not be reused.
- B. Build forms to shapes, lines, grades and dimensions indicated. Construct form work to maintain tolerances required by ACI 301. Forms shall be substantial, tight to prevent leakage of concrete, and properly braced and tied together to maintain position and shape. Butt joints tightly and locate on solid backing. Chamfer corners where indicated. Form bevels, grooves and recesses to neat, straight lines. Construct forms for easy removal without hammering, wedging or prying against concrete.
- C. Space clamps, ties, hangers and other form accessories so that working capacities are not exceeded by loads imposed from concrete or concreting operations.
- D. Build openings into vertical forms at regular intervals if necessary to facilitate concrete placement, and at bottoms of forms to permit cleaning and inspection.
- E. Build in securely braced temporary bulkheads, keyed as required, at planned locations of construction joints.
- F. Slope tie-wires downward to outside of wall.
- G. Brace, anchor and support all cast-in items to prevent displacement or distortion.
- H. During and immediately after concrete placing, tighten forms, posts and shores. Readjust to maintain grades, levels and camber.
- I. Concrete paving, Curbs, Curb and Gutters, Ramps:

1. Expansion Joints: Install at locations indicated, and so that maximum distance between joints is 20' for exterior concrete unless otherwise shown. Expansion joint material shall be full depth of concrete section. Recess for backer rod and sealant where required. Expansion joints shall not exceed ¼ inch depth measured from finish surface to top of felt or sealant, and ½ inch width.
2. Curbs, Valley Gutter, and Curb & Gutter: Install expansion joints at 60' on center, except when placing adjacent to concrete walks, the expansion joints shall align with the expansion joints shown for the concrete walks. Expansion joint material shall be full depth of concrete section. Recess for backer rod and sealant will be required.
3. Isolation Joints: 3/8" felt between walls and exterior slabs or walks so that paved areas are isolated from all vertical features, unless specifically noted otherwise on plans.
4. Exterior Concrete Paving: Install expansion joints at 20' on center maximum, both directions, unless shown otherwise on plans.
5. Ramps; whether shown or not all ramps shall have control joints and expansion joints.
  - a. Control joints on ramps shall be aligned and be placed in between with the vertical posts for the handrails. The curbs, if required shall have control joints that align with the handrail posts.
  - b. Expansion joints shall be placed at the upper, intermediate, and bottom landings.

### 3.05 FORM COATING

- A. Before placement of reinforcing steel, coat faces of all forms to prevent absorption of moisture from concrete and to facilitate removal of forms. Apply specified material in conformance with manufacturer's written directions.
- B. Before re-using form material, inspect, clean thoroughly and recoat.
- C. Seal all cut edges.

### 3.06 INSTALLATION

- A. General: Reinforcement shall be accurately placed at locations indicated on the drawings within required tolerances and providing required clearances. Reinforcement shall be secured prior to placement of concrete such that tolerances and clearances are maintained. Coverage shall be in accordance with Section 1907A.7 of the CBC. Keep a person on the job to maintain position of reinforcing as concrete is placed. Reinforcement must be in place before concreting is begun. Install dowels as shown on drawings. Give notice whenever pipes, conduits, sleeves, and other construction interferes with placement; obtain method of procedure to resolve interferences. All expansion and construction joints in concrete shall have dowels of size and spacing as shown, or as approved by Architect.
- B. Placing Tolerances:
  1. Per ACI 301 or CRSI/WCRSI Recommended Practice for Placing Reinforcing Bars, unless otherwise shown.
  2. Clear distance between parallel bars in a layer shall be no less than 1", the maximum bar diameter not 1 ½ times the maximum size of coarse aggregate.



C. Splices:

1. General: Unless otherwise shown on drawings, splice top reinforcing at midspan between supports, splice bottom reinforcing at supports and stagger splices at adjacent splices 5 foot minimum. Bar laps shall be wired together. Reinforcing steel laps shall be as follows:
  - a. Lap splices in concrete: Lap splice lengths shall not be less than 62 bar diameter for No. 5 bar, 56" minimum for No. 6 bars. No. 4 bar shall have a minimum of 24" splice. 93 bar diameters for No. 7 bars and larger.
  - b. All splices shall be staggered at 5 feet minimum.

3.07 INSPECTION

- A. Approval of reinforcing steel, after installation, must be received from Inspector. Architect, Structural Engineer and DSA must be notified 48 hrs. in advance of beginning of concrete placement operations.
- B. Slope of concrete forms and finish condition shall be checked with a two foot (2') digital level.

3.08 PLACING OF CONCRETE

- A. Adjacent finish surfaces shall be protected at all times during the concrete pour and finishing. Verify that all formwork is tight and leak-proof before concrete is poured. Finish work defaced during the concrete pour and finishing shall be replaced at no extra cost to the owner.
- B. Transport concrete from mixer to place of final deposit as rapidly as practicable by methods which will prevent separation or loss of ingredients. Deposit as close as practicable in final position to avoid re-handling or flowing. Partially hardened concrete must not be deposited in work. Concrete shall not be wheeled directly on top of reinforcing steel.
- C. Placing: Once started, continue concrete pour continuously until section is complete between predetermined construction joints. Prevent splashing of concrete onto adjacent forms or reinforcement and remove such accumulation of hardened or partially hardened concrete from forms or reinforcement before work proceeds in that area. Free fall of concrete shall not to exceed 4'-0" in height. If necessary, provide lower openings in forms to inject concrete and to reduce fall height.
- D. Remove form spreaders as placing of concrete progresses.
- E. Place footings as monolithic and in one continuous pour.
- F. Keep excavations free of standing water, but moisture condition sub-grade before concrete placement.
- G. Compacting: All concrete shall be compacted by mechanical vibrators. Concrete shall be thoroughly worked around reinforcement and embedded fixtures and into corners of forms. Vibrating shall not be applied to concrete which has already begun to initially set nor shall it be continued so long as to cause segregation of materials.
- H. Concrete Flatwork:

1. All flatwork shall be formed and finished to required line and grades. Flatwork shall be true and flat with a maximum tolerance of 1/8" in 10' for flatness. Flatwork which is not flat and are outside of the maximum specified tolerances shall be made level by the Contractor at no additional expense to the Owner.

[EDIT NOTE: for non-expansive soils, use the following paragraph regarding exterior flatwork subgrade preparation. Verify soil type and appropriate preparation measures with the soils report, soils engineer and civil engineer]

2. Thoroughly water and soak the flatwork subgrade as required to achieve required moisture content prior to the concrete pour. Provide damming as required to keep water within the formed area and to allow for proper saturation of the subgrade.
3. Concrete vibrator shall be used to assist concrete placement. Contractor shall have spare concrete vibrator on site during concrete placement.

[EDIT NOTE: for expansive soils, use the following paragraph regarding exterior slab subgrade preparation. Verify soil type and appropriate preparation measures with the soils report, soils engineer and civil engineer. It is critical for sites with expansive soils, to add a prominent note to the architectural site plan(s)/ Legend/Concrete Walk, requiring that the Contractor review this specification section 310000 requirements and become familiar with these mandatory subgrade preparation measures]

4. Thoroughly water and soak the exterior slabs, curbs, curb and gutters, footing subgrades with multiple daily waterings for at least three (3) days or as required to achieve required moisture content prior to the concrete pour in order to place the subgrade soils in full expansion. Provide damming as required to keep standing water within the formed area and to allow for proper saturation and full expansion of the subgrade soils. Remove any standing water before concrete placement.
- I. Placing in hot weather: Comply with ACI 305R-10. Concrete shall not exceed 85 degrees F at time of placement. Concrete shall be delivered, placed and finished in a sufficiently short period of time to avoid surface dry checking. Concrete shall be kept wet continuously after tempering until implementation of curing compound procedure in accordance with this specification.
  - J. Placing in cold weather: Comply with ACI 306R-16. Protect from frost or freezing. No antifreeze admixtures are permitted. When deposited concrete during freezing or near-freezing weather, mix shall have temperature of at least 50 degrees F but not more than 90 degrees F. Concrete shall be maintained at temperature of at least 50 degrees F for not less than 72 hours after placing or until it has thoroughly hardened. Provide necessary thermal coverings for any flat work exposed to freezing temperatures.
  - K. Horizontal construction joint: Keep exposed concrete face of construction joints continuously moist from time of initial set until placing of concrete; thoroughly clean contact surface by chipping entire surface not earlier than 5 days after initial pour to expose clean hard aggregate solidly embedded, or by approved method that will assure equal bond, such as green cutting. If contact surface becomes contaminated with soil, sawdust or other foreign matter, clean entire surface and re-chip entire surface to assure proper adhesion.

### 3.09 CONCRETE FINISHES

- A. Concrete Slab Finishing: Finish slab as required by ACI 302.1R. Use manual screeds, vibrating screeds to

- place concrete level and smooth. Use "jitterbugs" or other special tools designed for the purpose of forcing the coarse aggregate below the surface leaving a thick layer of mortar 1 inch in thickness. Surface shall be free from trowel marks, depressions, ridges or other blemishes. Tolerance for flatness shall be 1/8" in 10'. Provide final finish as follows:
1. Flatwork, medium broom finish: Typical finish to be used at all exterior walks and stairs.
  2. Ramps, heavy broom finish: Concrete surfaces with slope greater than 5% including all ramps. Brooming direction shall run perpendicular to slope to form non-slip surface
  3. Under no circumstances can water be added to the top surface of freshly placed concrete.
- B. Curb Finishing: Steel trowel.
- C. Joints and Edges: Mark-off exposed joints, where indicated, with 1/4" radius x 1" deep jointer or edging tool. Joints to be clean, cut straight, parallel or square with respect to concrete walk edge. Tool all edges of exposed expansion and contraction joints, walk edges, and wherever concrete walk adjoins other material or vertical surfaces.
1. The expansion joints shall be full depth as shown in the plan details. Failure to do so will result in non-compliance and shall be immediately machine cut by the contractor at his expense.
- D. Exposed Concrete Surface Finishing (not including top surface of flatwork): Remove fins and rough spots immediately following removal of forms from concrete which is to be left exposed. Damaged and irregular surfaces and holes left by form clamps and sleeves shall be patched with grout. Tie wires are to be removed to below exposed surface and holes pointed up with neat cement paste similar to procedure noted under "Patching" below. Removal of tie wires shall extend to distance of 2" below established grade lines. Ends of tie wires shall be cut off flush at all other, unexposed locations. Care shall be taken to match adjacent finishes of exposed concrete surface. After patching, all concrete that is to remain exposed, shall be sacked with a grout mixture of 1-part cement, 1 1/2- parts fine sand and sufficient water to produce a consistency of thick paint. After first wetting the concrete surface, apply mixture with a brush and immediately float entire surface vigorously using a wood float. Keep damp during periods of hot weather. When set, excess grout shall be scraped from wall with edge of steel trowel, allowed to set for a time, then wiped or rubbed with dry burlap. Entire finishing operation of any area shall be completed on the same day. This treatment shall be carried to 4" below grade, and all patching and sacking shall be done immediately upon removal of the forms.
- E. Stair Treads and Risers: Tool exterior stair tread nosing per ADA requirements and as detailed. Paint or stain tooled area at every stair tread nosing or as detailed. Stair tread nosing shall contain no pockets, voids or spalls. Patching is not allowed. Damaged nosing shall be replaced.

### 3.10 CURING

- A. Cured Concrete in Forms: Keep forms and top on concrete between forms continuously wet until removal of forms, 7 days minimum. Maintain exposed concrete in a continuous wet condition for 14 days following removal of forms.
- B. Flatwork/Variable Height Curbs, Curb and gutter, Valley Gutter: Cure utilizing Curing Compound. If applicable, the Contractor shall verify that the approved Curing Compound is compatible with the

approved colorant system. Upon completion of job, wash clean per manufacturer's recommendations.

1. Curing compound shall be applied in a wet puddling application. Spotty applications shall be reason for rejection and possibly concrete removal and replacement at the contractor's expense with no compensation from the owner.
- C. No Curing Compound shall be applied to areas scheduled to receive resilient track surface including, curbs, ramps, run ways, etc.

### 3.11 DEFECTIVE CONCRETE

- A. Determination of defective concrete shall be made by the Architect or Engineer. His opinion shall be final in identifying areas to be replaced, repaired or patched.
- B. The Owner reserves the right to survey the flatwork, if it is determined to be outside of the maximum tolerance for flatness. If the flatwork is found to be out of tolerance, then the Contractor will be required to replace concrete. The Contractor will be responsible for reimbursing the Owner for any surveying costs incurred. Determination of flatwork flatness, surveying and any remedial work must be completed far enough in advance so that the project schedule is maintained, delays are avoided and the new flatwork or flatwork repairs are properly cured.
- C. As directed by Architect, cut out and replace defective concrete. All defective concrete shall be removed from the site. No patching is to be done until surfaces have been examined by Architect and permission to begin patching has been provided.
- D. Permission to patch any area shall not be considered waiver of right, by the Owner, to require removal of defective work, if patching does not, in opinion of Architect, satisfactorily restore quality and appearance of surface.
- E. Defective concrete is:
  1. Concrete that does not match the approved mix design for the given installation type.
  2. Concrete not meeting specified 28-day strength.
  3. Concrete which contains rock pockets, voids, spalls, transverse cracks, exposed reinforcing, or other such defects which adversely affect strength, durability or appearance.
  4. Concrete which is incorrectly formed, out of alignment or not plumb or level.
  5. Concrete containing embedded wood or debris.
  6. Concrete having large or excessive patched voids which were not completed under Architect's direction.
  7. Concrete not containing required embedded items.
  8. Excessive Shrinkage, Traverse cracking, Cracking, Curling; or Defective Finish. Remove and replace if repair to an acceptable condition is not feasible.
  9. Concrete that is unsuitable for placement or has set in truck drum for longer than 90 minutes from the time it was batched.
  10. Expansion joint felt that is not isolating the full depth of the concrete section, and recessed as required for backer rod and sealant where required.
  11. Concrete that is excessively wet or excessively dry and will not meet the minimum or

maximum slump required per mix design.

12. Finished concrete with oil stains from equipment use, and or rust spots that cannot be removed.
  13. Control joints (weakened planed joints) that do not meet the required minimum depth shown on the drawings.
- F. Patching: Install specified Patching Mortar per manufacturer's recommendations. REPAIRS TO DEFECTIVE CONCRETE WHICH AFFECT THE STRENGTH OF ANY STRUCTURAL CONCRETE MEMBER OR COMPONENT ARE SUBJECT TO APPROVAL BY THE ARCHITECT AND DSA.

### 3.12 CONCRETE TESTING

- A. Comply with CBC Section 1903A, 1905A.1.16, 1910A and 1705A.3 and as specified in B. below. Costs of tests will be borne by the Owner.
- B. Four identical cylinder samples for strength tests of each class of concrete placed each day shall be taken not less than once a day, or not less than once for each 50 cubic yards of concrete, or not less than once for each 2,000 square feet of surface area for slabs or walls. In addition, samples for strength tests for each class of concrete shall be taken for seven-day tests at the beginning of the concrete work or whenever the mix or aggregate is changed.
- C. Strength tests will be conducted by the Testing Lab on one cylinder at seven (7) days and two cylinders at twenty-eight (28) days. The fourth remaining cylinder will be available for testing at fifty-six (56) days if the 28-day cylinder test results do not meet the required design strength.
- D. On a given project, if the total volume of concrete is such that the frequency of testing required by paragraph B. above would provide less than five strength tests for a given class of concrete, tests shall be made from at least five randomly selected batches or from each batch if fewer than five batches are used.
- E. Cost of retests and coring due to low strength or defective concrete will be paid by Owner and back-charged to the Contractor.
- F. Each truck shall be tested for slump before concrete is placed.

### 3.13 REMOVAL OF FORMS

- A. Remove without damage to concrete surfaces.
- B. Sequence and timing of form removal shall insure complete safety of concrete structure.
- C. Forms shall remain in place for not less than the following periods of time. These periods represent cumulative number of days during which temperature of air in contact with concrete is 60 degrees F and above.
  1. Vertical forms of foundations, walls and all other forms not covered below: 5 days.
  2. Slab edge screeds or forms: 7 days.

- 3. Concrete columns and beam soffits: 28 days.
- D. Concrete shall not be subjected to superimposed loads (structure or construction equipment) until it has attained its full design strength and not for a period of at least 21 days after placing. Concrete systems shall not be subjected to construction loads in excess of design loads.

3.14 CLEANING

- A. Refer to Section 01 74 00.
- B. Upon completion of work of this Section promptly remove from the working area all scraps, debris and surplus material of this Section.
- C. Clean excess material from surface of all concrete walks and utility structures.
- D. Power wash all concrete surfaces to remove stains, dried mud, tire marks, and rust spots.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Provide ornamental iron fencing along the public way and school frontage. Chain link fencing is provided on all other property lines.
- Spec'd material is galvanized. Confirm if is to be black vinyl coated is to be used.
- Provide no-climb material at very specific locations as requested by owner.
- Provide vinyl slats with "total privacy" wings at very specific locations as requested by owner.
- Maintenance gates at play fields to be 8 feet wide. Maintenance gates for all other areas to be 6 feet wide.
- Provide rolled curb access at maintenance gates that are accessible from parking lots.

## SECTION 32 31 13

## CHAIN LINK FENCES AND GATES

**PART 1 - GENERAL**

## 1.01 SUMMARY

## A. SECTION INCLUDES

1. Fence framework, fabric, and accessories.
2. Excavation for post bases; concrete foundation for posts.
3. Manual gates and related hardware.

## B. RELATED SECTIONS

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 08 71 00: Door Hardware.
3. Section 32 16 00: Site Concrete.

## 1.02 REFERENCES

- A. ANSI/ASTM A123 - Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
- B. ANSI/ASTM F567 – Installation of Chain link Fence.
- C. ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- D. ASTM C94 – Ready-mixed Concrete.
- E. Chain link Fence Manufacturers' Institute (CLFMI) – Product Manual.

## 1.03 SYSTEM DESCRIPTION

- A. Fence Height: 6'-0" unless otherwise noted.
- B. Line Post Spacing: At intervals not exceeding 10 feet.

## 1.03 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 01 33 00.



- B. Submit samples of Vinyl Slats for color selection by Engineer.

#### 1.04 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years experience.
- B. Installer: Company specializing in installations of chain-link fencing with a minimum of five years of experience. If any welding is required provide welders' certificates, verifying AWS qualification within the previous 12 months.

#### 1.05 FIELD MEASUREMENTS

- A. Verify field measurements are as indicated on shop drawings.

#### 1.06 WARRANTY

- A. Manufacture of slats to provide a 25 year warranty against color fading and breakage of slats.

### PART 2 – PRODUCTS

#### 2.01 MATERIALS

- A. Fabric:

**(DESIGNERS!! SELECT THE APPROPRIATE MESH FOR YOUR PROJECT. DELETE THOSE NOT USED.)**

1. Type A - Non-Slatted Fabric: Standard Industrial grade, 1-3/4 inch mesh, 9 gauge hot-dipped galvanized steel wire, top selvage, knuckle end closed, bottom selvage, knuckled end closed.
2. Type B - Non-Slatted Fabric: Black vinyl coated tight weave, 1" mesh, 9-gauge zinc coated steel wire coated with black vinyl, top selvage knuckled tight, bottom selvage knuckled end closed. Posts to be powder coated where vinyl coated fabric occurs. Finish: ASTM F 668 Class 2b, 7mil (0.18 mm) thickness thermally fused over zinc-coated wire. Color shall be: BLACK, GREEN, BROWN, BEIGE (to be chosen by Owner's Representative).
3. Type C - Non-Slatted Fabric: Black vinyl coated tight weave: 2" mesh, 9-gauge zinc coated steel wire coated with black vinyl, top selvage knuckled tight, bottom selvage knuckled end closed. Posts to be powder coated where vinyl coated fabric occurs. Finish: ASTM F 668 Class 2b, 7mil (0.18 mm) thickness thermally fused over zinc-coated wire. Color shall be: BLACK, GREEN, BROWN, BEIGE (to be chosen by Owner's Representative).
4. Type D - Privacy Slatted Fabric: Industrial grade. 3-1/2-inch x 5" diamond mesh interwoven wire with factory installed 2.310" wide PDS "IDS" slats full height or approved equal. Secure slats with monel-clinch-lock staples. 9-gauge zinc coated steel wire, top selvage knuckled tight, bottom selvage knuckled end closed. Color as selected by Owner from Manufacturer's Standard range of colors. Slats to be fabricated of extruded high-density virgin polyethylene, containing color pigmentation and U.V. inhibitors.

- B. Line Posts: ASTM F1083 SCH 40 galvanized, round, 2.875 inch diameter.
- C. Terminal and Corner Posts: ASTM F1083 SCH 40 galvanized, round, 4.000 inch diameter.
- D. Gate Posts: ASTM F1083 SCH 40 galvanized, round, 4.0 inch diameter.
- E. Gate Frame: 1-7/8 inch SCH 40 galvanized diameter, for fittings and truss rod fabrication.
- F. Top Rail, Middle Brace Rail and Bottom Rail: ASTM F1083 SCH 40 galvanized, round, 1.66 inch diameter, plain end, sleeve coupled **at top**.
- G. Tie Wires: 9 gauge galvanized steel wire.
- H. Concrete: ASTM C94; Portland Cement, 2,500 p.s.i. strength at 28 days, 3 inch slump; one inch maximum sized coarse aggregate.
- I. Kickplate: 12 ga. Steel hot dipped galvanized.
- J. Cane Bolt Receiver: 1-1/4" x 8" galvanized pipe.

## 2.02 ACCESSORIES

- A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.
- B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel galvanized.
- C. Gate Hardware: Fork latch with gravity drop mechanical keepers; three 180 degrees gate hinges per leaf and hardware for padlock. Padlock to be provided by District.
- D. ADA Accessible Gate Latch, Lockable; Paddle type lever that opens gate without full rotation.

## 2.03 FINISHES

- A. Components and Fabric: Galvanized to ANSI/ASTM A123; 1.2 oz./sq. ft.
- B. Hardware: Galvanized to ASTM A153, 1.2 oz./sq. ft. coating.
- C. Accessories: Same finish as framing.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install framework, fabric, accessories and gates in accordance with ANSI/ASTM F567-93 and manufacturer's instructions.

- B. Drill caissons to diameter and depth as shown in the drawings, and or details. Clean holes and remove all loose dirt to a hard undisturbed bottom.
  - 1. When placing fence posts in existing asphalt, the existing asphalt shall be cored drilled with a diamond core hole saw 3' larger than the caisson diameter. Under no circumstances shall an auger dirt bit be used to drill through the asphalt.
  - 2. When placing fence posts where the new surrounding finish surface will be asphalt, the fence

posts shall be placed first before the asphalt is laid. Top of post caisson shall be at the top of aggregate base.

- C. Set intermediate, terminal and gate posts plumb in concrete caisson. Slope top of concrete for water runoff. Use concrete vibrator in each caisson during concrete placement to settle and seat concrete.

**(DESIGNER! EDIT FOR FENCE HEIGHT)**

- D. Line, Terminal, and Gate Post Footing Depth Below Finish Grade: 42 inches and 12 inches diameter.
- E. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail, on bay from end and gate post.
- F. Provide top rail through line post tops and splice with 6 inch long rail sleeves.
- G. Install center and bottom rails all around enclosure.
- H. Stretch fabric between terminal posts.
- I. Position bottom of fabric 1 inch above finished grade.
- J. Fasten fabric to top, center and bottom rail and line posts with tie wire at maximum 12 inches on centers.
- K. Attach fabric to end, corner and gate posts with tension bars and tension bar clips at 12 inches on center.
- L. Install gate with fabric to match fence. Install three hinges per leaf, Install latches, catches, retainers and locking clamp.
- M. Provide kickplate at all accessible gate accesses. Weld to gate frame with 3/16" x 1" welds at 4" o.c. Weld all 4 corners. Grind all welds and edges smooth. Treat all welds with galvanizing zinc "Hot Stick."
- N. All field welding to be performed by certified welder and all welds are to be ground down smooth and treated.
- O. All areas of welds are to be thoroughly cleaned, fluxed, and treated with galvanizing zinc "Hot Stick". Do not over heat pipe when treating.
- P. At double swing gates, install cane bolt receiver in concrete measuring 8" diameter, 12" deep.

### 3.02 ERECTION TOLERANCES

- A. Maximum variation from plum: 1/8 inch.
- B. Maximum offset from true position: 3/8 inch.

- C. Components shall not infringe adjacent property lines.

END OF SECTION

## REVISION SUMMARY

## Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 2023-01-06 – Added gate hinge/closer information.

## DISTRICT DESIGN STANDARDS

## Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Provide ornamental iron fencing/gates along the public way and school frontage. Chain link fencing is provided on all other property lines.
- Maintenance gates at play fields to be 8 feet wide. Maintenance gates for all other areas to be 6 feet wide.
- Provide rolled curb access at maintenance gates that are accessible from parking lots.

## SECTION 32 31 19

## DECORATIVE METAL FENCES AND GATES

**PART 1 - GENERAL**

## 1.01 SUMMARY

## A. SECTION INCLUDES:

1. Ornamental picket fencing, gates and accessories.

## B. RELATED SECTIONS:

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 08 71 00: Door Hardware (except hinges which are specified herein).
3. Section 32 13 00: Portland Cement Concrete Paving.

## 1.03 SUBMITTALS

- A. Shop Drawings: Layout of all fences and gates with dimensions, details and finishes of component accessories and post foundations.
- B. Product Data: Manufacturer's catalogue cuts indicating material compliance and specified options including steel tube sizes.
- C. Samples: Color selections for polyester powder coat finish.

**PART 2 - PRODUCTS**

## 2.01 MANUFACTURER

- A. Products from other qualified manufacturers having a minimum of 5 years experience manufacturing ornamental picket fencing will be acceptable by the architect as equal if they meet the following specifications for design, size, gauge of metal parts and fabrication (or equal).
- B. Ornamental Picket Fence and Swing Gates:  
Style: Monumental Iron Works Imperial B-3 Horizontal Rails, or approved equal.  
Heights: 6'0" or as otherwise indicated on the Drawings.
- C. Approved Manufacturers:
  1. Monumental Iron Works, Baltimore, MD,

Phone (888) MH-Fence, (888) 643-3623

2. Ameristar, Tulsa, OK  
Phone (888) 333-3422
3. Merchant Metals  
Phone (770) 741-0300  
211 Perimeter Way, Suite 250  
Atlanta, GA 30346
4. LOCINOX USA.  
Phone (877) 562-4669  
460 Windy Point Drive  
Glendale Heights, IL 60139

## 2.02 ORNAMENTAL PICKET FENCE

- A. Pickets: Square tubular members, ASTM A513, hot-rolled structural quality steel. 50,000 psi (310 Mps) tensile strength, 60,000 psi (372 Mpa) yield strength. Minimum size pickets  $\frac{3}{4}$  inches square x 16 ga. Space pickets 3-15/16" maximum (100mm) face to face. Attach each picket to each rail with  $\frac{1}{4}$ " (6mm) industrial drive rivets. Size #4. Minimum gauge wall thickness solid gauge.
- B. Rails: "U" channels formed from hot-rolled structural steel having no pockets or shelves to hold water or moisture, 1-3/8" (35 mm) wide x 1-1/2" (38 mm) deep, 11-gauge (0.120" (3.05 mm) wall thickness. Punch rails to receive pickets and rivets and attach rails to rail brackets with 2 each,  $\frac{1}{4}$ " (6 mm) industrial drive rivets. Size #4. Steel for rail produced under ASTM A446. Provide top rail, bottom rail, and third rail 6" below top rail.
- C. Posts: Square tubular members, ASTM A500, hot-rolled structural quality steel, 50,000 psi (310 Mpa) Tensile strength, 60,000 psi (372 Mpa) yield strength, with ASTM A525 hot-dipped galvanized G90 coating. Minimum post size 4" sq., having minimum 12-gauge wall thickness. Post size at gates as required to support specified gate leaf size. Posts at all gates to receive LOCINOX hardware shall be between .2 inches and .313 inches thick.
- D. Accessories: post caps.
- E. Finish: After all steel components have been galvanized, clean and prepare the surface of all components to assure complete adhesion of finish coat. Apply 2.5 mil (0.0635) thickness of polyester resin-based powder coating by electrostatic spray process. Bake finish for 20 minutes at 450°C (232°C) metal temperature. Color as selected by Architect from manufacturer's full range of standard colors.

## 2.03 GATES

- A. Ornamental picket swing gates in same style configuration and height as specified fencing.
- B. Gate posts shall be of extra heavy-duty construction and size to adequately support each specified gate



leaf size without sag.

C. Provide panic hardware at non-vehicular gates.

D. Gate Hardware

1. See drawings for gate elevations and hardware groups.
2. Lever Hardware Kit – LOCINOX USA – LAKQ U2 chain link lock kit. For use at required accessible passage type gates not requiring panic devices.
3. Self-Closing Hinge System – LOCINOX USA – Mammoth-HD 180 Degree Closer and Hinge Kit for gates up to 440 lbs. Opening force shall be less than 5 lbs. For use at all accessible required gates along path of travel or along egress route with panic devices. Provide manufacturer's optional mounting hardware for thicker gate post material.
4. Heavy Duty Hinges: Provide heavy-duty weld hinges of size capable of supporting specified leaf width without sag or failure. Gorilla hinge or equal. For all maintenance type swing gates.

#### 2.04 ACCESSORIES

- A. Rail Attachment Brackets – Monumental Iron Works Pro-Arc swivel bracket with up to 30 degree swivel (up/down/left/right) or approved equal). Bracket to fully encapsulate rail end for complete security that is aesthetically pleasing. Note to Bidder: District has standardized on this specific bracket and requires it to be used regardless of which fence panel manufacture is submitted on. Bid accordingly.
- B. Industrial Drive Rivets: Of sufficient length to attach items in a secure non-rattling position. Rivet to have a minimum of 1100 lbs. (4894 N) holding power and a shear strength of 1500 lbs. (6674 N).
- C. Ornamental Picket Fence Accessories: Provide indicated items required to complete fence system. Galvanize each ferrous metal item in accordance with ASTM B695 and finish to match framing.
- D. Post Caps: Formed steel, cast of malleable iron or aluminum alloy, weathertight closure cap. Provide one flat style post cap for each post.
- E. Picket Tops: Flat top with polymer plug.
- F. Hinges: Provide heavy-duty weld hinges of size capable of supporting specified leaf width without sag or failure. Gorilla hinge or equal.
- G. Locking Clasps: Provide heavy-duty hardware to receive padlock at location where gate leaves meet each other or strike post.
- H. Padlocks: Padlocks are provided by District. Contractor to provide necessary padlock quantity to District. Once provided by Owner, Contractor shall re-key to match specific site keying.

- I. Cane Bolt: Provide heavy-duty cane bolt at all 2-leaf gate configurations. Provide at each leaf to secure each leaf into pavement below. Cane bolt shall be capable of being raised and locked in the retracted position when not in use. Provide 12 inch galvanized sleeve receivers encased with 12 inch round concrete in the close and open position. Cane bolts to freely drop and lift in the closed and open position.
- J. Knox Box: Model 3200 series, black. Fully weld to gate frame. Prime and paint affected finish. Location and quantity as shown on drawings. Boxes located at frontage of school shall have a reflective red adhesive sticker on front of lock body. Boxes located at other locations not on main school frontage shall have a reflective green adhesive sticker on front of lock body.
- K. Knox Locks: Model 3700 series, stainless steel, exterior use. Provide at all maintenance gates and fire apparatus gates along fire lane. All locks shall have a reflective green adhesive sticker around lock body.

## 2.05 SETTING MATERIAL

- A. Concrete: Minimum 28-day compressive strength of 3,000 psi.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Verify areas to receive fencing are completed to final grades and elevations.
- B. Ensure property lines and legal boundaries of work are clearly established.

### 3.02 INSTALLATION

- A. Install fence in accordance with manufacturer's instructions.
- B. Space posts uniformly not to exceed a full panel width. Face of post to closest picket not to exceed 3-7/8 inch spacing.
- C. Concrete Fence Set Posts: 24" min.  $\varnothing$  x36" min. deep or as otherwise indicated on drawings.
- D. Concrete Gate Swing Posts: Provide reinforced concrete footings as indicated on the Drawings.
- E. Check each post for vertical and top alignment and maintain in position during placement and finishing operation.
- F. Align fence panels between posts. Firmly attach rail brackets to posts with 1/4" (6 mm) bolt and lock nut, ensuring panels and posts remain plumb.
- G. Position bottom of picket 2 inches above existing/new finished grade. Distance from picket on each end of panel to the support post shall not be greater than 4".

- H. Where touch up paint is necessary, paint shall match powder coated finish. Unacceptable finishes will require re-powder coating.
- I. Cutting of manufacturer's brackets will not be accepted.

### 3.03 GATE INSTALLATION

- A. Install gates plumb, level and secure for full opening without interference.
- B. Attach hardware by means, which will prevent unauthorized removal.
- C. Adjust hardware for smooth operation.
- D. All gates with panic hardware to be third-party shop fabricated in a certified shop along with adjacent posts and header. Galvanized and powder coated finishes.
- E. At gates with LOCINOX closer, Install hinge and closer per manufacturer's recommendations. Provide required backing inside steel gate and post. Install using only manufacturer's provided hardware.
- F. Welding: All welds shall be shop fabricated prior to galvanizing unless otherwise acceptable to Owner's representative. And all field welds shall be completed by a Certified Structural Welder and shall be "spray-galvanized" or otherwise treated subject to the discretion of the Owner's Representative.
  - 1. All field welding to be performed by a certified welder and all welds are to be ground down smooth.
  - 2. All areas of welds are to be thoroughly cleaned and treated with two coats of cold galvanized spray.
  - 3. All maintenance-type hinges shall be welded to the gate post.

### 3.04 ACCESSORIES

- A. Install post caps and other accessories to complete fence. Post caps shall be riveted to post with two rivets on opposite sides of post.

### 3.05 CLEANING

- A. Clean up debris and unused material and remove from site.

### 3.06 ADDITIONAL SUPPLIED ITEMS

- A. Provide a bag of rivets to District.
- B. Provide (4) additional 10 feet long 4 inch square tubing posts.
- C. Provide twenty additional brackets to District.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 2025-01-31 – Various Revisions

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Controller to be Hunter ACC2.
- Controller shall have ethernet pulled to its location and be connected to the central control software.
- All controllers to be compatible with Hunter Centralis central control software and shall have the appropriate low voltage connections available.
- Controllers to be conventionally wired. No new two wire systems to be proposed.
- Regular Flow Application: Remote-Control Valves to be Hunter ICV.
- Low Flow Applications: Remote-Control Valves to be Hunter ICZ.
- Ball valves shall be brass with Stainless Steel hardware, no PVC.
- Gate valves shall have handwheel or operating nut with stainless steel hardware or powder coated cast iron.

- Install union on downstream side of remote control valve when using Leemco angle valve.
- Install unions on both sides of remote-control valve when not using Leemco angle valve.
- Booster Pump to be pre-manufactured and include VFD control.
- Master Valve to be normally open.
- Flow Sensor to be compatible with Hunter ACC2 controller.
- Primer to be used on all solvent weld connections. Grey glue (Weld-On 711 or approved equal) to be used on all solvent weld connections.
- Control/Master Valve/Flow Sensor Wire to be Paige Irrigation P7079D, Polyethylene (PE) coated.
- Leemco fittings to be used with mainline on large modernization projects and new irrigation systems. Remote Control valves assemblies to use Leemco angle valve with Leemco mainline fitting for connection to mainline.
- Upon approval by the District, where Leemco fittings are not currently being used on a site, Schedule 80 fittings and pipe to be used for remote control valve connections to mainline.
- Thrust blocks are not to be used on mainlines with Leemco fittings.
- Provide concrete thrust blocks for solvent weld mainline installations 3" and larger.
- Use Hunter MP Rotators when irrigating shrub/groundcover planting areas. When use of low emission overhead application is undesirable due to narrow planter widths or steep slopes use point source drip, Hunter IH riser with HEB emitter and diffuser cap.
- Tree Bubblers shall be Hunter RZWS, two per tree minimum. All trees should have a dedicated valve and bubblers, including in lawn areas.
- Hunter brand spray bodies and rotors are district standard.
- When possible, valve sports fields playing areas separately from common turf areas so that they can be maintained during drought water restrictions.
- No slip repair coupler fittings to be used.
- Provide spare mainlines at all hardscape crossings. Install two mainlines of equal diameter under all hardscape crossings in lieu of sleeving. The spare mainline shall extend a minimum of 12" past the hardscape and be pressure tested, capped, and located on the as-built drawings.
- Create irrigation hydrozones that account for water restrictions during droughts. Zone high profile landscape, trees, and sports fields separately.
- Provide concrete vaults with steel checker plate lids for all irrigation valves (automatic, quick coupler, gate, etc...). ex. Christy model #N09 for valves.
- Provide steel reinforced concrete collars around all valve boxes located in turf areas or where mowing/small utility equipment may drive over them. See SCUUSD standard details.
- Gardens that are intended to be maintained by the school site shall be designed as follows: designer shall provide water service, controller, and electrical service. Water service shall be connected to the overall irrigation mainline system and shall have a locking gate valve so that the maintenance department can shut-off the water in the event of a mainline/valve failure.
- Where possible, all valve boxes shall be placed in shrub planting beds. Valve boxes in lawn and hardscape should be avoided. If valve boxes need to be placed in lawn or hardscape areas, designer should use traffic rated concrete valve boxes with bolt down traffic rated steel lids with a 12" reinforced concrete border. Valve boxes should be placed at 6" intervals with reinforced concrete between boxes.

SECTION 32 80 00

IRRIGATION

**PART 1 – GENERAL**

Construction Documents and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to this section.

**1.01 SUMMARY**

**A. DESCRIPTION**

1. Scope of Work: Furnish all labor, materials, tools, equipment, and transportation required to perform and complete the installation of an automatic sprinkler irrigation system, including all piping, sprinkler heads, controls, connections, testing, etc. as shown on the Drawings and as specified herein. The water source for this project is potable water [non-potable water].
2. Utilize and accept as standards manufacturer's recommendations and/or installation details for any information not specifically detailed on the Drawings.

**B. RELATED SECTIONS**

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 03 10 00 - Concrete Forming.
3. Division 26 – Electrical.
4. Section 31 00 00 – Earthwork.
5. Section 32 16 00 - Site Concrete.
6. Section 32 90 00 – Landscaping.

**1.02 SUBMITTALS**

- A. Comply with requirements of Section 01 33 00 – Submittal Procedures.
- B. Product names are used as standards; provide proof as to equality of any proposed material and do not use other materials or methods unless approved in writing by the Owner's Representative. Submit no more than one request for substitution for each item. The decision of the Owner's Representative is final.
- C. Use equipment capacities specified herein as the minimum acceptable standards.
- D. List materials in the order in which they appear in Specifications; include substitutions. Submit the list for approval by the Owner's Representative.
- E. Make any mechanical, electrical, or other changes required for installation of any approved, substituted equipment to satisfaction of Owner's Representative and without additional cost to Owner. Approval by Owner's Representative of substituted equipment and/or dimensional drawing does not waive these requirements.

- F. Do not construe approval of material as authorization for any deviations from Specifications unless attention of Owner's Representative has been directed to specified deviations.
- G. Record Drawings: Upon completion of work, and as a precedent to final payment, deliver to Owner's Representative one complete set of reproducible originals of Drawings showing work exactly as installed
  - 1. Regularly update plans of the system and any changes made to the system throughout the project. Record all changes on this plan before trenches are backfilled.
  - 2. Record the as-built information on reproducible plans provided by the Architect. Complete and submit the Record Drawings to the Architect before applying for payment for work installed.
  - 3. As-built drawings are to be completed electronically with a pdf editing software or computer aided drafting software. As-built drawing done by hand will not be accepted for final submittal.
  - 4. Show the following on the Record Drawings accurately to scale and dimensioned from two permanent points of reference:
    - a. Distance of mainline from nearby hardscape.
    - b. Location of automatic control valves, quick couplers, and gate valves.
    - c. Location and size of all sleeves.
    - d. Location of automatic control wires and spares.
- H. Operation Manuals: Deliver two complete sets of manufacturer's warranties, Contractor guarantees, instruction sheets, parts lists and operation manuals to the Architect before requesting final acceptance of the project. Do not request final inspection until the sets are approved.

#### 1.03 QUALITY ASSURANCE

- A. Qualifications of Contractor: Work must be completed by a licensed Landscape Contractor. Provide proof of five years of continuous experience in landscaping and irrigation of projects of similar size (+/- 20% of the construction cost) and scope for education campuses. Contractor to have a minimum of two projects either completed or in construction in the last five years.
- B. Work Force: Ensure that an experienced foreman is present at all times during installation. Keep the same foreman and workers on the job from commencement to completion.
- C. Reviews: Specifically request reviews of all items listed below in "Inspection Requirements" prior to progressing to the next level of work.
- D. Certification: Ensure that the contractor installing the Central Control System is trained and certified in the installation of the Central Control System. The training and certification must have been completed within two years prior to the installation date.
- E. Standards:
  - 1. Provide work and material in full accordance with the rules and regulations of the California Electric Code; the California Plumbing Code; and other applicable state or local laws or regulations.
  - 2. Furnish, without extra charge, additional material and labor required to comply with these rules

and regulations, though the work may not be specifically indicated in the Specifications or Drawings.

3. Where the Specification requirements exceed those of the above-mentioned codes and regulations, comply with the requirements in the Specifications.

F. Comply with the requirements of Section 01 77 00 – Closeout Procedures.

G. Inspection Requirements

1. Request and hold a pre-construction meeting prior to beginning the work of this Section. Parties required to be in attendance are the Landscape Contractor, Project Inspector, Owner's Representative, and the Landscape Architect.
2. Prior to commencement of the work of this Section, obtain written verification from the project Civil Engineer that the rough grade in landscape areas is in conformance with Section 31 00 00 - Earthwork.
3. Obtain verification from Project Inspector for the following at the appropriate times during construction and prior to further progression of work in this Section:
  - a. Pressure testing of all mainlines and lateral lines (See "Hydrostatic Tests – Open Trench" in Part 3.05 of this Section),
  - b. Trench depth,
  - c. Sleeves under pavement,
  - d. Flushing of all mainlines and lateral lines,
  - e. Installation of mainline thrust blocks,
  - f. Installation of Leemco joint restraints and bolts,
  - g. Backfill and pipe bedding,
  - h. Layout of heads,
  - i. Operation of system and coverage adjustments (with Landscape Architect) after system is fully automated and operational, backfill of trenching is completed, and surface has been restored to original grades.
4. In case of failure to obtain any verification by the Project Inspector as required above, remove and replace work as necessary to obtain the verification at no additional cost to the Owner.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Use all means necessary to protect irrigation system materials before, during, and after installation and to protect related work and material.
- B. Handle plastic pipe carefully, especially protecting it from prolonged exposure to sunlight. Store pipe on beds that are the full length of the pipe, and keep pipe flat and off the ground with blocks.

#### 1.05 PROJECT/SITE CONDITIONS

- A. Information on Drawings relative to existing conditions is approximate. During progress of construction, make deviations necessary to conform to actual conditions, as approved by Owner's Representative, without additional cost to Owner. Accept responsibility for any damage caused to existing services. Promptly notify Owner's Representative if services are found which are not shown



on Drawings.

- B. Protect existing utilities within construction area. Repair damages to utility lines that occur as a result of operations of this work.
- C. Verify dimensions at building site and check existing conditions before beginning work. Make changes necessary to install work in harmony with other crafts after receiving approval by Owner's Representative.

#### 1.06 WARRANTY

- A. Guarantee all workmanship and materials hereunder against defective workmanship and materials, including damage by leaks and settlement of irrigation trenches, for the duration specified in Division 01 of these Specifications. (The Contractor is not responsible for vandalism or theft after date of final acceptance.)

#### 1.07 SYSTEM STARTUP

##### A. Booster Pump:

- 1. Order booster pump as soon as possible to avoid delays in the project.
- 2. After booster pump and electrical connections have been installed, power has been made available, the downstream irrigation system has been pressure-tested, heads have been set, and trenches have been backfilled and compacted, request that the booster pump manufacturer's technician participate in and/or direct the start-up of the booster pump. Start-up shall include all testing and settings for the following:
  - a. Flow
  - b. Pressure
  - c. Connections
  - d. Electrical currents
  - e. Wire connections
  - f. Pump installation
- 3. Upon successful completion of testing by the booster pump technician, request that a checklist/certification be completed and signed by the technician. Deliver copies of the certification to both the Owner's Representative and the Landscape Architect prior to the commencement of the landscape maintenance period.

##### B. Central Control System

- 1. Install controllers, master valves, flow sensors, ground system, wiring, cables, Ethernet and any other components not shown on the Drawings.
- 2. Request that the manufacturer's representative participate and/or direct the start-up of the Central Control System. Start-up shall include all testing and settings for the following:
  - a. Flow sensor
  - b. Grounding
  - c. Wire connections

- d. Pump start
  - e. Bypass
  - f. Overall instruction
- 3. Upon successful completion of testing by the technician from [enter technician company], request that a checklist/certification be completed and signed by the technician. Deliver copies of the certification to both the Owner's Representative and the Landscape Architect prior to the commencement of the landscape maintenance period.
  - 4. Run the system; record the flows per valve and report them to the Owner's Representative.

#### 1.08 MAINTENANCE

- A. Furnish three complete sets of operating maintenance instructions bound in a hardback binder and indexed. Start compiling data upon approval of list of materials. Do not request final inspection until booklets are approved by Owner's Representative.
- B. Incorporate the following information in these sets:
  - 1. Complete operating instructions for each item of irrigation equipment.
  - 2. Typewritten maintenance instructions for each item of irrigation equipment.
  - 3. Manufacturer's bulletins which explain installation, service, replacement parts, and maintenance.
  - 4. Service telephone numbers and/or addresses posted in an appropriate place as designated by Owner's Representative.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS

- A. Use materials as specified; any deviation from the Specifications must first be approved by the Owner's Representative in writing. All material containers or certificates shall be clearly marked by manufacturer as to contents for inspection.
- B. Automatic Controller: [see design standards].
- C. Master Valves and Flow Sensors: [see design standards].
- D. Automatic Control Valves: [see design standards].
- E. Drop Control Kit: [see design standards].
- F. Gate Valve: [see design standards].
- G. Pipe and Fittings:
  - 1. PVC pipe: for all mainline and lateral lines, PVC schedule 40 up to 3" size and PVC Class 200 for 4" and larger.
  - 2. PVC fittings three-inch (3") size and smaller: High impact, standard weight, Schedule 40, molded

PVC as manufactured by George Fischer, Lasco, Spears, or approved equal. [LEEMCO APPLICATION - PVC fittings for mainline two inches (2") and smaller and all lateral lines: High impact, standard weight, Schedule 40, molded PVC as manufactured by George Fischer, Lasco, Spears, or approved equal.]

3. PVC fittings four-inch (4") size and larger: High impact, standard weight, Class 200 gasketed, molded PVC as manufactured by George Fischer, Lasco, Spears, or approved equal. [LEEMCO APPLICATION - Ductile iron fittings for all mainline fittings two and one-half inches (2 ½") and larger: Leemco joint restraint fittings or approved equal.]
  4. All plastic pipe and fittings: Continuously and permanently marked with manufacturer's name, type of material, IPS size, schedule, NSF approval, and code number.
  5. Threaded PVC pipe and nipples: IPS Schedule 80 when necessary to use threaded connections to gauges, valves, or control valves. Threaded adapters may be used in place of nipples when making pipe to valve connections.
  6. Use 45-degree fittings for changes in depth of pipe, and at transition from main line to automatic control valves.
  7. Piping above ground: Schedule 40 galvanized steel with cast-iron fittings.
  8. Piping used for electrical purposes to be Schedule 40 PVC Rigid Nonmetallic Conduit electrical conduit.
- H. Booster Pump: [see design standards].
- I. PVC Primer: Weld-On P-70 Purple Primer or approved equal.
- J. PVC Glue: Weld-On 711 Gray heavy bodied PVC Cement or approved equal.
- K. Sprinkler Heads: [see design standards].
- L. Quick Coupler Valves: Rainbird 44np or approved equal.
- M. All Valve Boxes and Covers:
1. Turf and Hardscape Areas: Concrete manufactured with steel checker plate lid with "Irrigation – Non-Potable" permanently embossed on cover. Christie or approved equal.
  2. Shrub Areas: Plastic manufactured with "Irrigation-Non-Potable" permanently embossed on cover.
- N. Reduced Pressure Backflow Preventer: Zurn-Wilkins with Placer Waterworks insulated cage.
- O. Automatic Sprinkler Control Wire:
1. Connections between remote control valves and controller: 14 AWG direct burial plastic polyethylene (PE) insulated wire, Paige Electric P7079D or approved equal. Common wire to be white, and lead wire to be colored. If multiple controllers are used, a different color is to be used for each controller's lead wire. (Use red for the first controller). Spare wires are to be yellow.
  2. UL Listed waterproof sealing pack for wire connections: 3M DBR/Y-6, or approved equal.
  3. Provide adequate working space around electrical equipment in compliance with local codes

and ordinances.

4. Electrical, other than low voltage, such as power wiring, conduit, fuses, thermal overloads and disconnect switches, is included under Division 26 of these Specifications.

P. Automatic Sprinkler Control Decoder Cable [For expansion of existing two-wire systems only]:

1. Connections between remote control valve decoders and controller: Hunter Jacketed Decoder Cable, Paige Electric P7354D. If multiple controllers are used, a different color jacket is to be used for each controller.
2. UL Listed waterproof sealing pack for wire connections: 3M DBR/Y-6, or approved equal.
3. Provide adequate working space around electrical equipment in compliance with local codes and ordinances.
4. Electrical, other than low voltage, such as power wiring, conduit, fuses, thermal overloads and disconnect switches, is included under Division 26 of these Specifications.

Q. Single Station Decoder: match existing two-wire system decoder.

R. Trace Wire:

1. Direct burial #12 AWG Solid, steel core soft drawn tracer wire, 250# average tensile break load, 30 mil high molecular-high density polyethylene jacket complying with ASTM-D-1248, 30-volt rating. Color shall be green.
2. Connectors: UL Listed waterproof sealing pack for wire connections: 3M DBR/Y-6, or approved equal.

S. Master Valve and Flow Sensor Wire:

1. Master valve wires are to be 14 AWG direct burial plastic polyethylene (PE) insulated wire, Paige Electric P7079D or approved equal. Wire color to be blue for the lead and white for the common. If there are two master valves, the second master valve wire is to be blue/white striped for the lead and white for the common.
2. Flow sensor wires are to be 14 AWG direct burial plastic polyethylene (PE) insulated wire, Paige Electric P7079D or approved equal. Wire color to be black for the lead and white for the common. If there are two flow sensors, the wires leading to each flow sensor is to be a different color.

T. Unions And Flanges:

1. Steel unions and flanges two inches (2") and smaller: 150 lb. screwed black (brass to iron seat) or galvanized malleable iron (ground joint).
2. Steel unions and flanges two and one-half inches (2 ½") and larger: 150 lb. black flange union, flat-faced, full gasket.
3. Gaskets: One-sixteenth inch (1/16") thick rubber Garlock No. 122, Johns-Manville or approved equal.
4. Flange Bolts: Open-hearth bolt steel, square heads with cold pressed hexagonal nuts, cadmium plated in ground. Provide copper-plated steel bolts and nuts or brass bolts and nuts for brass flanges.

- U. Pipe Supports: Adjustable saddle support type support.
- V. Valve Identification Tags: Christy's irrigation ID tags, standard yellow color or approved equal.
- W. Sand for Trench Backfill: Natural sand, free of roots, bark, sticks, rags, or other extraneous material.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Locations of existing utilities and other improvements shown on the Drawings are approximate. Verify existing conditions and, should any utilities be encountered that are not indicated on the plans, notify the Owner's Representative immediately. Accept responsibility for any damages caused to existing services.

#### **3.02 PREPARATION**

- A. Scheduling: Notify the Project Inspector prior to commencing and/or continuing the work of this Section. Remove and replace, at no cost to Owner, any work required as a result of failure to give the appropriate notification.
- B. Examination: Examine conditions of work in place before beginning work; report defects.
- C. Measurements: Take field measurements; report variance between plan and field dimensions.
- D. Protection: Maintain warning signs, shoring and barricades as required. Prevent injury to, or defacement of, existing improvements. At no additional cost to Owner, repair or replace items damaged by installation operations.
- E. Existing Tree Protection:
  - 1. Avoid unnecessary root disturbance, compaction of soils within drip line, or limb breakage.
  - 2. Do not store material or dispose of any material other than clean water within the drip line.
  - 3. Provide adequate irrigation during construction.
  - 4. Replace any tree damaged during construction with a tree of equal size and value at no additional cost to Owner.
  - 5. Adjust trench locations in field to minimize damage to existing elements and plant roots of trees-to-remain at no additional cost to Owner.
- F. Surface Preparation: Prior to beginning sprinkler irrigation work, complete placement of topsoil as specified in Section 31 00 00 – Earthwork. Notify Project Inspector of irregularities if any.

#### **3.03 INSTALLATION**

- A. Automatic Controller

1. Automatic Controller: Install system and components as per Drawings and manufacturer's recommendations. All wiring connections shall be neatly accomplished within the controller cabinet. Connect Ethernet and grounding system as per manufacturer's recommendations.
2. Connect automatic control valves to controller(s) in sequence as shown on Drawings.
3. Install all exposed wires to a minimum of twenty-four inches (24") beyond controller within a UL approved rigid conduit.

B. Master Valves and Flow Sensor

1. Master Valve: Install as per manufacturer's recommendation. Connect master valve wiring to the automatic controller. Install wire in a conduit. Wire is not to have any splices between the valve and the controller.
2. Connect Master Valve to decoder cable using a single-station line decoder.
3. Flow Sensor: Install as per manufacturer's recommendation. When using a "saddle" installation, install at the correct depth in the pipe and orientate the paddle properly for accurate reading of flow. Connect flow sensor wire to the automatic controller. Install wire in a conduit. The wire is not to have any splices between the valve and the controller.
4. Connect Flow Sensor to decoder cable using a sensor decoder.

C. Reduced-Pressure Backflow-Prevention Device

1. Install where shown, per code, and per manufacturer's specification and written instructions.
2. Provide pipe supports and accessories as necessary to properly secure the assembly.

D. Booster Pump Assembly

1. Booster Pump: Install as per manufacturer's directions and as detailed on Drawings. Lay out piping in field for exact locations and/or connections.
2. Booster Pump Pad: Install on a level, raised utility pad so booster pump is set level. Encase anchor bolts in the concrete pad.
3. Piping Assembly: Lay out system plumb and level. Paint entire assembly, including the pipe supports. Use metal pipe for all exposed pipe and extend below the ground to the horizontal main line pipe.
4. Coordination: Lay out conduit for electrical components to minimize conduit above grade.

E. Control Wires

1. General: Install control wires beneath sprinkler main line whenever possible; tape wires to mainline pipe. Provide one spare wire for each controller.
2. Slack Wire: Provide eighteen inches (18") of slack wire for each wire connected to automatic control valve. Slack wire shall be coiled and left in the valve box. Tape wires in bundles every ten feet (10'); do not tape wires in sleeves.
3. Expansion and Contraction: Snake wire in trench to allow for contraction of wire.
4. Wire Passing Under Existing or Future Paving or Construction: Encase in PVC Schedule 40 or galvanized steel conduit extending at least twelve inches (12") beyond edges of paving or construction.

5. Wire Connections: Install wire connections in a waterproof sealing pack.
6. Wire Splicing: Permit splicing only on runs exceeding 500 feet. Locate all splices within valve boxes.
7. Wire Termination: Install wire in a valve box with eighteen inches (18") of slack wire coiled and individually capped with approved waterproof sealing pack.
8. Spare Wire: Install two (2) spare wires along each wire path. If there is more than one wire path from the controller, the contractor to install two (2) spare wires per path. Provide eighteen inches (18") of slack wire at each automatic control valve.

F. Decoder Cable

1. General: Install control wires beneath sprinkler main line whenever possible.
2. Slack Cable: Provide eighteen inches (18") of slack cable at each automatic control valve. Slack cable shall be coiled and left in the valve box.
3. Expansion and Contraction: Snake cable in trench to allow for contraction of cable.
4. Cable Passing Under Existing or Future Paving or Construction: Encase in PVC Schedule 40 or galvanized steel conduit extending at least twelve inches (12") beyond edges of paving or construction.
5. Connections: Install cable connections in a waterproof sealing pack.
6. Splicing: Permit splicing only on runs exceeding 500 feet. Locate all splices within valve boxes.
7. Cable Termination: Install cable in a valve box with eighteen inches (18") of slack cable coiled and individually capped with approved waterproof sealing pack. Ground cable at all cable terminations.

G. Trace Wire

1. General: Install trace wire above sprinkler main line whenever possible; tape wire to mainline pipe at 10' intervals to ensure the wire remains adjacent to the pipe.
2. Wire Connections: Install wire connections in a waterproof sealing pack.
3. Trace wire access points shall be accessible at all automatic control valves.
4. At all mainline end caps, a minimum of six feet (6') of tracer wire shall be coiled and secured to the cap for future connections. The end of the tracer wire shall be spliced to the wire of a six-pound zinc anode and is to be buried at the same elevation as the irrigation mainline.
5. Testing: The contractor shall perform a continuity test on all trace wires in the presence of the client. If the trace wire is found to be not continuous after testing, Contractor shall repair or replace the failed segment of the wire.

H. Automatic Control Valves and Quick Coupler Valves

1. Install where shown and where practical; place no closer than twelve inches (12") to walk edges, building walls, or fences. Refer to detail for example.
2. Thoroughly flush mainline before installing valve.
3. Install valves in ground cover areas where possible. Valves shall be installed with lid flush to finish grade of soil. Upon acceptance of 90-day maintenance period, contractor shall cover boxes with bark mulch.

I. Piping

1. General: Install in conformance with reference standards, manufacturer's written directions, as shown on Drawings and as herein specified.
2. Workmanship:
  - a. General: Install sprinkler irrigation equipment in planted areas throughout the site.
  - b. Coordination: Organize location of sleeves with other trades as required.
3. Pipeline Assembly:
  - a. General:
    - 1) Cutting: Cut pipe square; remove rough edges or burrs.
    - 2) Solvent-welded Connections: Use materials and methods recommended by the pipe manufacturer.
    - 3) Brushes: Use non-synthetic brushes to apply solvents and primer.
    - 4) Cleaning: Clean pipe and fittings of dirt, moisture, and debris prior to applying solvent or primer.
    - 5) Assembly: Allow pipe to be assembled and welded on the surface or in the trench.
    - 6) Expansion and Contraction: Snake pipe from side to side of trench to allow for expansion and contraction.
    - 7) Location: Locate pipes as shown on Drawings except where existing supply valves, utilities or obstructions prohibit or where slight changes are approved to better suit field conditions.
  - b. Elastomeric Seal (Gasket) Joints:
    - 1) General: Assemble in strict conformance with the pipe manufacturer's instruction.
    - 2) Rubber Rings: Use rubber rings specific for water service systems.
    - 3) Cleaning: Thoroughly clean ring and groove of dirt, moisture and debris using a clean, dry cloth. Do not use solvents, lubricants, cleaning fluids or other material for cleaning.
    - 4) Seating: Properly seat ring in groove.
    - 5) Spigot: Clean spigot-end of pipe as in "Cleaning" above prior to applying lubricant recommended by pipe manufacturer. Insert spigot into bell and seat to full depth required.
  - c. Connections:
    - 1) Threaded Plastic Pipe Connection:
      - a) Use Teflon tape or pipe joint compound.
      - b) When assembling to threaded pipe, take up joint no more than one full turn beyond hand-tight
    - 2) Metal Valves and Plastic Pipe: Use threaded plastic male adapters.
    - 3) Metal to Metal Connections:
      - a) Use specific joint compound or gasket material for type of joint made. Where pipe of dissimilar metals are connected, use dielectric fittings.
      - b) Where assembling, do not allow more than three full threads to show when joint is made up.
    - 4) Where assembling soft metal (brass or copper) or plastic pipe, use strap-type friction wrench only; do not use a metal-jawed wrench.
    - 5) Threading:



- a) Do not permit the use of field-threading of plastic pipe or fittings. Use only factory-formed threads.
- b) Use factory-made nipples wherever possible. Permit the use of field-cut threads in metallic pipe only where absolutely necessary. When field-threading, cut threads accurately on axis with sharp dies.
- c) Use pipe joint compound for all threaded joints. Apply compound to male thread only.
- d. Sleeves and conduits:
  - 1) Use sleeves of adequate size to accommodate retrieval for repair of wiring or piping and extend a minimum of twelve inches (12") beyond edges of walls or paving.
  - 2) Provide removable, non-decaying plug at end of sleeve to prevent entrance of soil.
- e. Unions: Locate unions for easy removal of equipment or valve.
- f. Joint Restraints: Install per manufacturer's recommendations.
- g. Capping: Plug or seal opening as lines are installed to prevent entrance materials that would obstruct pipe. Leave in place until removal is necessary for completion of installation.
- h. Drip Irrigation Tubing: Install as per Drawings.

#### J. Sprinkler Heads

- 1. Sprinkler heads: Locate as shown on the Drawings except where existing conditions prohibit, or slight changes are approved to achieve as good or better coverage under the same conditions. Do not allow sprinkler head spacing to exceed the maximum shown on the Drawings. Plumb heads.
- 2. Handling, Assembly of Pipe, Fittings, and Accessories: Allow only skilled tradesmen to handle and assemble pipe, fittings and equipment. Keep interior of pipes, fittings and accessories clean at all times. Close ends of pipe immediately after installation; leave closure in place until removal is necessary for completion of installation. Do not permit bending of pipe.
- 3. Flushing: Remove end heads and operate system at full pressure until all rust, scale, and sand is removed. Divert water to prevent ponding or damage to finished work.
- 4. Coverage: Accept responsibility for full and complete coverage of irrigated areas to satisfaction of Landscape Architect and make necessary adjustments to better suit field conditions at no additional costs to Owner.

### 3.04 CONSTRUCTION

#### A. Grading

- 1. Install all irrigation features to their finished grade and at depths indicated. Complete and /or accommodate all rough grading and/or finish grading before commencing with trenching.

#### B. Layout

- 1. Lay out work as accurately as possible to Drawings. Drawings are generally diagrammatic to extent that swing joint offsets and fittings are not shown. Record all changes on the Record Drawings.

2. Do not willfully install the irrigation system as shown on Drawings when it is obvious, in the field, that obstructions or other discrepancies exist which may not have been considered in the design. Notify Owner's Representative of discrepancies before proceeding.

C. Excavating And Trenching

1. General: Perform excavations as required for installation of work included under this Section, including shoring of earth banks to prevent cave-ins. Restore surfaces, existing underground installations, etc., damaged or cut as result of this work to their original condition and in a manner approved by the Landscape Architect.
2. Width:
  - a. Make trenches wide enough to allow a minimum of six inches (6") between parallel pipelines and three inches (3") between side of pipe and side of trench. Do not allow stacking of pipe within trench.
  - b. Allow a minimum clearance of twelve inches (12") in any direction from parallel pipes of other trades.
3. Preparation of Excavations: Remove rubbish and rocks from trenches. Bed pipe on a minimum of three inches (3") of clean, rock-free soil to provide a firm, uniform bearing for entire length of pipeline. Cover pipe with a minimum of three inches (3") of clean, rock-free soil. If clean, rock-free soil is not available, use sand for pipe bedding and three inches (3") of backfill above the pipe. The remainder of the trench backfill material can be native soil. Do not allow wedging or blocking of pipe.
4. Minimum depth of cover: Unless shown otherwise, provide the following minimums:
  - a. Mainline: twenty-four inches (24") cover.
  - b. Lateral line: twelve inches (12") cover for spray heads, and eighteen inches (18") cover for rotor heads.
5. Conflicts with other trades:
  - a. Hand-excavate trenches where potential conflict with other underground utilities exist.
  - b. Where other utilities interfere with irrigation trenching and piping work, adjust the trench depth as instructed by Owner's Representative.

D. Thrust Blocks

1. To resist system pressure on ring-tite PVC pipe and PVC fittings, provide thrust blocks at any change of direction, change of size, dead end, and/or valves at which thrust develops when closed. See thrust block details for examples.
2. Use cast-in-place concrete and size thrust blocks based on an average soil-safe bearing load of 700 lbs. per square foot.
3. Form thrust blocks in such a manner that concrete comes in contact only with the fittings. Place thrust block between adequately compacted soil and the fitting.
4. Thrust blocks are to be constructed of concrete with a minimum of 2500psi.
5. Thrust blocks are to be free, separate, and independent of adjacent or nearby thrust blocks.

E. Backfill And Compacting

1. General: Do not begin until hydrostatic tests are completed. When system is operating and after required tests and inspections have been made, backfill trenches under paving areas to the compaction rate specified in Section 31 00 00 – Earthwork.
2. Place backfill in six-inch (6") layers and compact with an acceptable mechanical compactor.
  - a. Compact backfill material in landscape areas to eighty-five percent (85%) maximum dry density of the soil.
  - b. If settlement occurs along trenches, make adjustments in pipes, valves, and sprinkler heads, soil, sod or paving as necessary to bring the system, soil, sod or paving to the proper level or the permanent grade, without additional cost to the Owner.
3. Excess Soil: Remove all rocks, debris, and excess soil that results from sprinkler irrigation trenching operations, landscape planting, and soil preparation operations off site at no additional cost to the Owner. If soil meets topsoil requirements in Section 31 00 00 – Earthwork, it may be used for finish grading.
4. Finishing: Dress-off areas to eliminate construction scars.

F. Flushing Lines

1. Thoroughly flush lines prior to installing valves, performing hydrostatic testing, or installing sprinklers. Divert water to prevent washouts.

G. Concrete Work

1. Underground anchors and pads for valves boxes are included under this Section of Specifications. Concrete shall have a minimum strength of 2500 psi. The slump test shall be a four inch (4") maximum slump. At twenty-eight days, the concrete shall have a minimum strength of 2500 psi. Use materials and mix in accordance with ASTM C 94. Refer to Section 32 16 00 - Site Concrete.

3.05 FIELD QUALITY CONTROL

- A. Visual Inspection: Verify that all pipe is homogenous throughout and free from visual cracks, holes, or foreign materials. Inspect each length of pipe. All materials are subject to impact test at the discretion of the Landscape Architect.
- B. Hydrostatic Tests – Open Trench:
1. Center-load piping with a small amount of backfill to prevent arching or slipping under pressure.
  2. Request the presence of the Project Inspector in writing at least forty-eight hours in advance of testing.
  3. At no additional cost to Owner, test in the presence of the Project Inspector.
  4. Apply continuous static water pressure of 100 psi when welded plastic joints have cured at least twenty-four hours, and with the risers capped, as follows: test main lines and submains for four hours; test lateral lines for two hours.
  5. Repair leaks resulting from tests; and repeat tests.
  6. Test to determine that all sprinkler heads function according to manufacturer's data and give full coverage according to intent of Drawings. Replace any sprinklers not functioning as

specified with ones that do, or otherwise correct system to provide satisfactory performance.

- C. Continuity Testing: Test locating device and control wires for continuity prior to and after back-filling operations.

### 3.06 ADJUSTING

- A. Adjusting System: Prior to acceptance, satisfactorily adjust and regulate entire system. Set watering schedule on controller appropriate to types of plants and season of year. Adjust remote control valves to operate sprinkler heads at optimum performance based on pressure and simultaneous demands through supply lines.
- B. System Layout: Provide reduced prints of Record Document irrigation plans, laminated in four (4) mil. plastic, of size to fit controller door. Enlarge remote-control valve designations as necessary for legibility. Color-code areas covered by each station. Affix plans to inside of controller door.
- C. Instructions: Upon completion of work, instruct maintenance personnel on operation and maintenance procedures for entire system.
- D. Flow Charts: Record and prepare an accurate flow-rate chart for each automatic control valve.

### 3.07 CLEANING

Remove debris resulting from work of this Section.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.
- 2025-01-31 – Various Revisions

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Do not use fruiting trees or shrubs that are known to have a fruit that can be messy or could be thrown.
- Oak trees are an acceptable tree, but locate trees outside of interior campus to minimize the mess of acorns.
- Do not use trees that are known to have aphid problems near hardscape or parking lots.
- Trees not to be used: Redwood, Liquidamber, Palm, Crape Myrtle, Chinese Tallow, Ornamental Pears
- Trees to be used in limited quantities: London Plane
- Aim to provide 30% evergreen tree species

- Avoid using trees that only flower in the summer. The intent is to have flowering trees that flower when school is in session
- Limit planting trees within 20' of a building to reduce tree canopy from overhanging the building roof
- Designer to coordinate location of trees with all utilities during the CD phase of the project. 10' separation between trees and utilities is recommended.
- Tree shading in parking lots, hardscape, and landscape shall follow title 24 guidelines. Additionally, designer shall achieve a minimum of 30% tree shading in the areas used by children during the school day.
- Design shall try to incorporate a an accessible forest in the design, specifically near/around play structures.
- Consider maintenance practices for district maintenance personal when siting all tree locations
- No vines on buildings. If vines are used elsewhere they needs to be prunable with a pole saw.
- Plants not to be used: Agapanthus, Palm, plants from bulbs,
- All plants and trees need to be commercially available
- District is trying to reduce landscape water use, aim to use plant material that is appropriate for their specific microclimate and meet WUCOLS and Green Building Code standards. Designer to incorporate drought tolerant and Biophilic landscaping wherever possible. Planting design should be student and maintenance friendly.
- Provide native California plants demonstration gardens or specific planting areas for teaching purposes.
- Only use Native Preservation Sod Mix by Delta Bluegrass for bioswale planting. Bioswale or No-Mow sod not to be used.
- Bio-Retention recommended plants (when sod can't be used): Carex, Juncus, Sisyrinchium, Lomandra.
- Limit the use of turf in the interior of the campus.
- Turf in play areas to be a Hybrid Bermuda. Double Play Bermudagrass seed blend is preferred for hydroseeding applications.
- Bark in planting areas to be Walk-On Bark as provided by Redi-Gro or equal.
- Plants to be spaced in planting areas to allow for maintenance access throughout the planter area. Designer shall show plant material at mature size on the plans. Include space between plant groupings to allow for maintenance staff to walk through planters to maintain weeds and plants.
- Site design shall take into account the following clearances for maneuvering mower decks; 20' minimum in sports fields; 5' minimum in small lawn areas.
- Outdoor Classrooms:
  - Consider a shade structure in addition to trees for outdoor learning areas to provide immediate shade when project is handed over to the district.
  - Include flexible seating for students so that teachers can group students in rows, tables, or in a circle.
  - Consider placing smaller, simpler gardens and outdoor learning areas throughout the campus to allow for multiple user groups in separate areas of the campus.
- Kinder/Pre-K Yard:
  - Consider shading, including tree coverage in yards. Consider nature play elements in addition to traditional play elements.
  - Diversify play area to include spaces for imaginative play, quiet reflection, and constructive play (building, shaping, and manipulating things to create something new).

SECTION 32 90 00

LANDSCAPING

**PART 1 - GENERAL**

**1.01 SUMMARY**

**A. Section Includes:**

1. Scope of Work: Furnish all labor, materials, tools, equipment, and transportation required to perform and complete the following work as specified herein:
2. Soil Preparation and Fertilization
3. Planting
4. Hydroseeding and/or Sodding
5. Weed Control
6. Decomposed Granite
7. Infield Mix
8. Mulch
9. Clean-up
10. Landscape Maintenance Period
11. Guarantee
12. Work not included in this Section: Landscape elements such as concrete walks, fencing, outdoor lighting, rough grading, and clearing are not a part of this Section unless shown on the landscape Drawings.

**B. Related Sections:**

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 31 00 00 – Earthwork.
3. Section 32 80 00 – Irrigation.

**1.02 SUBMITTALS**

**A. See Section 01 33 00 – Submittal Procedures for additional requirements.**

- B. Plant Material:** Within fifteen (15) days after award of contract, locate plant materials required for construction. Ensure that trees and shrubs are contract- grown from a certified nursery. Notify Owner's Representative of plant material "tied off" for review at selected nursery. If specified material is not obtainable, submit the following to Owner's Representative: proof of non-availability, proposal for use of equivalent material, photographs of alternative choices of plant material. Include clear, written description of type, size, condition, and general character of plant material.

- C. Data Sheets: Provide product data for each type of landscape material indicated in the Drawings and Specifications.
- D. Samples: Submit samples of the following materials to Landscape Architect for approval:
  - 1. Soil amendment: (3) one-quart zip-locked plastic bags.
  - 2. Bark Mulch: (3) one-quart zip-locked plastic bags.
  - 3. Imported Topsoil: (3) one-quart zip-locked plastic bags. (if needed)
  - 4. Baseball Infield Mix: (3) one-quart zip-locked plastic bags.
  - 5. Decomposed Granite: (3) one-quart zip-locked plastic bags.
- E. Provide soils analysis reports prepared by a qualified soils laboratory in compliance with the Soil Testing Requirements under "Soil Testing" in Part 3.02 of this Section.
- F. Prior to planting, submit copies of all trucking or packaging tags for all soil amendment, fertilizer and other additives to Landscape Architect so the quantities can be verified.
- G. Record Drawings: Upon completion of work, and as a precedent to final payment, deliver to Owner's Representative one complete set of reproducible originals of Drawings showing work exactly as installed.

#### 1.03 QUALITY ASSURANCE

- A. Qualifications: Work must be completed by a licensed Landscape Contractor. Provide proof of five years of continuous experience in landscaping and irrigation of projects of similar size (+/- 20% of the construction cost) and **scope for education campuses**. Contractor to have a minimum of two projects either completed or in construction in the last five years.
- B. Contractor shall be a certified installer of DuraEdge infield mix.
- C. Work Force: Ensure that an experienced foreman is present at all times during installation. Keep the same foreman and workers on the job from commencement to completion.
- D. Reviews: Specifically request reviews of all items listed below in "Inspection Requirements" prior to progressing to the next level of work. The Owner's Representative reserves the right to inspect and reject material, both at place of growth and at site, before and/or after planting, for compliance with requirements for name, variety, size and quality.
- E. Reference Standards: Meet or exceed Federal, State and County laws requiring inspection of all plants and planting materials for plant disease and insect control.
- F. Delivery, Storage, and Handling:
  - 1. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.
  - 2. Bulk Materials:



- a. Do not dump or store bulk materials near structures, utilities, walkways or pavements, or on existing turf areas or plants.
- b. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
- c. Accompany each delivery of bulk fertilizers [lime] and soil amendments with appropriate certificates.

G. Plant Material:

1. Conform to the current edition of Horticultural Standards for quality of Number 1 grade nursery stock as adopted by the American Association of Nurserymen. Conform to sizes specified on plant legend. Select plants which have a natural shape and appearance.
2. Select only plants that are true to name, and tag one of each bundle or lot with the name of the plant in accordance with the standards of practice of the American Association of Nurserymen. In all cases, botanical names shall take precedence over common names.
3. Tag each plant of a patented variety with the variety and identification number, where applicable, as it is delivered to the job site.
4. Select only plants which have been nursery-grown in accordance with good horticultural practices and which have been grown under climatic conditions similar to those in the locality of the project for at least one year.
5. Select only plants which are typical of their species or variety; have normal habits of growth; are sound, healthy, vigorous, well-branched and densely-foliated when in leaf; are free of disease, insect pests, eggs or larvae; and have a healthy and well-developed root system.
6. Select only container stock that has been grown in the containers in which delivered for at least six (6) months, but not over two (2) years. Provide samples to show that there are no root-bound conditions.
7. Do not use plants that are severely pruned or headed-back to meet size requirements.
8. Do not plant container-grown plants that have cracked or broken balls of earth when taken from the container. Remove canned stock carefully from cans after containers have been cut on two sides with tin snips or other approved cutter.
9. Coordinate a time for the Landscape Architect to inspect the plants upon their delivery to the project site.
10. At any time prior to final acceptance, be prepared to replace any plants that are rejected by the Owner's Representative because of physical damage to the plant.
11. Do not remove container-grown stock from containers before time of planting.
12. Be prepared to replace plants which are rejected by the Owner's Representative for the following reasons:
  - a. Trunk bark damage caused by sunburn,
  - b. Trunk bark wounds caused by rubbing stakes or ties,
  - c. Trunk bark damage caused by ties that have girdled the tree,
  - d. Tree head development that is lopsided and not symmetrical in form,
  - e. Tree branches that cross or touch,
  - f. Tree branches with double leaders (unless multi-trunk trees are specified).

13. Stake shrubs with one-inch by one-inch by eighteen-inch (1"x1"x18") stakes in such manner that the stakes are not visible, and tie to upright position if they lean and/or are not growing in a vertical position.
  14. Furnish quantities necessary to complete the work as shown on the Drawings and, if necessary, make up for any discrepancies in the quantities given in the Plant List at no additional cost to Owner.
- H. Decomposed Granite with Binder Mock-up:
1. Install 4 ft wide x 10 ft long mock-up of decomposed granite with Stabilizer additive at location as directed by owner's representative for review and acceptance prior to placement of decomposed granite.
- I. Comply with the requirements of **Section 01 77 00 – Closeout Procedures.**

#### 1.04 INSPECTION REQUIREMENTS

- A. Landscape Architect reserves the right to examine and reject plant material both at place of growth and at site, before and after planting, for compliance with requirements of name, variety, size, and quality.
- B. Request and hold a pre-construction meeting prior to beginning the work of this Section. Parties required to be in attendance are the Landscape Contractor, Project Inspector, Owner's Representative, and Landscape Architect.
- C. Obtain verification from Project Inspector for the following at the appropriate times during construction and prior to further progression of work in this Section:
  1. Rough grading is to tolerances specified in **Section 31 00 00 – Earthwork.**
  2. The placement of landscape backfill material is as specified in this Section.
  3. Prior to the commencement of the work specified in this Section, the coverage and operation of the sprinkler irrigation system are as specified in Section 32 80 00 - IRRIGATION.
  4. The soil amendment does not include any metal fragments. (Obtain a letter from the manufacturer stating that the material submitted for use on this project has no metal or foreign objects. Submit this letter as part of the Data Sheet submittal package [see "Submittals and Substitutions" in this Section])
  5. Required Test: For each load of soil amendment delivered to the site, spread at least two cubic yards (2 cy) of material onto a paved surface approximately two inches (2") deep. Pass a magnetic rake over the material in two directions. If any metal is found, test the entire load in the same manner. Perform all testing in the presence of the Project Inspector.
  6. Soil amendments, fertilizer, bark mulch and materials used for hydroseeding have been delivered to the site by the supplier, the invoices from the supplier indicate the project name and quantities delivered, and the Project Inspector has received copies of all such documents.

- 7. Prior to planting, amendments and conditioners have been incorporated as per pre-planting recommendations, and planting areas have been made ready to receive planting.
- D. In case of failure to obtain any verification by the Project Inspector as required above, remove and replace work as necessary to obtain the verification at no additional cost to the Owner.
- E. Beginning of Maintenance Period: Verify all work is complete, then request and hold a meeting to include the Landscape Architect, Project Inspector, Architect and Owner's Representative for authorization to begin the landscape maintenance period.
- F. End of Maintenance: Verify that all work is complete and acceptable, and that the maintenance has been completed per specifications; and continue to provide landscape maintenance until the Owner's Representative has accepted the work.

#### 1.05 PROJECT/SITE CONDITIONS

- A. Provide protection for persons and property throughout progress of work. Use temporary barricades as required. Proceed with work in such manner as to minimize spread of dust and flying particles and to provide safe working conditions for personnel. Store materials and equipment where directed.
- B. Existing Construction: Execute work in an orderly and careful manner to protect paving, work of other trades, and other improvements.
- C. Existing Utilities: Provide protection for existing utilities within construction area. At no additional cost to Owner, repair any damages to utility lines that occur as a result of this work.
- D. Landscaping: Protect landscape work and materials from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods.
- E. Paving: Maintain cleanliness of paving areas and other public areas used by equipment, and immediately remove spillage; remove rubbish, debris, and other material resulting from landscaping work, leaving site in a safe and clean condition.
- F. Planting Schedule / Environmental Requirements
  - 1. Install, establish, and maintain all lawn areas for a minimum of ninety (90) days prior to date of substantial completion. Coordinate schedule with other work and overall project schedule. Failure to install lawn areas by this date shall result in assessment of liquidated damages.
  - 2. Proceed with work in an orderly and timely manner to complete installation of landscaping within contract limits.
  - 3. Planting Season Limits: Do not plant when grounds are wet or temperature is below 25° F. Do not proceed with any soil preparation and fertilization if all planting cannot be completed within Planting Season Limit.

1.06 WARRANTY

- A. The guarantee period for lawn and plant material shall be the duration of the landscape maintenance period, from commencement until final acceptance of the work of this Section. See Division 01 for other applicable guarantee requirements.
- B. During the guarantee period, repair and/or replace plants and lawn not in satisfactory growing condition, as determined by Owner's Representative, without additional cost to Owner. Plants are to be replaced as per "Landscape Maintenance" in Part 3.05 of this Section, using plants of the same kind and size specified in plant list.
- C. DuraEdge Infield Mix installation shall be warrantied for 5 years.

1.07 MAINTENANCE

- A. Beginning of Landscape Maintenance Period:
  - 1. General: Landscape Maintenance Period does not begin until all work is installed and as determined by Landscape Architect, in writing.
  - 2. For sod applications, the 90-day maintenance period may begin after the second mow has occurred and the owner's representative and landscape architect have approved the installation. All fences shall be removed.
  - 3. For Hydroseed applications, the 120-day maintenance period may begin after the lawn has evenly germinated to an approximated blade height of one and one-half inches (1 ½"), as determined by Landscape Architect, in writing.
  - 4. The contractor shall submit a copy of the complete maintenance program for the next 90 days, including a list of proposed chemicals, so the Owner can coordinate the scheduled . Contractor shall include MSDS for any chemicals proposed to be used and the time that each chemical will be used. The Owner must be notified at least 24-hours in advance when maintenance personnel will be on campus and when chemicals will be used. All maintenance personnel shall be finger-printed per school requirements and shall check-in at the school office each time they enter the campus.
  - 5. Booster Pump: Upon successful completion of testing by the booster pump technician, request that a checklist/certification be completed and signed by the technician. Deliver copies of the certification to both the Owner's Representative and the Landscape Architect prior to the commencement of the landscape maintenance period.
  - 6. Central Control System: Upon successful completion of testing by the technician from [enter technician company], request that a checklist/certification be completed and signed by the technician. Deliver copies of the certification to both the Owner's Representative and the Landscape Architect prior to the commencement of the landscape maintenance period.
  - 7. On-site Inspection: When all work is complete, request and hold a meeting to include the Landscape Architect, Project Inspector, Architect and Owner's Representative who must together authorize and determine the start date for the landscape maintenance period.

Coordinate and give notice of the date and time of the on-site meeting to all parties at least Seventy-two (72) hours in advance.

8. Acceptability: In cases where the lawn has reached adequate fullness and germination in some areas but not all, and authorization has not been given to begin the maintenance period, proceed with mowing, trimming, spraying, etc., as necessary prior to the beginning of the maintenance period.

B. Duration of Landscape Maintenance Period:

The Landscape Maintenance Period shall continue for a minimum of ninety (90) calendar days for shrub areas and sodded lawn. Hydroseeded lawn shall be maintained for 120 days. During this time, continuously maintain all areas involved until final acceptance of the work by the Owner's Representative. See Landscape Maintenance Period procedure in Part 3.05 of this Section.

C. Final Acceptance of the Landscape Maintenance Period:

Request the final inspection Seventy-two (72) hours in advance. If items require attention, hold on-site meetings until Landscape Architect can certify, in writing, and in concurrence with the Owner's Representative, the successful completion of the Landscape Maintenance Period.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Use material in new and perfect condition as specified. Any deviations or substitutions from the Specification and Drawings must first be approved by Owner's Representative in writing prior to use.
- B. Topsoil: Fertile; friable; natural loam surface soil; reasonably free of subsoil, clay lumps, brush, weeds and other litter; and free of roots, stumps, stones/rocks, and other extraneous or toxic matter harmful to plant growth.
- C. Soil Amendment: One-percent nitrogen-impregnated bark product with a ninety-percent (90%) bark base and zero to one-quarter inch (0-1/4") particle size, or approved equivalent. Do not spread until testing requirements have been satisfied.
- D. Fertilizer/Soil Conditioner: Gro-Power Plus or approved equal.
- E. Fertilizer for Trees and Shrubs: Seven-gram Gro-Power Planting Tablets (12-8-8 NPK) or approved equal.
- F. Vitamin B-1: "Superthrive", "Liquinox Start", "Cal-Liquid", or approved equal.
- G. Bark Mulch: Untreated, shredded cedar.
- H. Tree-staking System: As indicated on Drawings.

- I. Pre-Emergent Weed Control: Oxadiazon, "Treeflam", "Ronstar 2G", "Surflan" (Elano Products Company), or approved equal.
- J. Decomposed Granite:
  - 1. Reddish-brown in color.
  - 2. A mixture of fines to three-eighths inch (3/8") size particles with no clods.
  - 3. Free of vegetation, other soils, debris and rocks, and of such nature that it can be compacted readily under watering and rolling.
- K. Decomposed Granite Binder: Shall be Stabilizer by Stabilizer Solutions.
- L. Infield Mix: DuraEdge Classic Infield Mix, or approved equal.
- M. Infield Topdressing: DuraEdge Play Ball, or approved equal.
- N. Fieldstones: As indicated on Drawings.
- O. River Cobble: As indicated on Drawings.
- P. Erosion Control Blankets: The erosion control/re-vegetation blanket shall be lightweight and comprised primarily of straw, excelsior, virgin wood fiber, jute or coconut fibers. It shall conform easily to the soil surface allowing vegetation to emerge unimpeded, contain no growth-inhibiting additives and shall be free of weed-seed and other contaminants. The blanket shall be designed to be left in place to degrade. Include manufacturer's recommended biodegradable staples, six inches (6") long.
- Q. Jute Mesh: Shall be of a uniform, open, plain weave, flame-retardant mesh, made from unbleached single jute yarn. The shall be of loosely twisted construction and shall not vary in thickness by more than one-half its normal diameter. Jute mesh shall be furnished in rolled strips and shall meet the following requirements:
  - 1. Width: 48 inches, with a tolerance of +/- one inch.
  - 2. 78 warp ends per width, 41 weft ends per yard.
  - 3. Weight shall average 1.22 pounds per linear yard, with a tolerance of +/- 5%.
  - 4. Jute Mesh staples: 18" long, #10 steel wire.
- R. Weed Fabric: As indicated on Drawings.
- S. Header Boards: As indicated on Drawings.
- T. Root Barrier: As indicated on Drawings.
- U. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, three ounces per square yard (3 oz/sq. yd.) (101 g./sq. m.) minimum, composed of fibers formed into a stable network so that fibers retain their relative positions. Fabric shall be inert to biological degradation and resistant to naturally-encountered chemicals, alkalis, and acids.

V. Nursery Plant Stock:

1. As indicated on Drawings. Do not remove container-grown stock from containers until planting time. Plants shall be true to name.
2. Healthy, shapely, well-rooted, not pot-bound, free from insect pests or plant diseases and properly "hardened off" before planting. Replace plants that are not alive or are not in satisfactory growing condition, as determined by the Landscape Architect, without additional cost to Owner. The Landscape Architect may reject plants before and/or after planting.
3. Labeled. Label at least one tree and one shrub of each species with a securely-attached, waterproof tag bearing legible designation of botanical and common name.

W. Lawn Sod:

1. April 1st thru September 30th Installation: One Hundred percent (100%) Hybrid Bermuda.
2. October 1st thru March 31st Installation: One Hundred percent (100%) Hybrid Bermuda, overseeded with rye grass.

X. Lawn Hydroseed: Premium, new crop seed, delivered to site in original, unopened containers bearing a dated guaranteed analysis. Hydroseed may be installed April 15 thru July 31<sup>st</sup> only. Hydroseed mixture shall be as follows:

1. Seed: Double Play Bermuda Grass seed blend
2. Starter Fertilizer: 16-20-0 with biosolids or approved equal.
3. Wood Fiber Mulch: As manufactured by Conwed or approved equal.
4. Soil Binding Agent: Polyacrylamide or approved equal.
5. Herbicide: Tenacity or approved equal.

Y. Bermuda Sprigs: Healthy lateral living stems, rhizomes, or stolons, four to six inches (4" - 6") long with leaves or a minimum of two nodes and attached roots free of soil.

**PART 3 - EXECUTION**

3.01 EXAMINATION

- A. Examine the site, verify grade elevations, and observe conditions under which work is to be performed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the Owner's Representative.
- B. Proceed with complete landscape work as rapidly as portions of the site become available, working within seasonal limitations for each kind of landscape work required.
- C. Determine location of underground utilities and perform work in a manner which will avoid possible damage. Hand-excavate, as required, to minimize possibility of damage to underground utilities. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.

- D. When conditions detrimental to sod or plant growth are encountered, such as rubble fill, adverse drainage condition, or other obstructions, notify the Owner's Representative before planting.

### 3.02 PREPARATION

#### A. Soil Testing

1. Coordinate soil testing in an expeditious and timely manner as required for on-site topsoil materials. Contract with a soil laboratory and include cost of sampling and testing in contract price. Take one (1) sample for every 5,000 square feet of landscape area up to a maximum of six (6) samples under the direction of and in the presence of the Owner's Representative.
2. Submit each sample, according to the quantity of soil required by testing laboratory, to a competent laboratory approved by the Owner's Representative.
3. Provide analysis of soil samples for pH, salinity, ammonia, phosphate, potassium, calcium, magnesium, boron, and sodium levels. Provide appraisal of chemical properties, including particle size determination, and recommendations for types and quantities of amendments and fertilizers.

#### B. Clearing of Vegetation:

1. If live perennial weeds exist on site at the beginning of work, spray with a non-selective systemic contact herbicide as recommended and applied by an approved licensed landscape pest control advisor and applicator. Leave sprayed plants intact for at least 15 days.
2. Clear and remove existing weeds by mowing or grubbing off all plant parts at least one-quarter inch ( $\frac{1}{4}$ " ) inch below surface of soil over entire areas to be planted.

#### C. Soil preparation:

1. Loosen soil in all planting areas, and on slopes flatter than 3:1 gradient, to a depth of six to eight inches (6" - 8") below finish grade. All debris, foreign matter, and stones shall be removed prior to the placing of any fertilizers or conditioners. Soil preparation is for all shrub planting beds, lawn hydroseeded areas and sodded lawn areas.
2. Conduct the required soil tests and instruct the lab to include a minimum of the following soil improvements in the recommendation on the soils report.
  - a. Soil Amendment: Two cubic yards (2 cy) per 1,000 square feet.
  - b. Gro-Power Plus: One hundred fifty pounds (150 lbs) per 1,000 square feet.
  - c. If the lab recommends less than six cubic yards (6 cy) of soil amendment, the excess bid amount shall be applied to the cost of any additional recommended soil improvements, or returned to the Owner as a credit
3. Apply amendments as follows, using rates recommended by the soils testing laboratory (the rates of amendments shown below are for bidding purposes only):
  - a. Fertilizer/Soil Conditioner: Broadcast 150 pounds of Gro Power Plus per 1,000 square feet in all planting areas and rototill to a depth of six to eight inches (6" - 8"). Remove from the site any rock and debris brought to the surface by



cultivations. "Cultipack" all areas to receive sod or hydroseed.

- b. Apply soil amendment to all planting areas at the rate of six cubic yards (6 cy) per 1,000 sf and rototill into the top six to eight inches (6" – 8").
4. Upon completion of finish grading, request a review and obtain approval of Landscape Architect prior to commencement of planting or hydroseeding.

D. Finish Grading for all Planting areas

1. Refer to Earthwork Specification Section for Rough Grading.
2. Grade to elevations and contours shown on Drawings. Fill low spots with landscape backfill material and grade to surface drain in manner indicated on Drawings.
3. Finish-grade so that the entire area within the contract lines has a natural and pleasing appearance as specified and as directed by Landscape Architect.
4. Adjust sprinkler heads flush to finish grade in preparation to receive hydroseeding or one-half inch above finish grade in preparation to receive sod. Reset sprinkler heads flush to grade after turf has germinated.
5. Flag the sprinkler heads and valve markers.

E. Planting Pits for Trees:

1. Excavate pits with vertical sides and with bottom of excavation slightly raised at center to provide proper drainage.
2. Set container-grown stock in center of pit on earth pedestal. Separate roots and/or prune roots as directed by Landscape Architect. In hot weather, pre-wet pit. Loosen outside roots from sides and bottom of root ball. When set, place additional backfill around base and sides of root ball. Work each layer to settle backfill and eliminate voids and air pockets. Water after placing final layer of backfill.
3. Loosen hard subsoil in bottom of excavation. Extend excavation as required to insure proper drainage from plant pits.
4. Fill excavated planting pits with water to half the depth of pit. Pits should drain within four hours (4 hrs). If planting pits do not drain, notify Project Inspector immediately. Do not proceed with planting until Landscape Architect has resolved a method to provide drainage.

F. Planting Pits for Shrubs/Groundcover:

1. Excavate pits and trenches with vertical sides and with bottom of excavation slightly raised at center to provide proper drainage.
2. Loosen hard subsoil in bottom of excavation. Extend excavation as required to insure proper drainage from plant pits.
3. Fill excavated planting pits with water to half the depth of pit. Pits should drain within four hours (4 hrs). If planting pits do not drain, notify Project Inspector immediately. Do not proceed with planting until Landscape Architect has resolved a method to provide drainage.

3.03 INSTALLATION

A. Root Barrier

1. Root barriers location are specifically shown on the plan. If a tree is moved during construction to a location where root barrier is not shown on the plan, the following minimum requirements are to be met:
  - a. Install root barrier where trees are planted within sixty inches (60") of paving or other hardscape elements, such as walls, curbs, and walkways.
  - b. Install root barrier continuously for a distance of five feet (5') in each direction from the tree trunk, for a total distance of ten feet (10') per tree. If trees are spaced closer, use a single continuous piece of root barrier.
2. Align root barrier vertically and run it linearly along and adjacent to the paving or other hardscape elements to be protected from invasive roots.
3. Position top of root barrier just below the top of adjacent hardscape element but above finish grade of the soil so that is visible.
4. If there are concrete spoils or overpour that is impeding the root barrier from being installed directly adjacent to the hardscape element, the contractor is to remove the extra concrete in a manner that does not damage the integrity of the hardscape element.
5. Do not distort or bend root barrier during construction activities.
6. Do not install root barrier surrounding the root ball of tree.

B. Lawn Hydroseeding:

1. Do not begin hydroseeding until finish-grading has been checked by Landscape Architect. If work is rejected due to failure to obtain Landscape Architect's approval prior to hydroseeding, redo rejected work at no additional cost to Owner.
2. General: Hydroseeding is an artificial planting process which provides vegetation to an area by using a mixture of soil conditioner/fertilizer, seed, binder, and wood fiber mulch. This mixture should be of such character that it will disperse into a uniform slurry when mixed with water in a mechanical mixer.
3. Equipment: Use a standard hydraulic mulching machine with a continuous agitation system that keeps material in uniform suspension throughout mixing and distribution cycles and with a minimum mixing tank capacity of 500 gallons (3,000+ sq. ft. of coverage).
4. Mix per 1,000 square feet:
  - a. Lawn Seed X lbs.
  - b. Starter Fertilizer 25.0 lbs.
  - c. Wood Fiber Mulch: 45 lbs.
  - d. Soil Binding Agent: 3 oz.
  - e. Herbicide: 0.7 oz.
5. Application: Spray the slurry mix, under pressure, uniformly over the soil surface in a one-step operation. Protect adjacent paving, building walls, etc.
6. Clean any overspray from surfaces at end of each day's work.
7. Permit slurry to "set" approximately twenty-four hours (24 hrs.) before watering. Once watering has begun, do not allow newly hydroseeded areas to dry out.

C. Irrigated Bio-Swale Hydroseeding:

1. Do not begin hydroseeding until finish-grading has been checked by Landscape Architect. If work is rejected due to failure to obtain Landscape Architect's approval prior to hydroseeding, redo rejected work at no additional cost to Owner.
2. General: Hydroseeding is an artificial planting process which provides vegetation to an area by using a mixture of soil conditioner/fertilizer, seed, binder, and wood fiber mulch. This mixture should be of such character that it will disperse into a uniform slurry when mixed with water in a mechanical mixer.
3. Equipment: Use a standard hydraulic mulching machine with a continuous agitation system that keeps material in uniform suspension throughout mixing and distribution cycles and with a minimum mixing tank capacity of 500 gallons (3,000+ sq. ft. of coverage).
4. Mix per 1,000 square feet:
  - a. Lawn Seed 3.25 lbs.
  - b. Starter Fertilizer 20.0 lbs.
  - c. Wood Fiber Mulch: 75.0 lbs.
5. Application: Spray the slurry mix, under pressure, uniformly over the soil surface in a one-step operation. Protect adjacent paving, building walls, etc.
6. Clean any overspray from surfaces at end of each day's work.
7. Permit slurry to "set" approximately twenty-four hours (24 hrs.) before watering. Once watering has begun, do not allow newly hydroseeded areas to dry out.

D. Non-Irrigated Bio-Swale Hydroseeding:

1. Do not begin hydroseeding until finish-grading has been checked by Landscape Architect. If work is rejected due to failure to obtain Landscape Architect's approval prior to hydroseeding, redo rejected work at no additional cost to Owner.
2. General: Hydroseeding is an artificial planting process which provides vegetation to an area by using a mixture of soil conditioner/fertilizer, seed, binder, and wood fiber mulch. This mixture should be of such character that it will disperse into a uniform slurry when mixed with water in a mechanical mixer.
3. Equipment: Use a standard hydraulic mulching machine with a continuous agitation system that keeps material in uniform suspension throughout mixing and distribution cycles and with a minimum mixing tank capacity of 500 gallons (3,000+ sq. ft. of coverage).
4. Mix per 1,000 square feet:
  - a. Lawn Seed 3.25 lbs.
  - b. Starter Fertilizer 20.0 lbs.
  - c. Wood Fiber Mulch: 75.0 lbs.
5. Application: Spray the slurry mix, under pressure, uniformly over the soil surface in a one-step operation. Protect adjacent paving, building walls, etc.
6. Clean any overspray from surfaces at end of each day's work.

E. Lawn Sod:

1. Cultivate all lawn areas to a depth of six inches (6"). If cultivation does not break lumps, pull a spike-toothed harrow over the area behind the tractor.
2. Give all lawn areas that are to be sodded a smooth finish to prevent pockets. Do not allow any abrupt changes of surface. Prior to installation of sod, roll the grade with a 200-pound

water-ballast roller. Request that the lawn grade be inspected and approved by the Landscape Architect prior to sodding to determine its suitability for planting. Obtain such approval prior to commencing sodding operations.

3. Do not take heavy objects (except lawn rollers) over lawn areas after they have been prepared for planting.
4. Completely lay the sod within twelve hours (12 hrs.) of delivery. Do not leave sod on pallets in the hot sun longer than necessary.
5. Unroll sod carefully. Lay sod tight without any visible open joints, and without overlapping; stagger end joints twelve inches (12") minimum. Do not stretch or overlap sod pieces. Do not place sod in pieces smaller than twenty-four inches (24") in length by width of roll.
6. When new sod is to match existing turf, cut the edge of the existing turf in a series of straight lines that will accept new sod rolls in full width of the sod roll. Make the transition of grade between existing turf and new sod to be seamless with no change in elevation.
7. Immediately after laying sod, roll lawn areas with a 200-pound water-ballast roller.
8. Trim sod to conform to lawn shapes designated in Drawings.
9. On slopes of six inches (6") per foot and steeper, lay sod perpendicular to slope and secure every row with wooden pegs at a maximum of two feet (2') on center. Drive pegs flush with soil portion of sod.
10. Ensure that finished appearance is that of one continuous lawn.
11. Do not lay whole lawn before watering. When a conveniently large area has been sodded, water lightly to prevent drying. Continue to lay sod and to water until installation is complete.
12. All sod areas must be approved by Landscape Architect.
13. Water the complete lawn surface thoroughly. Moisten soil at least eight inches (8") deep. Repeat sprinkling at regular intervals to keep sod moist at all times until rooted. After sod is established, decrease frequency and increase amount of water per application as necessary.

F. Lawn Bermuda Sprigging: Plant freshly shredded sod sprigs after finish grade is properly prepared and thoroughly soaked a day in advance. Plant sprigs at a rate of [rate] deep. Place individual sprigs with roots and portions of stem in moistened soil [rate] apart in rows [rate] apart, and fill furrows without covering growing tips. Lightly roll and firm soil around sprigs after planting. Water thoroughly and keep soil moist. Weed by hand or hoe. Do not treat sprig area with herbicide.

G. Trees, Shrubs, and Groundcover:

1. Lay out individual tree and shrub locations and areas for multiple plantings. Stake the locations, outline the areas, and secure the Owner's Representative's acceptance before beginning the planting work. Make minor adjustments as requested.
2. Scarify root ball prior to planting. Plant in holes twice the diameter of the root ball and to a depth equal to the container's height. Place the shrub and/or groundcover so the top of the root ball is one inch (1") higher than the surrounding grade; place the tree so that the crown of the trunk is two inches (2") higher than the surrounding grade. Set container-grown stock in center of pit. In hot weather, pre-wet the pit. When set, place additional backfill around base and sides of root ball. Work each layer to settle backfill

and eliminate voids and air pockets. Thoroughly compact lower half of backfill in plant pit. See staking or guying detail. Water after planting. Provide a berm or watering basin for each tree. Add Vitamin B-1, in the proper solution as recommended by the manufacturer, to the second watering of the basin.

3. Place fertilizer planting tablets in root zone and alongside each plant. Follow manufacturer's instructions for number of tablets to use for each container size.
4. See Drawings for additional information.
5. Grooming and Staking of Trees:
  - a. Prune, thin-out and shape trees in accordance with standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise directed by Landscape Architect, do not cut tree leaders, and remove only injured or dead branches from flowering trees.
  - b. Paint cuts over one-half inch ( $\frac{1}{2}$ " ) in size with standard tree paint or compound, covering exposed, living tissue. Use paint that is waterproof, antiseptic, adhesive, elastic and free of kerosene, coal tar, creosote, and other substances harmful to plants. Do not use shellac.
  - c. Stake or guy trees immediately after planting, as indicated on Drawings.
6. Grooming of Shrubs:
  - a. Prune, thin-out and shape shrubs in accordance with standard horticultural practice. Prune shrubs to retain natural character and to accomplish their use in landscape design. The required plant size is its size after pruning.
  - b. Remove and replace excessively pruned or malformed new plants resulting from improper pruning.
7. Request review by the Landscape Architect after locating, but prior to planting all trees. Under the direction of the Landscape Architect, make slight adjustments to plant material location as necessary to reflect original intention of Drawings.

H. Weed Control

1. Apply pre-emergent weed control to all planting areas (except lawn) after completion of all planting and one complete watering. Follow manufacturer's directions. To prevent washing away of weed control, do not over-water after its application. Do not allow any weed control into lawn areas. Treat any existing noxious weeds, such as Johnson grass, with Roundup in successive treatments until all roots are destroyed, then remove all grass and roots. Notify Owner's Representative of time of installation for verification of application.

I. Bark Mulch

1. Apply mulch at the rate of three inches (3") deep to all planting areas, exclusive of lawn, after the planting and weed control are completed. Twelve inches (12") from planter edges, taper full depth of mulch to meet adjacent grades. Do not place mulch within three inches (3") of trunk or stems.

J. Decomposed Granite

1. Prepare all areas to receive decomposed granite, and treat sub-grade with weed control.
2. Install a two-inch (2") lift, and wet and roll to compact to ninety percent (90%).
3. Install the remaining material to achieve the required thickness when it is wet and rolled.
4. Remove all weed grass and re-compact the surface by the end of the landscape maintenance period.

K. Decomposed Granite With Binder

1. General: Prepare all areas to receive decomposed granite, and treat sub-grade with weed control.
2. Placement:
  - a. Do not install during rainy conditions or below 40 degree Fahrenheit and falling.
  - b. After pre-blending, place the Stabilized decomposed granite on prepared sub-grade. Level to desired grade and cross section.
  - c. Water heavily for full-depth moisture penetration of the Stabilized pathway profile, 25 to 45 gallons of water per 1-ton must be applied. During water application randomly test for depth using a probing device, which reaches full depth.
3. Compaction:
  - a. Upon thorough moisture penetration, compact aggregate screening to 85% relative compaction by equipment such as; a 2 to 4-ton double drum roller or a 1,000-lb. single drum roller. The roller size will depend on the depth of the pathway. DO NOT use a vibratory plate compactor or vibration function on roller as vibration separates large aggregate particles. Do not begin compaction for 6 hours after placement and up to 48 hours.
  - b. If surface aggregate dries significantly quicker than subsurface material, lightly mist surface before compaction.
  - c. Take care in compacting decomposed granite when adjacent to planting and irrigation systems. Hand tamping with an 8" or 10" hand tamp recommended.
4. Inspection:
  - a. Finished surface of pathway shall be smooth, uniform and solid. There shall be no evidence of chipping or cracking. Cured and compacted pathway shall be firm throughout profile with no spongy areas. Loose material will not be present on the surface after installation, but may appear after use and according to environmental conditions. Pathway should remain stable underneath the loose granite on top. Any significant irregularities in path surface shall be repaired to the uniformity of entire installation.
5. Repairs:
  - a. Excavate damaged area to the depth of the stabilized decomposed granite and square off sidewalls.
  - b. If area is dry, moisten damaged portion lightly.
  - c. Pre-blend the dry required amount of Stabilizer powder with the proper amount of decomposed granite in a concrete mixer.

- d. Add water the pre-blended decomposed granite and stabilizer. Thoroughly moisten mix with 25 to 45 gallons per 1-ton of pre-blended material or to approximately 10% moisture content.
  - e. Apply moistened pre-blended decomposed granite to excavated area to finish grade.
  - f. Compact with an 8"-10" hand tamp or 250 to 300-pound roller. Keep traffic off area for 12 to 48 hours after repair has been completed.
6. Upon end of landscape maintenance period, all weed/grass shall have been removed and surface re-compacted.

L. Infield Mix

1. See section 1.03, Quality Assurance, for contractor qualifications.
2. Contractor shall layout the infield, identifying home plate, all bases, and pitching rubber. Install home plate, base pins and pitching rubber. If equipment is not specified locations to be marked with a ¾" diameter x 12" long galvanized pipe. Pipe to be buried in the ground, so the top is flush with finish grade.
3. Contractor shall layout edge of infield with white marking paint the edge of infield.
4. Infield mix to be thoroughly blended by the supplier prior to delivery to the site. Delivery tickets showing quantities and mixture shall be given to landscape architect.
5. When layout of infield has been completed and verified by landscape architect, contractor shall excavate all areas to receive infield mix to a 4" depth. Excess soil shall be distributed on site.
6. .Place the material in lifts of 2 to 3 inches and lightly compact until an optimum compaction between 85 and 90 percent is achieved on a standard proctor test (ASTM D 689-07). Scarify the surface to facilitate bonding of the next list and repeat until finish grade elevation is achieved. Completing this process as described will minimize settling and improve the performance of the product.
7. If unable to achieve optimum compaction, a light application of water may be needed.
8. For best results, the material shall be finish graded with a laser device that allows accuracy to +/- 1/8 inch. A slope of ½ percent to 1 percent shall be placed in the infield surface in order to facilitate surface drainage.
9. The finish surface of the infield shall be smooth and free from any visible dips, humps, bumps, or other blemishes which would hinder the removal of water through positive surface drainage. A finished elevation survey shall be conduction to assure proper installation.
10. Following successful inspection, topdressing shall be applied to the surface at a rate of 1 pound per square foot.

M. Erosion Control Blanket

1. When planting operations have been completed and finish-grade has been re-established, request review of surface grade, and obtain approval of Landscape Architect before installation of blanket. Install material as per Drawings.

N. Jute Mesh

1. Jute mesh shall be installed at the locations shown on the plans.
2. Jute mesh shall be placed after cultivation and before planting. Soil surface should be reasonably smooth, remove rocks or other obstructions that rise above the level of the soil. Jute mesh shall be placed loosely on the finish grade up and down the slope in a manner to fit the soil surface contour and shall be held in place staples driven vertically into the soil at approximately 24" spacing and no more than 12" when overlapping mesh. Jute mesh strips shall be overlap along the sides by at least 6" and if more than one roll is required going down the slope, the ends going down the slope should overlap by at least 3'. Ends of strips shall be tucked into the soil by at least 6".

### 3.04 CLEANING

- A. During construction, keep the site free of rubbish and debris, and clean up the site promptly when notified to do so. Take care to prevent spillage on streets from hauling and immediately clean up any such spillage and/or debris deposited on streets due to the work of this Section.
- B. During all phases of the construction work, take all precautions to abate dust nuisance by clean-up, sweeping, sprinkling with water, or other means as necessary.

### 3.05 PROTECTION: MAINTENANCE

- A. The Landscape Maintenance Period will begin when all the Landscape Maintenance Period Requirements have been met (See Part 1 of these Specifications).
- B. Cleaning: Maintain cleanliness on paving areas and other public areas used by equipment and immediately remove all spillage. Remove from project site all rubbish and debris found thereon and all material and debris resulting from landscaping work, leaving the site in a safe and clean condition.
- C. Maintenance:
  1. Sprinkler Irrigation System:
    - a. Check system weekly for proper operation. Flush lateral lines out after removing last sprinkler head or two at each end of lateral. Adjust all heads as necessary for unimpeded coverage.
    - b. Set and program automatic controllers for seasonal water requirements. Provide the Owner's Representative with keys to the controllers and instructions on how to turn off system in case of emergency.
    - c. Repair all damages to sprinkler irrigation system as part of the contract work. Make repairs within one watering period or one week, whichever is the least amount of time.
  2. Turf Areas:
    - a. Begin mowing turf when grass has reached a height of three inches (3") and cut to a height of one and one-half inches to two inches (1 ½" - 2"). Mow at least weekly after the first cut. Turf must be well-established and free of bare spots and weeds, to satisfaction of Landscape Architect, prior to final acceptance. Do not mow lawns when the soil is not able to support maintenance equipment.



- Repair wheel marks and ruts caused by the maintenance equipment at no additional cost to the Owner.
- b. Pick up grass clippings and remove from the site and premises.
  - c. Trim edges at least twice monthly for neat appearance. Vacuum or blow clippings off walks.
  - d. Water the lawns at such frequency as weather conditions require to replenish soil moisture below the root zone. Normally, a total of one and one-half inches (1 ½") of water is needed weekly in hot weather.
  - e. Fertilize the lawn areas at the beginning of the Landscape Maintenance Period and at the completion of the Landscape Maintenance Period. Use a fertilizer with the following characteristics:
    - 1.) Slow release, Best 16-6-8, or approved equal, at the rate of 6.25 lbs per 1,000 square feet from March through October.
    - 2.) Calcium Nitrate (15-0-0) at the rate of 6.5 lbs per 1,000 square feet from November through February.
  - f. Broadcast fertilizer using a mechanical spreader; do not apply by hand-broadcasting. Sweep all fertilizer off hardscape into adjacent planters.
  - g. Weekly as needed and as directed, re-sod lawn areas with material that matches previously installed material. Use sod to repair any bare areas. Repair areas to receive sod as follows:
    - 1.) Mark out areas to receive new sod repair.
    - 2.) Cut straight lines that will accept sod the full width of the roll and a minimum of twenty-four inches (24") in length.
    - 3.) Transition the grade between existing turf and new sod seamlessly, with no change in elevation.
3. Trees and Shrubs:
- a. Water enough that moisture penetrates throughout root zone and only as frequently as necessary to maintain healthy growth.
  - b. Construct and/or remove water basins around each plant, depending on the time of the year and as directed.
  - c. Do not prune unless directed by the Landscape Architect.
  - d. Re-stake and re-tie trees as needed and as directed by the Landscape Architect. Do not allow tops of tree stakes to protrude into head of tree.
  - e. Replace any dead, dying or vandalized plant material on a weekly basis throughout the Landscape Maintenance Period.
4. Insecticide and Herbicide Application:
- a. If needed, control weeds with selective herbicides and sprays. In areas where crabgrass has infested the lawn, apply pre-emergent herbicides such as Dacthal by Amvac, Balan, or Betasan by Gowan for control prior to crabgrass germination. Control insect pests if necessary.
  - b. Use only a licensed Pest Control Operator to apply herbicides and sprays and to maintain a log for applications indicating material, timing, and rate.
5. Decomposed Granite with Binder:
- a. Remove debris, such as paper, grass clippings, leaves or other organic material by mechanically blowing or hand raking the surface as needed.

- b. During the first year, a minor amount of loose aggregate will appear on the paving surface (1/16" to 1/4"). If this material exceeds a ¼", redistribute the material over the entire surface. Water thoroughly to the depth of 1". Compact with power roller of no less than 1,000 lbs. This process should be repeated as needed.
  - c. If cracking occurs, sweep fines into the crack, water thoroughly and hand tamp with an 8"-10" hand tamp plate.
- 6. Pre-scheduled On-site Meetings: Hold regularly-scheduled (monthly or bimonthly as determined by the owner) on-site meetings with the Project Inspector and Owner's Representative. Dates and times will be jointly agreed upon.
- 7. Request, forty-eight hours (48 hrs.) in advance, on-site visits by the Landscape Architect to determine the end of the Landscape Maintenance Period.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Water Utilities
  - Water piping 3" and smaller shall be Type K tubing, hard temper, 4" and larger shall be PCV PVC C900 DR18. Fire water piping from FDC to building shall be PVC C900 DR14
  - Thrust blocks shall be required on all water pipes 4" and larger.
  - Bedding shall be sand. Detectable warning tape shall be installed above water line and tracer wire shall be attached to the top of pipe.
  - Valves shall be gate valves; ball valves shall not be used. Valves shall be placed at each building service location and distributed through the site to allow for repair of branches without requiring an entire site shut down. Valves shall be placed in ground boxes and permanently marked. Valves shall be set at 18" below finish surface.

- It is recommended that existing water utilities beneath pavement that is being removed be replaced with new. Confirm with District utilities to be replaced. Underground utility locating to be provided with topographic survey.
- Sewer Utilities
  - Sanitary sewer piping shall be PVC SDR 35.
  - Sewer bedding and initial backfill to be  $\frac{3}{4}$ " Crushed Rock.
  - Provide 2-way cleanout(s) within 5ft of all connections to building.
  - Provide cleanouts at a distance of no greater than 100ft.
  - Provide a cleanout at all sewer elbows.
  - It is recommended that existing sewer utilities beneath pavement that is being removed be replaced with new. Confirm with District utilities to be replaced. Underground utility locating to be provided with topographic survey.

SECTION 33 00 00

SITE UTILITIES

**PART 1 - GENERAL**

1.01 SUMMARY

A. SECTION INCLUDES:

1. Domestic water piping system.
2. Fire protection piping systems.
3. Sewer piping system.
4. Other water and sewer items that may be specified or shown on the drawings.

B. RELATED SECTIONS

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 01 50 00, Construction Facilities and Temporary Controls.
3. Section 31 23 33, Trenching and Backfilling.
4. Section 32 16 00, Site Concrete.
5. Section 33 00 00, Earthwork.
6. Section 31 31 00, Soil Treatment

1.02 REFERENCES AND STANDARDS

- A. ANSI/ASTM D698-00 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.
- B. ANSI/ASTM D1556-00 - Test Method for Density of Soil in Place by the Sand-Cone Method.
- C. ANSI/ASTM D1557-02 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb. (4.54 Kg) Rammer and 18 inch (457 mm) Drop.
- D. ANSI/ASTM D 3017-05 Test Methods for Moisture Content of Soils and Soil-Aggregate Mixture by Nuclear Methods (Shallow Depth).
- E. ANSI/ASTM D 4318-05 Test Method for Liquid Limit, Plastic Limit, and Plasticity Limit.
- F. CALTRANS Standard Specifications.
- G. CAL-OSHA, Title 8, Section 1590 (e).

- H. Any work within the street, highway or right-of-way shall be performed in accordance with the requirement of the governmental agencies having jurisdiction, and shall not begin until all of those governing authorities have been notified.
- I. NFPA 13, 24 and 25, latest editions.
- J. California State Health and Safety Code Section 116875, Lead Free Public Water Systems.
- K. California Plumbing Code, latest edition.

#### 1.03 SUBMITTALS

- A. Refer to Section 01 33 00.
- B. Manufacturer's Data: Submit list and complete descriptive data of all products proposed for use. Include manufacturer's specifications, published warranty or guarantee, installation instructions, and maintenance instructions.
- C. Provide sieve analysis from accredited testing lab on pipe bedding material. Analysis shall have a current date not older than project contract signing date.
- D. Substitution: Provide all data of proposed material being submitted as a substitution. Provide comparison with specified product data and identify all differences. Failure to provide comparison will be reason for rejection.

#### 1.04 QUALITY ASSURANCE

- A. Use only new materials and products, unless existing materials or products are specifically shown otherwise on the drawings to be salvaged and re-used.
  - 1. Sun damaged or discolored PVC pipe will be rejected.
- B. All materials, components, assemblies, workmanship and installation are to be observed by the Owner's Inspector of Record. Work not so inspected is subject to uncovering and replacement.
- C. The representatives of the Owner's testing lab will not act as supervisor of construction, nor will they direct construction operations. Neither the presence of the Owner's testing lab representatives nor the testing by the Owner's testing lab shall excuse the contractors or subcontractors for defects or deficiencies discovered in their work during or following completion of the project. Correcting inadequate compaction is the sole responsibility of the contractor.
- D. Contractor shall be solely responsible for all subgrades built. Any repairs resulting from inadequate compaction or incorrect grades will be the responsibility of the contractor.
- E. Per 2016 NFPA 13 provide Contractor's material and test certificate to the Owner, Architect, Project Inspector and Local Fire Authority.

1.05 FEES, PERMITS, AND UTILITY SERVICES

- A. Obtain and pay for permits and service charges required for installation of Work. Arrange for required inspections and secure written approvals from authorities having jurisdiction.
- B. Upon completion of work within right-of-way, provide copies of written final approval to the Architect.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Transport, store and handle in strict accord with the local jurisdiction.
- B. Make delivery to job when notified by Contractor verifying that the job is ready to receive the work of this Section and that arrangements have been made to properly store, handle and protect such materials and work.

1.07 PROJECT CONDITIONS

- A. Existing civil, mechanical and electrical improvements are shown on respective site plans to the extent known. Should the Contractor encounter any deviation between actual conditions and those shown, he is to immediately notify the Architect before continuing work.
- B. Contractor shall acquaint himself with all site conditions. If unknown active utilities are encountered during work, notify Architect promptly for instructions. Failure to notify will make Contractor liable for damage to these utilities arising from Contractor's operations subsequent to discovery of such unknown active utilities.

1.08 WARRANTY

- A. Refer to General Conditions and Section 01 78 36.

1.09 PROTECTION

- A. Adequate protection measures shall be provided to protect workmen and passers-by on and off the site. Adjacent property shall be fully protected throughout the operations. Blasting will not be permitted. Prevent damage to adjoining improvements and properties both above and below grade. Restore such improvements to original condition should damage occur. Replace trees and shrubs outside building area disturbed by operations.
- B. In accordance with generally accepted construction practices, the Contractor shall be solely and completely responsible for working conditions at the job site, including safety of all persons and property during performance of the work. This requirement shall apply continuously and shall not be limited to normal working hours.
- C. Any construction review of the Contractor's performance conducted by the Geotechnical Engineer is not intended to include review of the adequacy of the Contractor's safety measures, in, on, or

near the construction site.

- D. Provide shoring, sheeting, sheet piles and or bracing to prevent caving, erosion or gullyng of sides of excavation.
- E. Surface Drainage: Provide for surface drainage during period of construction in manner to avoid creating nuisance to adjacent areas. The contractor shall make a reasonable effort on a daily basis to provide pumps and all equipment necessary to keep all excavations and the site free from water during entire progress of work, regardless of cause, source, or nature of water.
- F. Adjacent streets and sidewalks shall be kept free of mud, dirt or similar nuisances resulting from earthwork operations.
- G. The site and adjacent influenced areas shall be watered as required to suppress dust nuisance. Dust control measures shall be in accordance with the local jurisdiction.
- H. Trees: Carefully protect existing trees that are to remain. Provide temporary irrigation as necessary to maintain health of trees.

#### 1.10 SEASONAL LIMITS

- A. No fill material shall be placed, spread or rolled during unfavorable weather conditions. When work is interrupted by rains, fill operations shall not be resumed until field tests indicate that moisture content and density of fill are satisfactory.

#### 1.11 RECORD DRAWINGS

- A. Keep a daily record of all pipe placed in ground, verified by Project Inspector.
- B. Upon completion of this Contract, furnish one tracing showing all outside utility lines, piping, etc., installed under this Contract. Locate and dimension all work with reference to permanent landmarks.
- C. All symbols and designations used in preparing "RECORD" drawings shall match those used in Contract drawings.
- D. Properly identify on as-builts and provide dimensions for all stubs for future connections. Provide concrete markers 6" dia. 12" deep, flush with finish grade at the ends of all stubbed pipes.

### PART 2 – PRODUCTS

#### 2.01 MATERIALS - GENERAL

- A. Provide each item listed herein or shown on drawings of quality noted or approved equal. All material shall be new, full weight, standard in all respects and in first-class condition. Insofar as possible, all materials used shall be of same brand or manufacture throughout for each class of material or equipment. Materials shall be of domestic manufacture and shall be tested within Continental United States.



- B. Grade or quality of materials desired is indicated by trade names or catalog numbers stated herein.
- C. Dimensions, sizes, and capacities shown are minimum and shall not be changed without permission of Architect.
- D. All materials in this section used for any public water system or domestic water for human consumption shall be lead free.
  - 1. For the purposes of this section, "lead free" means not more than 0.2 percent lead when used with respect to solder and flux and not more than 8 percent when used with respect to pipes and pipe fittings.
  - 2. All pipe, pipe or plumbing fitting or fixtures, solder, or flux shall be certified by an independent American National Standards Institute (ANSI) accredited third party, including, but not limited

to, NSF International, as being in compliance with this section.

- E. All materials used for fire system piping shall be UL and FM approved.

## 2.02 VALVE BOXES

- A. Provide at each valve or cock in ground a Christy, Brooks, or equal to Christy G05CT, concrete valve box with cover marked for service, domestic water shall be marked "Water" and fire supply shall be marked "Fire". Furnish extension handles for each size square nut valve, and provide "fork" handle for each size of "wheel handle" valve as required. Do not locate valve boxes in walk, or covered passages, curbs, or curb & gutters, unless necessary. If valve location is within concrete or asphalt paved surface valve box shall be as detailed on plans for such condition. Provide valve box extensions as required to set bottom of valve box to bottom of piping in which valve is installed. Provide Owner with set of special wrenches and/or tools as required for operation of valves.

## 2.03 PIPES AND FITTINGS

- A. Sanitary Sewer: PVC sewer pipe and fittings with Ring-Tite joints, ASTM D3034 SDR35.
- B. Domestic water Lines 3 1/2" and smaller: Type K copper tubing, hard temper, with wrought copper fittings. [Edit note] Schedule 80 PVC.
- C. Water lines 4" and larger: AWWA C-900 Class 150/DR18 with rubber gasket joints.
- D. Fire lines 4" and larger: AWWA C-900 Class 200/DR14 with rubber gasket joints.
- E. Solder: Lead Free. 95/5; 95% Tin / 5% Antimony.
- F. Ductile Iron Pipe; Class 350, Cement Lined
- G. Ductile Iron Pipe Fittings; AWWA C110, C153, Ebba Iron, Star Romac, Sigma, or approved equal.
- H. Mechanical Fitting Bolts; Bolts and nuts shall be carbon steel with a minimum 60,000 psi tensile strength conforming to ASTM A 307, Grade A. Bolts shall be standard ANSI B1.1 Class 2A course threads. Nuts shall conform to ASTM A 563 and be standard ANSI B1.1, Class 2A course thread. All bolts and nuts shall be zinc coated.
- I. Fasteners Anti-Rust Coatings; After assembly, coat all fasteners with an Asphaltic Bituminous coatings conforming to latest edition NFPA 24.
- J. Ductile Iron Pipe Wrap; 8 mil polyethylene pipe wrap conforming to ANSI/AWWA C105/A21.5 standards.
- K. Pipe Insulation; Pipe exposed to atmospheric conditions 1/2" thru 4" NPT; Johns Manville rigid fiberglass insulation, Micro Lok HP; Owens Corning Fiberglas SSL II; Conforming to ASTM C 612, Type 1A or type 1B.
- L. Aluminum field applied pipe insulation jacket; comply with ASTM B209, ASTM C1729, ASTM C1371

Manufacturers; Childers Metals; ITW Insulation Systems Aluminum Jacketing; or an approved equal.

1. Finish shall be flat mill finish
2. Factory Fabricated Fitting Covers; 45 and 90 degree elbows, tee's, valve covers, end caps, unions, shall be of the same thickness and finish of jacket.
3. The fittings shall be composed of 2-pieces
4. Adhesives; per the manufacturers requirements
5. Joint Sealant; shall be silicone, and shall be aluminum in color.

M. Sewer Forced Main; HDPE, DR 11, color gray with green stripe by JM Eagle or approved equal.

## 2.04 SANITARY SEWER MANHOLES

- A. Shall be constructed as shown on plan details.

## 2.05 CLEANOUTS

- A. Cleanouts of same diameter as pipe up to 8" in size shall be installed in all horizontal soil and waste lines where indicated and at all points of change in direction. Cleanouts shall be located not less than 18" from building so as to provide sufficient space for rodding. No horizontal run over 100 feet shall be without cleanout whether shown on drawings or not.
- B. All cleanout boxes shall be traffic rated with labeled lid, Christy G05CT or approved equal. Lid shall be vandal proof with stainless steel screws

## 2.06 UNIONS

- A. Furnish and install one union at each threaded or soldered connection to equipment and 2 unions, one on each side of valves on pipes ½" to 3".
- B. Locate unions so that piping can be easily disconnected for removal of equipment or valve. Provide type specified in following schedule:

### Type of Pipe Union

|                  |                                                                                                       |
|------------------|-------------------------------------------------------------------------------------------------------|
| Steel Pipe:      | 150 lb. Screwed malleable ground joint, brass, brass-to-iron seat, black or galvanized to match pipe. |
| Copper tubing:   | Brass ground joint with sweat connections.                                                            |
| PVC Sch 80 pipe: | PVC union, FIPT X FIPT                                                                                |

## 2.07 VALVES

- A. Provide valves as shown and other valves necessary to segregate branches or units. Furnish valves suitable for service intended. Valves shall be properly packed and lubricated. Valves shall be non-rising stem. Place unions adjacent to each threaded or sweat fitting valve. Install valves with

bonnets vertical. All valves shall be lead free.

- B. Valves ½" thru 2"; shall be made of bronze, full size of pipe and lead free. Nibco S-113-FL Series; American G-300 Series; Matco 511 FL Series; Apollo 102T-FL Series. Brass valves of brass parts

within valves will not be accepted.

- C. Valves, 2 ½" thru 3" shall be class 150; Shall be made of bronze, full size of pipe; Jenkins Fig. 2310 J; Lunkinheimer Fig. 2153; Crane Fig. 437; Stockham Fig. B-128.
- D. Valves, Flanged; 4" thru 12" Ductile Iron Resilient Wedge Gate Valve; Nibco F 609 RW; American 2500 Series; Kennedy 8561; Mueller 2360 Series.

## 2.07 FIRE HYDRANTS

- A. Clow 960 (DEIT NOTE: VERIFY HYDRANT TYPE WITH LOCAL JURISDICTION) Factory Painted or per Local Jurisdiction Requirements, or an approved equal, 36" minimum bury, two 2-1/2" hose nozzles, one 4-1/2" pumper nozzle, and break-off check valve, Clow LBI 400A or approved equal . Hydrant shall conform to, and installation shall comply with the Local Jurisdiction.

## 2.08 POST INDICATOR

- A. Post Indicator shall be Mueller Co. A-20806 (adjustable) with tamper switch or an approved equal.

## 2.09 BACKFLOW PREVENTERS

Double Check Valve, Double Check Detector and Reduced Pressure Backflow Preventers

- A. Backflow preventers shall be as approved by the local agency and by the State of California's Department of Health Services most recent list of approved reduced pressure backflow preventers. All approved backflow preventers shall have ductile iron bodies.
  - 1. Provide Backflow preventer blankets with locking device. Weatherguard R-30 insulated or equal.
  - 2. Provide ball valve at all test ports with brass plug in valve.
  - 3. Provide a minimum of 2 valve tamper switches on fire prevention Backflows.

## 2.10 TAPPING SLEEVE

- A. Shall be used on pipe sizes 6" thru 12" and shall be made with stainless steel material including stainless steel bolts. Flanges shall be ductile iron or high carbon steel. Gaskets shall seal full circumference of pipe. Shall be manufactured for operating pressure of 200 psi, and shall pass test pressure of 300 psi. Romac SST series; Smithblair 662; Mueller H304; Ford "FAST" tapping sleeve.

## 2.11 SERVICE SADDLES

- A. Shall be used on pipe size 2" thru 4". Body shall be made from ductile iron with epoxy coating or bronze. Cascade Style CSC-1; A.Y. McDonald model 3891 AWWA/3892 FNPT; Smith-Blair #317; Ford S70, S71, S90, (style B).

## 2.11 TRACER WIRE

- A. No. 10 THW solid copper wire. Solder all joints

## PART 3 - EXECUTION

### 3.01 DRAWINGS AND COORDINATION

- A. General arrangement and location of piping, etc., are shown on Drawings or herein specified. Install work in accord therewith, except for minor changes that may be necessary on account of other work or existing conditions. Before excavation, carefully examine other work that may conflict with this work. Install this work in harmony with other craft and at proper time to avoid delay of work.
- B. Verify invert elevations at points of connection to existing systems prior to any excavation. If invert elevations differ from that shown on drawings, notify Architect immediately.
- C. In advance of construction, work out minor changes if conflicts occur with electrical or mechanical. Relocate services to suit actual conditions and work of other trades to avoid conflict therewith. Any adjustments or additional fittings to make adjustments shall not be cause for additional costs to the owner.
- D. Execute any work or apparatus shown on drawings and not mentioned in specifications, or vice versa. Omission from Drawings or Specifications of any minor details of construction, installation, materials, or essential specialties does not relieve Contractor of furnishing same in place complete.
- E. Graded pipes shall take precedence. If conflict should occur while placing the domestic water and fire service piping, the contractor shall provide any and all fittings necessary to route the water lines over or under such conflicting pipes at no additional costs to the owner.

### 3.02 ACCESS

- A. Continuously check for clearance and accessibility of equipment or materials specified herein to be placed. No allowance of any kind shall be made for negligence on part of Contractor to foresee means of installing his equipment or materials into proper position.

### 3.03 EXCAVATING AND BACKFILLING

- A. Excavation and Bedding:
  - 1. General: Trench straight and true to line and grade with bottom smooth and free of irregularities or rock points. Trench width to be a minimum of 12" wider than outside diameter of pipe. Follow manufacturer's recommendations for use of each kind and type of pipe.
  - 2. Bedding: Provide a bedding as noted on drawing details for the full length of the pipe. Bedding shall have a minimum thickness beneath the pipe of 4" or 1/8 the outside diameter of the pipe, which ever is greater. Provide bell holes and depressions for pipe joints only of size required to properly make joint.
  - 3. If the trenches for the site utilities falls within areas to be lime treated, the piping shall be installed prior to any lime treatment operations, providing the elevation of the piping is below the treatment section.
    - a. If trenching is necessary in areas that have been previously lime treated the contractor shall backfill the trench with class 2 aggregate base, with minimum section equal to the lime

treated section and compacted to 95%.

B. Laying of Pipe:

1. General: Inspect pipe prior to placing. Sun damaged pipe will be rejected. Set aside any defective or damaged material. Do not place pipe in water nor place pipe when trenches or weather are unsuitable. Lay pipe bell up grade, true to line and grade.
  - a. Sewer pipe shall be laid in strict conformity to the prescribed line and grade, with grade bars set and each pipe length checked to the grade line. Three consecutive points on the same rate of slope shall be used at all times to detect any variation from a straight grade. In any case of discrepancy, work shall be stopped and the discrepancy immediately reported to the Owner's Representatives. In addition, when requested by the Owner's Representative, a string line shall be used in the bottom of the trench to insure a straight alignment of the sewer pipe between manholes. The maximum deviation from grade shall not be in excess of 1/4 inch. In returning the pipe to grade, no more than 1/4" depression shall result.
  - b. The Contractor shall expose the end of existing pipe to be extended, for verification of alignment and elevation, prior to trenching for any pipe which may be affected. All costs of such excavation and backfill shall be included in the price paid for the various items of work.
  - c. A temporary plug, mechanical type shall be installed on sewer pipe at the point of connection to existing facilities. If connecting to a public facility the plug shall conform to the requirements of the local jurisdiction. This plug shall remain in place until the completion of the balling and flushing operation.

EDIT NOTE: USE IF SEWER IS PLACED ABOVE GRADE

- d. Any portions of the new sewer above ground shall be made using no-hub cast iron soil pipe, using no-hub fittings and couplings. The transition from PVC to cast iron shall be made below grade.
  - e. Above ground sewer piping shall be supported using unistrut and the appropriate pipe strap. Unistrut shall be fastened to the building structures wood frame. Unitstrut shall be fastened to the structure using 2- 3/8" X3" lag bolts. Spacing shall be per plumbing code for pipe type and size.
  - f. In cases where above ground sewer cannot be fastened to a structure, the contractor shall use "Doublestrut" unistrut for a pedestal type pipe hanger. The pedestal shall be placed into a pier footing 9" diameter, 18" deep.
  - g. Pedestals shall be spaced no greater than the required pipe hanger spacing schedule for pipe type and size in the CPC Plumbing Code
2. Bell and Spigot Joints: Lubricate inside of bells and outside of spigots with soap solution. Wedge joints tight. Bell of bell and spigot pipe to be pointed up grade.

C. Backfilling:

1. General: Do not start backfill operations until required testing has been accomplished.
2. Compaction and Grading: Remainder of backfill shall be in accordance with Section 31 23 33 – TRENCHING AND BACKFILLING.
3. If trenching in area previously lime or cement treated backfill top of trench section, same depth as lime or cement treatment with Class 2 Aggregate Base compacted to 95% minimum relative compaction.

### 3.04 INSTALLATION OF WATER PIPING

- A. The contractor shall be responsible for determining the installed depth of all water piping, based on surfaces grades and minimum required depth of cover.
- B. Immediately cap or plug ends of, and opening in, pipe and fittings to exclude dirt until final connections made. Use reducing fittings where any change in pipe size occurs. Bushings shall not



be used.

- C. General: Should existing conditions or other work prevent the running of pipes or the setting of equipment at the points indicated by drawings, changes as authorized by the Architect shall be made without additional cost to the Owner.
- D. All bolts used on mechanical fittings shall be thoroughly coated with an asphaltic bituminous coating conforming to 2016 NFPA 24, 10.4.1.1.
- E. All buried metal shall be incased with 8 mil polyethylene wrap so that no soil is in contact with metal. Ends of polyethylene wrap shall be taped to provide seal with pipe.
- F. Do not install water lines in same trench with non-metallic sewer lines unless bottom of water pipe at all points is at least 12" above top of sewer line and water line is placed on solid shelf excavated at one side of common trench with a minimum of 12 inch horizontal separation.
- G. Under no circumstance shall a fitting be located directly under a structural footing without prior approval from the Architect.
- H. In locations where existing domestic pipe is rerouted, the new pipe shall be assembled using restrained fittings at all joints including factory pipe joints. Tapped restrained blind flanges shall be temporarily installed at each end of the assembled pipes until testing and chlorination is completed and approved.

### 3.05 CLOSING IN OF UNINSPECTED WORK

- A. Do not allow or cause work installed to be covered up or enclosed before it has been inspected, tested, and approved. Should work be enclosed or covered up before it has been approved, uncover work at own expense. After it has been inspected, tested and approved, make repairs necessary to restore work of other contractors to condition in which it was found at time of cutting.

### 3.06 CARE AND CLEANING

- A. Repair or replace broken, damaged, or otherwise defective parts, materials, and work. Leave entire work in new condition satisfactory to Architect. At completion, carefully clean and adjust equipment, fixtures and trim that are installed as part of this work. Leave systems and equipment in satisfactory new operating condition.
- B. Drain and flush piping to remove grease and foreign matter.
- C. Sewer piping shall be balled and flushed.
- D. Clean out and remove surplus materials and debris resulting from the work, including surplus excavated material.
- E. Flush fire service piping in the presence of the project inspector. Flushing shall be continued for a sufficient time as necessary to ensure all foreign material has been removed. Flow rate shall be equal to site fire flow requirements.

### 3.07 SEWER INTERNAL INSPECTIONS

- A. Upon completion of construction and prior to final inspection, the Contractor shall clean the entire new pipeline of all dirt and debris. Any dirt or debris in previously existing pipes or ditches in the area, which resulted from the new installation, shall also be removed. Pipes shall be cleaned by the controlled balling and flushing method. Temporary plugs shall be installed and maintained during cleaning operations at points of connection to existing facilities to prevent water, dirt, and debris from entering the existing facility.
- B. Provide video inspection for all site sewer piping. An electronic copy of the video inspection shall be provided to the project inspector for review and approval prior to acceptance of the piping. FOR ELK GROVE USD ONLY

### 3.08 TEST OF PIPING

- A. Pressure Test piping at completion of roughing-in, in accord with following schedule, and show no loss in pressure or visible leaks after minimum duration or four (4) hours at test pressures indicated.
- B. Chlorination tests shall be performed after all fixtures and any required mechanical devices are installed and the entire system is complete and closed up.
- C. In cases where new domestic water piping is assembled for re-routing of existing domestic water pipe, the contractor shall perform the following testing prior to connecting the new water pipe to the existing system.
  - 1. The pipe shall be pressure tested and per the test schedule.
  - 2. The pipe shall be pressure tested down within the trench.
  - 3. The contractor shall dig a temporary ditch below the existing pipe to drain to a sump that is lower than the bottom of the trench and to the side of the trench. The sump shall be 30% larger than the total volume of water within the testing pipe assembly.
  - 4. After pressure testing and chlorination has taken place and accepted, the contractor shall drain the pipe into the sump and pump the sump out as it is filling.
  - 5. The temporary test fittings at each end of the pipe assembly shall be removed and the final restrained couplings installed.
  - 6. The existing piping shall be cut and the water within the pipe shall drain below the pipe to the temporary sump. Pump the sump as it is being filled up. Take extreme caution not to contaminate the existing pipe with any contaminants within the trench.
  - 7. Before making the final coupling connections, the restrained couplings at each end of the new pipe shall be thoroughly swabbed inside the fitting with a solution of chlorine mixed with water at a rate of 1part chlorine to 4 parts potable water.
  - 8. After final connections are made, a visual inspection shall be made after fittings are wiped off. If after 1 hr, no noticeable drips are noted the pipe can be backfilled.
  - 9. The contractor shall flush all water piping affected by chlorination until it is within acceptable levels approved by certified testing lab.

#### TEST SCHEDULE

| <u>System Tested</u>                                                       | <u>Test Pressure PSIG Test With</u> |
|----------------------------------------------------------------------------|-------------------------------------|
| SACRAMENTO CITY UNIFIED SCHOOL DISTRICT<br>VERSION DATE SEPTEMBER 30, 2022 | PROJECT NAME / NUMBER               |

|                                                                     |                                                                               |
|---------------------------------------------------------------------|-------------------------------------------------------------------------------|
| Public water mains                                                  | Per local jurisdiction requirements.                                          |
| Private domestic water piping and fire mains serving fire hydrants: | 150 Lbs. Water 4 hrs.                                                         |
| Fire Protection Piping from PIV to fire riser:                      | 200 Lbs. Water pressure, 4 hrs duration with no pressure loss.                |
| Sanitary Sewer Piping:                                              | Sewer system shall be tested for leakage per local jurisdiction requirements. |

D. Testing equipment, materials, and labor shall be furnished by contractor.

### 3.09 WATER SYSTEM STERILIZATION

- A. Public Water Mains: Shall be flushed and disinfected per the local jurisdiction requirements
- B. Clean and disinfect all site water systems connected to the domestic water systems in accordance with AWWA Standard C651 and as required by the local Building and Health Department Codes, and EPA.
  - 1. Clean and disinfect industrial water system in addition to the domestic water system.
  - 2. Disinfect existing piping systems as required to provide continuous disinfection upstream to existing valves. At Contractors option, valves may be provided to isolate the existing piping system from the new piping system.
- C. Domestic water sterilization shall be performed by a licensed “qualified applicator” as required by CAL-EPA Pesticide Enforcement Branch for disinfecting and sterilizing drinking water.
- D. Disinfecting Agent: Chlorine product that is a registered product with Cal-EPA for use in California potable water lines, such as Bacticide, CAL-EPA Registration No. 37982-20001.
- E. Contractor to provide a 1” service valve connected to the system at a point within 2’-0” of its junction with the water supply line. After sterilization is complete Contractor to provide cap at valve.
- F. Sterilization Procedure to be as follows:
  - 1. Flush pipe system by opening all outlets and letting water flow through the system until clear water flows from all outlets.
  - 2. Inject disinfecting agent to provide a minimum chlorine residual concentration of at least 50 parts per million (ppm) of free chlorine at each outlet.
  - 3. Provide sign at all outlets which reads “Water Sterilization in Progress – Do not operate”. Remove signs at conclusion of test.

4. Close all outlets and valves, including valve connecting to water supply line and 1" service valve. Retain treated water in pipe for a minimum of twenty-four hours. Should chlorine residual at pipe extremities be less than 50 PPM at this time, pipe shall be re-chlorinated. As an option, the water systems may be filled with a water-chlorine solution containing a minimum of 200 PPM of chlorine and allowed to stand for three hours.
  5. After chlorination, flush lines of chlorinated water and refill from domestic supply. Continue flushing until residual chlorine is less than or equal to 0.2 ppm, or a residual the same as that of the test water.
- G. Chemical and bacteriological tests shall be conducted by a state-certified laboratory and approved by the local authorities having jurisdiction.
- H. Submit written report to Health Department as required by State Regulations. Provide a copy of report to Architect prior to completion of project.
- I. The costs of sterilization and laboratory testing shall be paid for by the contractor.

### 3.10 CLEANING

- A. Refer to Section 01 74 00.
- B. Upon completion of work of this Section promptly remove from the working area all scraps, debris and surplus material of this Section.

END OF SECTION

## REVISION SUMMARY

### Notice to All Users and Designers!

The following revision dates summarize significant changes included in this specification section since the last release. The revisions summarized below are included in this section.

Please delete this page prior to issuance.

- 2022-09-30 - Section revised for format, standards check, reorganized to fit CSI Section Format Outline.

## DISTRICT DESIGN STANDARDS

### Notice to All Users and Designers!

In many cases, the District does not govern the technical 3-part specifications for the Design Team. The design standards information shown below is provided to convey the District's intentions on manufacturers, products and procedures that the District does or does not want to be used on their projects. The items listed below are to assist you with understanding what needs to be reflected in your 3-part specification without forcing a pre-written specification upon you. Where a 3-part specification section is provided by the District, the items below are design parameters to be considered when applying this specification section to your design. The design team shall confirm and coordinate all product and system requirements with the District during design regardless of them being design standards or full 3-part specifications.

When provided, the full 3-part specification is intended for new construction work. The design team shall be responsible for modifying this specification as required for repair or modernization work.

Please delete this page prior to issuance.

*All items highlighted in yellow within the specification shall be coordinated by the design team on a project specific basis. Designer is expected to modify this specification as required to coordinate with the full body of project specific specifications.*

- Storm piping shall be PVC SDR 35 or HDPE.
- Storm bedding and initial backfill to be  $\frac{3}{4}$ " Crushed Rock.
- Provide a cleanout at all storm elbows where an inlet or manhole is not located.
- Downspouts shall be connected to the storm drain using a JR Smith 4510 cleanout or approved equal. Downspouts shall not spill to grade at walkway or any location where pedestrians travel.
- Provide ADA compliant grates at all inlets with openings of  $\frac{1}{2}$ " max.
- It is recommended that existing storm utilities beneath pavement that is being removed be replaced with new. Confirm with District utilities to be replaced. Underground utility locating to be provided with topographic survey.
- Storm drain structures may be precast or cast in place.

SECTION 33 40 00

SITE DRAINAGE

**PART 1 - GENERAL**

1.01 SUMMARY

A. SECTION INCLUDES:

1. Storm Drain piping, fittings, structures.

B. RELATED SECTIONS

1. The General Conditions, Supplementary Conditions and Division 1 are fully applicable to this Section, as if repeated herein.
2. Section 01 50 00, Construction Facilities and Temporary Controls.
3. Section 31 23 33, Trenching and Backfilling.
4. Section 32 16 00, Site Concrete.
5. Section 33 00 00, Earthwork.
6. Section 31 31 00, Soil Treatment

1.02 REFERENCES AND STANDARDS

- A. ANSI/ASTM D698-00 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.
- B. ANSI/ASTM D1556-00 - Test Method for Density of Soil in Place by the Sand-Cone Method.
- C. ANSI/ASTM D1557-02 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb. (4.54 Kg) Rammer and 18 inch (457 mm) Drop.
- D. ANSI/ASTM D 3017-05 Test Methods for Moisture Content of Soils and Soil-Aggregate Mixture by Nuclear Methods (Shallow Depth).
- E. ANSI/ASTM D 4318-05 Test Method for Liquid Limit, Plastic Limit, and Plasticity Limit.
- F. CALTRANS Standard Specifications.
- G. CAL-OSHA, Title 8, Section 1590 (e).
- H. Any work within the street, highway or right-of-way shall be performed in accordance with the requirement of the governmental agencies having jurisdiction, and shall not begin until all of those governing authorities have been notified.
- I. NFPA 13, 24 and 25, latest editions.
- J. California State Health and Safety Code Section 116875, Lead Free Public Water Systems.

- K. California Plumbing Code, latest edition.

#### 1.03 SUBMITTALS

- A. Refer to Section 01 33 00.
- B. Manufacturer's Data: Submit list and complete descriptive data of all products proposed for use. Include manufacturer's specifications, published warranty or guarantee, installation instructions, and maintenance instructions.
- C. Provide sieve analysis from accredited testing lab on pipe bedding material. Analysis shall have a current date not older than project contract signing date.
- D. Substitution: Provide all data of proposed material being submitted as a substitution. Provide comparison with specified product data and identify all differences. Failure to provide comparison will be reason for rejection.

#### 1.04 QUALITY ASSURANCE

- A. Use only new materials and products, unless existing materials or products are specifically shown otherwise on the drawings to be salvaged and re-used.
  - 1. Sun damaged or discolored PVC pipe will be rejected.
- B. All materials, components, assemblies, workmanship and installation are to be observed by the Owner's Inspector of Record. Work not so inspected is subject to uncovering and replacement.
- C. The representatives of the Owner's testing lab will not act as supervisor of construction, nor will they direct construction operations. Neither the presence of the Owner's testing lab representatives nor the testing by the Owner's testing lab shall excuse the contractors or subcontractors for defects or deficiencies discovered in their work during or following completion of the project. Correcting inadequate compaction is the sole responsibility of the contractor.
- D. Contractor shall be solely responsible for all subgrades built. Any repairs resulting from inadequate compaction or incorrect grades will be the responsibility of the contractor.
- E. Per 2016 NFPA 13 provide Contractor's material and test certificate to the Owner, Architect, Project Inspector and Local Fire Authority.

#### 1.05 FEES, PERMITS, AND UTILITY SERVICES

- A. Obtain and pay for permits and service charges required for installation of Work. Arrange for required inspections and secure written approvals from authorities having jurisdiction.
- B. Upon completion of work within right-of-way, provide copies of written final approval to the Architect.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Transport, store and handle in strict accord with the local jurisdiction.
- B. Make delivery to job when notified by Contractor verifying that the job is ready to receive the work of this Section and that arrangements have been made to properly store, handle and protect such materials and work.

1.07 PROJECT CONDITIONS

- A. Existing civil, mechanical and electrical improvements are shown on respective site plans to the extent known. Should the Contractor encounter any deviation between actual conditions and those shown, he is to immediately notify the Architect before continuing work.
- B. Contractor shall acquaint himself with all site conditions. If unknown active utilities are encountered during work, notify Architect promptly for instructions. Failure to notify will make Contractor liable for damage to these utilities arising from Contractor's operations subsequent to discovery of such unknown active utilities.

1.08 WARRANTY

- A. Refer to General Conditions and Section 01 78 36.

1.09 PROTECTION

- A. Adequate protection measures shall be provided to protect workmen and passers-by on and off the site. Adjacent property shall be fully protected throughout the operations. Blasting will not be permitted. Prevent damage to adjoining improvements and properties both above and below grade. Restore such improvements to original condition should damage occur. Replace trees and shrubs outside building area disturbed by operations.
- B. In accordance with generally accepted construction practices, the Contractor shall be solely and completely responsible for working conditions at the job site, including safety of all persons and property during performance of the work. This requirement shall apply continuously and shall not be limited to normal working hours.
- C. Any construction review of the Contractor's performance conducted by the Geotechnical Engineer is not intended to include review of the adequacy of the Contractor's safety measures, in, on, or near the construction site.
- D. Provide shoring, sheeting, sheet piles and or bracing to prevent caving, erosion or gullyng of sides of excavation.
- E. Surface Drainage: Provide for surface drainage during period of construction in manner to avoid creating nuisance to adjacent areas. The contractor shall make a reasonable effort on a daily basis to



provide pumps and all equipment necessary to keep all excavations and the site free from water during entire progress of work, regardless of cause, source, or nature of water.

- F. Adjacent streets and sidewalks shall be kept free of mud, dirt or similar nuisances resulting from earthwork operations.
- G. The site and adjacent influenced areas shall be watered as required to suppress dust nuisance. Dust control measures shall be in accordance with the local jurisdiction.
- H. Trees: Carefully protect existing trees that are to remain. Provide temporary irrigation as necessary to maintain health of trees.

#### 1.10 SEASONAL LIMITS

- A. No fill material shall be placed, spread or rolled during unfavorable weather conditions. When work is interrupted by rains, fill operations shall not be resumed until field tests indicate that moisture content and density of fill are satisfactory.

#### 1.11 RECORD DRAWINGS

- A. Keep a daily record of all pipe placed in ground, verified by Project Inspector.
- B. Upon completion of this Contract, furnish one tracing showing all outside utility lines, piping, etc., installed under this Contract. Locate and dimension all work with reference to permanent landmarks.
- C. All symbols and designations used in preparing "RECORD" drawings shall match those used in Contract drawings.
- D. Properly identify on as-builts and provide dimensions for all stubs for future connections. Provide concrete markers 6" dia. 12" deep, flush with finish grade at the ends of all stubbed pipes.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS

- A. Pipe: Use one of the following, unless noted on the Drawings otherwise.
  - 1. Polyvinyl Chloride Pipe (PVC): SDR35 conforming to ASTM D3034 with elastomeric joints conforming to ASTM D3212. Sun damaged pipe will be rejected.
  - 2. High density polyethylene pipe (HDPE): The pipe shall be corrugated exterior/smooth interior pipe and water tight per ASTM D3212 with dual wall water tight gasket fittings.
- B. Perforated Pipe (for subdrains): Shall be ADS N12 pipe, 3 hole, ASTM F 405, AASHTO M 252; PVC ASTM D3034 SDR-35 storm drain pipe
- C. Manhole: Shall be as shown on the drawing details.

- D. Drop Inlet: Shall be as shown on the drawing details.
- E. Curb Inlet: Shall be as shown on the drawing details.
- F. Mortar: For pipe connections to concrete drainage structures, conform to ASTM C270 type N mortar. Place within one half hour after adding water.
- G. Crushed Rock: Imported washed crushed rock. Minimum 100% passing 3/4 inch sieve.
- H. Trench drain: Polycast, Polydrain or equal and as shown on drawings.
- I. Area Drains: Shall be as shown on the drawing details.
- J. Floor Drains: Shall be as shown on the drawing details.
- K. Clean-outs: Shall be as shown on the drawing details.
- L. Planter drains: Shall be as detailed on the drawing details.
- M. Filter Fabric: Mirafi 140N.

### **PART 3 - EXECUTION**

#### **3.01 INSPECTION LAYOUT AND PREPARATION**

- A. Prior to installation of the work of this Section, carefully inspect and verify by field measurements that installed work of all other trades is complete to the point where this installation may properly commence
- B. Layout all work, establish grades, locate existing underground utilities, set markers and stakes, setup and maintain barricades and protection facilities; all prior to beginning actual earthwork operations. Layout and staking shall be done by a licensed Land Surveyor or Professional Civil Engineer.
- C. Verify that specified items may be installed in accordance with the approved design.
- D. In event of discrepancy, immediately notify Owner and the Architect. Do not proceed in discrepant areas until discrepancies have been fully resolved.

#### **3.02 INSTALLATION**

- A. General: Installation shall be in strict conformance with referenced standards, the manufacturer's written directions, as shown on the drawings and as herein specified.
- B. Verify invert elevations at points of connection to existing systems prior to any excavation. If invert elevations differ from that shown on drawings, notify Architect immediately.
- C. Excavation and Bedding:

1. General: Trench straight and true to line and grade with bottom smooth and free of irregularities or rock points. Trench width in accordance with pipe manufacturer's recommendations and as per the drawings. Follow manufacturer's recommendations for use of each kind and type of pipe.
2. Bedding: Provide bedding as detailed on plans for the full length of the pipe. Bedding shall have a minimum thickness beneath the pipe of 4" or 1/8 the outside diameter of the pipe, which ever is greater. Provide bell holes and depressions for pipe joints only of size required to properly make joint.
3. If the trenches for the site drainage fall within areas to be lime treated, the piping shall be installed prior to any lime treatment operations.
  - a. If additional piping is added to previously lime treated areas, the contractor shall backfill the trench with class 2 aggregate base and compact to 95%.

D. Laying of Pipe:

1. General: Inspect pipe prior to placing. Set aside any defective or damaged material. Do not place pipe in water nor place pipe when trenches or weather are unsuitable. Lay pipe upgrade, true to line and grade.
2. Bell and Spigot Joints: Lubricate inside of bells and outside of spigots with soap solution or as recommended by manufacture. Wedge joints tight. Bell of bell and spigot pipe to be pointed upgrade.
3. Pipe shall be bedded uniformly throughout its length.
4. Pipe elevation shall be within 0.02 feet of design elevation as shown on plans.
5. Off Site Work: All work beyond the property lines shall be done in strict conformance with the requirements of the governing agency.

E. Backfilling:

1. General: Do not start backfill operations until required testing has been accomplished.
2. Trenches and Excavations: Backfill with material as detailed on plans, filling both sides of the pipe at the same time, carefully tamping to hold pipe in place without movement. Refer to Section 31 23 33 – TRENCHING AND BACKFILLING for fill above this layer.

F. Grouting of Pipes: Grout pipes smooth and water tight at drop inlet, manholes, and curb inlets. Grout back side of hood at curb inlets all grouting shall be smooth and consistent.

G. Off Site Work: All work beyond the property lines shall be done in strict conformance with the requirements of the local agency.

H. Cutting and Patching: Remove and replace existing surface features per applicable specification section (i.e. asphaltic concrete or concrete paving) where pipe is installed in areas of existing improvements.

### 3.03 TOLERANCES

A. Storm Drain structure grates

1. In landscape and lawn areas +/- 0.05'.
2. In sidewalk and asphalt pavement +/- 0.025'.

3. In curb and gutter application  $\pm 0.0125'$ .

B. Cleanout Boxes and Lids

1. In landscape areas; 0.10 higher than surrounding finish grade,  $\pm 0.05'$ .
2. In sidewalks and asphalt pavement; Flush with surrounding finish grade,  $\pm 0.025'$ .

3.03 DEWATERING

- A. Contractor to provide trench dewatering as necessary, no matter what the source is, at no additional cost to the owner.
- B. If the previously excavated material from trenching is too wet to achieve trench backfill compaction the contractor shall make a reasonable effort to aerate and dry the material per section 31 00 00, 3.08, B

3.04 FLUSHING

- A. The Contractor shall thoroughly ball and flush the storm drain system to remove all dirt and debris. Discharge water to an approved location.

3.05 CLEANING

- A. Refer to Section 01 74 00.
- B. Upon completion of work of this Section promptly remove from the working area all scraps, debris and surplus material of this Section.
- C. Clean the dirt, rocks, and debris from all storm drain inlets, structures, and connecting pipes.

END OF SECTION