Alameda-Contra Costa Transit District

D3 Richmond Yard Reactivation
P2095 - IFB #2016-1360

TECHNICAL SPECIFICATIONS - Divisions 01 thru 45

Bid Set

DBA Project Number B4030.00

20 November 2015
# TECHNICAL SPECIFICATIONS

## TABLE OF CONTENTS

### DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

Note the Division 00 Procurement and Contracting Documents are furnished as a separate document

### DIVISION 01 – GENERAL REQUIREMENTS – Part 1

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>00 11 00</td>
<td>Summary</td>
</tr>
<tr>
<td>00 14 00</td>
<td>Time for Completion, Liquidated Damages, Contractor’s License</td>
</tr>
<tr>
<td>01 20 00</td>
<td>Price and Payment Procedures</td>
</tr>
<tr>
<td>01 21 00</td>
<td>Allowances</td>
</tr>
<tr>
<td>01 26 00</td>
<td>Contract Modification Procedures</td>
</tr>
<tr>
<td>00 30 00</td>
<td>Administrative Requirements</td>
</tr>
<tr>
<td>01 31 00</td>
<td>Project Management and Coordination</td>
</tr>
<tr>
<td>01 32 00</td>
<td>Construction Progress Documentation</td>
</tr>
<tr>
<td>01 33 00</td>
<td>Submittal Procedures</td>
</tr>
<tr>
<td>01 40 00</td>
<td>Quality Requirements</td>
</tr>
<tr>
<td>01 42 00</td>
<td>References</td>
</tr>
<tr>
<td>01 48 00</td>
<td>Control of Work</td>
</tr>
<tr>
<td>01 50 00</td>
<td>Temporary Facilities and Controls</td>
</tr>
<tr>
<td>01 55 26</td>
<td>Traffic Control System</td>
</tr>
<tr>
<td>01 58 13</td>
<td>Project Information Signs</td>
</tr>
<tr>
<td>01 60 00</td>
<td>Product Requirements</td>
</tr>
<tr>
<td>01 70 00</td>
<td>Execution and Closeout Requirements</td>
</tr>
<tr>
<td>01 71 13</td>
<td>Mobilization</td>
</tr>
<tr>
<td>01 71 23</td>
<td>Construction surveying</td>
</tr>
<tr>
<td>01 71 25</td>
<td>Utility Potholing</td>
</tr>
<tr>
<td>01 79 00</td>
<td>Demonstration and Training</td>
</tr>
</tbody>
</table>

### DIVISION 01 – GENERAL REQUIREMENTS – Part 2

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 74 19</td>
<td>Construction Waste Management</td>
</tr>
<tr>
<td>01 84 15</td>
<td>Supporting from Structure</td>
</tr>
<tr>
<td>01 91 13</td>
<td>General Commissioning Requirements</td>
</tr>
</tbody>
</table>

### DIVISION 02 – EXISTING CONDITIONS

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>02 41 00</td>
<td>Selective Site Demolition</td>
</tr>
<tr>
<td>02 41 19</td>
<td>Selective Structure Demolition</td>
</tr>
<tr>
<td>02 82 13</td>
<td>Asbestos Abatement</td>
</tr>
<tr>
<td>02 82 33</td>
<td>Removal and Disposal of Material Containing Toxic Metals</td>
</tr>
<tr>
<td>02 84 16</td>
<td>Hazardous Materials Removal and Disposal</td>
</tr>
</tbody>
</table>
DIVISION 03 – CONCRETE

03 05 00 Concrete Floor Sealer
03 11 00 Concrete Formwork and Accessories
03 21 00 Reinforcing Steel
03 25 30 Fiber Reinforced Polymer Coatings
03 30 00 Cast in Place Concrete
03 37 19 Pneumatically Placed Concrete
03 54 19 Concrete Floor Underlayment

DIVISION 04 – MASONRY

04 05 00 Mortar and Grout
04 90 00 Exterior Building Cleaning

DIVISION 05 – METALS

05 12 00 Structural Steel
05 50 00 Metal Fabrications

DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES

06 05 73 Wood Treatment
06 10 53 Miscellaneous Rough Carpentry
06 41 00 Architectural Wood Casework
06 64 00 Plastic Paneling (FRP)

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

07 14 16 Elastomeric Liquid waterproofing
07 18 16 Vehicular Traffic Coatings
07 21 00 Thermal Insulation
07 22 16 Roof Board Insulation
07 26 23 Below-Grade Vapor Retarders
07 54 23 Thermoplastic-Polyolefin Roofing
07 62 00 Sheet Metal Flashing and Trim
07 65 26 Self-Adhering Sheet Flashing
07 84 00 Firestopping
07 92 00 Joint Sealants
07 92 19 Acoustical Joint Sealants
07 95 00 Expansion control

DIVISION 08 – OPENINGS

08 11 13 Hollow Metal Doors and Frames
08 31 13 Access Doors and Frames
08 56 19 Pass Windows
08 71 00 Door Hardware
08 80 00 Glazing
08 83 00 Mirrors
DIVISION 09 – FINISHES

09 22 16  Non-Structural Metal Framing
09 22 26.23 Metal Suspension Systems
09 28 13  Cementitious Backing Boards
09 29 00  Gypsum Board
09 30 00  Tile
09 51 13  Acoustical Panel Ceilings
09 53 23  Acoustical Ceiling Suspension Assemblies
09 61 43  Water Vapor Emission and Humidity Testing and Control Systems
09 65 13  Resilient Base and Accessories
09 65 16  Resilient Sheet Flooring
09 65 19  Resilient Tile Flooring
09 68 13  Tile Carpeting
09 72 16  Vinyl-Coated Fabric Wall Coverings
09 81 00  Acoustic Insulation
09 91 00  Painting
09 96 56  Epoxy Coatings
09 96 59  Tile Surface Refinishing
09 96 69  Electrostatic Painting
09 97 23  Elastomeric Coatings

DIVISION 10 – SPECIALTIES

10 11 00  Visual Display Surfaces
10 14 00  Signage
10 21 13.20 Phenolic Toilet Compartments
10 22 13  Wire Mesh Partitions
10 28 13  Toilet Accessories
10 41 16  Emergency Key Access Systems
10 44 00  Fire Protection Specialties
10 81 13  Bird Control Devices

DIVISION 11 – EQUIPMENT

11 11 10  Vehicle Service Equipment
11 11 29  Shop Equipment
11 11 40  Relocation of Existing Equipment Directives
11 12 00  Parking Control Equipment
11 24 19  Vacuum Equipment
11 31 00  Residential Appliances
11 99 00  Miscellaneous Equipment

DIVISION 12 – FURNISHINGS

12 21 13  Horizontal Louver Blinds
12 36 16  Stainless Steel Countertops
12 36 61  Solid Surfacing Countertops

DIVISION 13 – SPECIAL CONSTRUCTION

13 34 23  Prefabricated Shelters
13 34 40  Prefabricated Guard Booth
DIVISION 14 – CONVEYING EQUIPMENT

14 22 10 Modernization of Hydraulic Passenger Elevators
14 45 00 Vehicle Lifts

DIVISION 21 – FIRE PROTECTION

21 00 50 Basic Fire Sprinkler Materials and Methods
21 10 00 Fire Sprinkler System

DIVISION 22 – PLUMBING

22 00 50 Basic Plumbing Materials & Methods
22 10 00 Plumbing Piping Systems
22 40 00 Plumbing Fixtures
22 50 00 Plumbing Equipment

DIVISION 23 – HEATING, VENTILATION AND AIR CONDITIONING ((HVAC))

23 00 50 Basic HVAC Materials & Methods
23 05 93 Testing, Adjusting, and Balancing for HVAC
23 80 00 Heating, Ventilating, and Air Conditioning Equipment

DIVISION 26 – ELECTRICAL

26 00 10 Basic Electrical Requirements
26 00 60 Power System Study
26 00 90 Electrical Demolition
26 05 19 Building Wire 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 53 Electrical Identification
26 22 13 Dry Type Transformers
26 24 16 Panelboards
26 27 16 Cabinets and Enclosures
26 27 26 Wiring Devices
26 28 16 Overcurrent Protective Devices
26 28 19 Disconnect Switches
26 29 00 Motor Controls
26 32 13 Packaged Engine Generator System
26 36 23 Transfer Switches
26 50 00 Lighting
26 61 13 Fire Alarm System
DIVISION 27 – COMMUNICATIONS

27 00 10 Basic Communications Requirements
27 05 26 Communications Grounding and Bonding
27 05 28 Communications Pathways
27 05 36 Communications Cable Trays
27 11 00 Communications Equipment Rooms
27 13 13 Communications Copper Backbone Cabling
27 13 23 Communications Optical Fiber Backbone Cabling
27 15 00 Communications Horizontal Cabling
27 51 13 Communications Paging System

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

28 13 00 Security Alarm Monitoring System
28 13 53 IP Video Intercom
28 23 00 Video Surveillance System

DIVISION 31 – EARTHWORK

31 23 00 Excavation and Fill
31 23 33 Trenching and Backfilling
31 31 19 Vegetation Control

DIVISION 32 – EXTERIOR IMPROVEMENTS

32 05 23 Cement and Concrete for Exterior Improvements.
32 11 00 Base Courses
32 13 00 Rigid Paving
32 16 13 Concrete Curbs and Gutters
32 17 13 Parking Bumpers
32 17 23 Pavement Markings
32 17 26 Tactile Warning Surfaces
32 21 12.73 Gate Operators

DIVISION 33 – UTILITIES

33 05 16 Utility Structures
33 05 50 Fuel Dispensing Equipment
33 05 90 Fuel / Fluid Monitoring System
33 30 00 Sanitary Sewerage Utilities
33 40 00 Storm Drainage Utilities
33 44 19 Storm Water Treatment

DIVISION 40 – PROCESS INTEGRATION

40 12 13 Breathable Air Systems

DIVISION 41 – MATERIAL PROCESSING AND HANDLING EQUIPMENT

41 34 23 Spray Painting booths

DIVISION 45 – INDUSTRY-SPECIFIC MANUFACTURING EQUIPMENT

45 39 00 Fabricated Equipment

END OF TABLE OF CONTENTS
# DIVISION 01 - TABLE OF CONTENTS –Part 1

## INTRODUCTORY INFORMATION

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TABLE OF CONTENTS</td>
<td>i</td>
</tr>
<tr>
<td></td>
<td>DIVISION 01 – GENERAL REQUIREMENTS</td>
<td>1</td>
</tr>
<tr>
<td>01 11 00</td>
<td>SUMMARY</td>
<td>1</td>
</tr>
<tr>
<td>01 14 00</td>
<td>TIME FOR COMPLETION, LIQUIDATED DAMAGES, CONTRACTOR’S LICENSE</td>
<td>7</td>
</tr>
<tr>
<td>01 20 00</td>
<td>PRICE AND PAYMENT PROCEDURES</td>
<td>9</td>
</tr>
<tr>
<td>01 21 00</td>
<td>ALLOWANCES</td>
<td>13</td>
</tr>
<tr>
<td>01 26 00</td>
<td>CONTRACT MODIFICATION PROCEDURES</td>
<td>15</td>
</tr>
<tr>
<td>01 30 00</td>
<td>ADMINISTRATIVE REQUIREMENTS</td>
<td>19</td>
</tr>
<tr>
<td>01 31 00</td>
<td>PROJECT MANAGEMENT AND COORDINATION</td>
<td>23</td>
</tr>
<tr>
<td>01 32 00</td>
<td>CONSTRUCTION PROGRESS DOCUMENTATION</td>
<td>37</td>
</tr>
<tr>
<td>01 33 00</td>
<td>SUBMITTAL PROCEDURES</td>
<td>47</td>
</tr>
<tr>
<td>01 40 00</td>
<td>QUALITY REQUIREMENTS</td>
<td>57</td>
</tr>
<tr>
<td>01 42 00</td>
<td>REFERENCES</td>
<td>63</td>
</tr>
<tr>
<td>01 48 00</td>
<td>CONTROL OF WORK</td>
<td>67</td>
</tr>
<tr>
<td>01 50 00</td>
<td>TEMPORARY FACILITIES AND CONTROLS</td>
<td>71</td>
</tr>
<tr>
<td>01 55 26</td>
<td>TRAFFIC CONTROL SYSTEM</td>
<td>81</td>
</tr>
<tr>
<td>01 58 13</td>
<td>PROJECT INFORMATION SIGNS</td>
<td>89</td>
</tr>
<tr>
<td>01 60 00</td>
<td>PRODUCT REQUIREMENTS</td>
<td>93</td>
</tr>
<tr>
<td>01 70 00</td>
<td>EXECUTION AND CLOSEOUT REQUIREMENTS</td>
<td>99</td>
</tr>
<tr>
<td>01 71 13</td>
<td>MOBILIZATION</td>
<td>105</td>
</tr>
<tr>
<td>01 71 23</td>
<td>CONSTRUCTION SURVEYING</td>
<td>107</td>
</tr>
<tr>
<td>01 71 25</td>
<td>UTILITY POTHOLING</td>
<td>109</td>
</tr>
<tr>
<td>01 79 00</td>
<td>DEMONSTRATION AND TRAINING</td>
<td>111</td>
</tr>
</tbody>
</table>

**END OF Division 01 TABLE OF CONTENTS – Part 1**

Note: Additional Division 01 Sections are included separately in the Technical Specifications

NOVEMBER 2015
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Contract description.

B. Definitions.

C. Licenses and Permits.

D. Sequence of the Work.

E. Contractor’s use of site and premises.

F. Holidays and Working Hours

1.2 CONTRACT DESCRIPTION

A. The D3 Richmond Yard Reactivation project includes the renovation, reactivation, and re-commissioning of the AC Transit District’s Richmond Yard (D3) located at 2016 Macdonald Ave., Richmond, CA 94801. This yard is a bus service, maintenance, and transportation facility on an approximately 6-acre site with approximately 50,000 square feet of structures including a maintenance and transportation building with rooftop parking, a fueling and service structure, a bus wash structure and a paved bus parking area. The D3 is the smallest facility in AC Transit’s inventory of bus maintenance and service yards and was deactivated in 2011 with only limited service activities currently occurring on the site. The purpose of this project is to bring the existing site and buildings back into full service ready conditions.

B. The Maintenance and Transportation Building is the largest structure on the site and includes the bus maintenance areas, a transportation office that dispatches drivers and buses, and a rooftop parking area. The building is a masonry and concrete structure constructed in approximately 1988 with 2 stories and a roof that is used as an employee parking area. The ground level story is at grade and is used primarily for bus maintenance operations and includes below grade service pits below some maintenance bays. The ground level include both low bay and high bay maintenance areas. The second floor covers roughly half of the area of the ground floor and extends over low bay maintenance and storage functions. The second floor includes the transportation offices, bus driver ready rooms, toilets and lockers, facility maintenance offices, storage and light service accessory spaces. The rooftop parking is accessed via a street level ramp and ramps from a low point on the south end to high points above the transportation spaces at the north end. All of this buildings spaces are vacated and bare of equipment, furniture, fixtures, and parked vehicles. The planned work for this building is to repair, alter and improve the existing spaces and bring them to an operable and code compliant condition. Work includes but is not limited to hazardous materials abatement, structural repairs and strengthening of existing structural components, extensive vehicle maintenance re-equipping, accessibility modifications of toilet and shower facilities, reconfiguration of offices and some internal walls, new casework and finishes, plumbing and HVAC
replacements, electrical and lighting work, fire sprinkler modifications, fire alarm system replacement, telecommunications and security system replacement, and related work.

C. The Fuel and Service Island includes an area of fully enclosed rooms that adjoin a large canopy structure that protects the fueling and service islands. The planned work includes alterations and improvements that extend the useful life of the fueling and service building and fueling systems. Work includes but is not limited to hazardous materials abatement, refurbishing and replacing fueling and fuel management systems, re-equipping with new compressors and lube equipment, accessibility modifications, repurposing of existing rooms, new finishes, plumbing and HVAC replacements, electrical and lighting work, fire sprinkler modifications, fire alarm system replacement, telecommunications and security system replacement.

D. The project also includes an extensively paved yard that is used for bus circulation and parking. The yard is surrounded by a tall masonry wall with vehicular gates at 3 points. Work on the site is intended to repair existing pavements and utilities and extend the useful life of the yard. Work includes but is not limited to pavement repair and replacement, a storm water treatment system upgrade, sewer utility work, replacement of an emergency generator, providing open sided canopies at a hazardous materials storage area and an existing industrial water treatment area, site lighting improvements, site security systems, and repairs of gate operators.

E. A bus wash facility also exists on the site and is planned for refurbishment and repair under a separate construction contract which may overlap with the schedule of this contract. Work of this contract includes pavement and storm drainage modifications up to the edges of the bus wash structure, and installation of security systems on the bus wash structure.

DEFINITIONS
Refer to the “Definitions and Terms” in Division 00 Section 00 72 00 “General Conditions”, except as provided herein.

City of Richmond: City of Richmond Public Works authorized representative.

1.3 LICENSES, PERMITS, INSPECTIONS, AND MONUMENT PRESERVATION

A. Licenses

The prime Contractor shall possess a valid Class “A” California General Engineering Contractor License. The prime Contractor or a subcontractor of the prime contractor shall hold a valid:

1. “C10” California Electrical Contractor License
2. Class “B”

The Contractor will also be required to ensure that all subcontractors working on this project are holding valid licenses suitable for their trade. Subcontractors of the prime contractor working on sanitary sewer systems shall have a Class “A” California General Engineering Contractor License or a “C42” California Sanitation System Contractor License. Subcontractors of the prime contractor working on water mains shall have a Class “A”
California General Engineering Contractor License or a “C34” California Pipeline Contractor License. The prime contractor or a subcontractor of the prime contractor working on water mains holding a valid Class “A” California General Engineering Contractor License or Class “C34” Pipeline Contractor shall have previous experience of not less than one year in installing potable water mains 6” to 20” size.

B. Permits, Inspections and Monument Preservation

The Contractor will not be responsible for applying, paying fees that are required by City of Richmond as AC Transit will be the responsible party. Coordination for the execution of the Permit with the City of Richmond including the associated inspection work required by the City of Richmond will be the responsibility of the Contractor. The Contractor must maintain records of inspections associated with all permits and for inspections of and for the completion of work, and submit them to AC Transit as part of the Contract Closeout documents. Any and all encroachment permits will be the responsibility of the Contractor to obtain if needed.

1. City of Richmond encroachment permits are available at the City of Richmond Permit Counter. [http://www.ci.richmond.ca.us](http://www.ci.richmond.ca.us)

City of Richmond - Permit Center
450 Civic Center Plaza
Richmond CA 94804-1630

### 1.5 SEQUENCE OF THE WORK

A. The AC Transit D3 Facility is currently a limited use Maintenance Facility and is being used for ongoing fueling activities at the Fuel Island. Fueling operations are currently provided to law enforcement vehicles on a daily basis during all hours. Operation of the Fueling Facility with vehicular access from the Bissel gate must be maintained during construction to the maximum extent possible. Temporary shutdowns of the Fueling Facility will be allowed as required to complete the work, but must be scheduled with as much lead time and notice as possible. Shut downs shall be scheduled with no less than 2 weeks notice to AC Transit.

B. The Contract Scope of Work requires concrete roof deck repairs and replacement of the vehicular traffic coating which provides waterproofing of the Maintenance building roof area. Roof work shall be scheduled when weather conditions are forecast to be rain free, and the Contractor will ensure that the watertight integrity of the building envelope is maintained during all construction activities for the duration of the project. Work shall also be planned so that all sumps, pits and equipment wells are maintained dry and water free. The Contractor shall assume all responsibility to maintain a watertight building over the course of the project duration and will be held responsible for any and all water damage from water intrusion.

C. Work to replace pavements and or underground utilities shall be scheduled to minimize weather impacts and or stormwater damage of exposed subgrades.

D. The execution of other work on the project will be at the discretion of the Contractor with the exception of any and all shut downs of water, fueling, electrical, or other project
infrastructure that must be coordinated with the Project Engineer/Construction Manager. Suitable notice consisting of a minimum 72 hours’ notice must be given in advance of any utility shutdown or activity that curtails ongoing AC Transit Operations.

E. AC Transit will be providing Owner Supplied materials, furniture, fixtures and equipment in the Maintenance Facility building as work nears completion. Contractor will provide necessary access and coordination as needed and work with AC Transit to schedule maintenance activities and/or installation of Owner supplied materials. Expected work activities include but not limited to the rebuilding of the Bus Wash Infrastructure, installation of communication and computer equipment, and installation of building furniture, fixtures and equipment. The Project Engineer/Construction Manager will provide a 7 day notice of any scheduled Owner activities.

1.6 CONTRACTOR’S USE OF SITE AND PREMISES

A. Contractor will limit construction access and work to normal workdays and work hours which are defined as Monday thru Friday from 7:00 am to 7:00 pm.

B. Contractor has use of the project site for laydown activities and to store materials and perform work as needed except as follows:

1. From the main gate to the fuel island, vehicular access must be maintained for 24/7 operational use of the fueling facility.

2. Contractor shall also maintain vehicular access and a minimum of 10 parking spaces on the site for Owner, CM, AE, and City building inspectors and related personnel use throughout the duration of the contract.

3. Provide emergency vehicle access to the buildings and site as required by the fire department and other Authorities Having Jurisdiction.

4. The Owner intends to procure a separate contract for refurbishment of the bus wash system which may overlap the schedule of this contract. When notified that the bus wash contract has been awarded by AC Transit, the contractor shall provide vehicular access to the bus wash area from the main gate, a 40’ perimeter area around the bus wash structure and a minimum 60’ by 100’ lay down area in close proximity to the bus wash for the use of another contractor.

1.7 HOLIDAYS AND WORKING HOURS

The following are the designated holidays:

| January 1st (New Year’s Day - Observed) | September 10th (Admissions Day) |
| 3rd Monday in January (ML King Jr. Day) | November 11th (Veterans Day) |
| February 12th (Lincoln’s birthday) | 4th Thursday in November (Thanksgiving) |
| 3rd Monday in February (President’s Day) | The Friday after Thanksgiving |
| Last Monday in May (Memorial Day) | December 24th (Christmas Eve) |
| July 4th (Independence Day) | December 25th (Christmas Day) |
| 1st Monday in September (Labor Day) | |

NOVEMBER 2015
If a designated holiday falls on a Sunday, the following Monday is a designated holiday. If November 11th falls on a Saturday, the preceding Friday is a designated holiday.

The Contractor’s working hours must be from 7:00 AM TO 7:00 PM, Monday through Friday.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION
SECTION 01 14 00

TIME FOR COMPLETION, LIQUIDATED DAMAGES, CONTRACTOR’S LICENSE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Overall Time for Completion.

B. Liquidated Damages and Classification of.

C. Contractor’s License.

1.2 OVERALL TIME FOR COMPLETION AND LIQUIDATED DAMAGES

A. This Section describes the Contract Time for the overall completion of the entire Work and this section describes the Contract Time for the overall completion of the entire Project and Intermediate milestones and their associated liquidated Damages.

B. Contractor shall complete the entire Work under this Contract in 275 calendar days beginning with the date specified in the Notice-to-Proceed. This includes satisfactory completion of all landscaping including hardscape, inspections, testing, documentation, as-built drawings, Punchlists, final clean-up and full demobilization. Failure to complete by this number of days will result in the assessment of Liquidated Damages in the amount of $3,000 per calendar day until the Work is completed to the satisfaction of the Engineer.

C. The Contractor shall achieve Substantial Completion in 250 calendar days beginning with the date specified in the Notice-to-Proceed. This includes all Maintenance Building Office improvements including power supply, interior finishes, communication systems, and Electronic devices.

PART 2 - PRODUCTS

Not Used

END OF SECTION
SECTION 01 20 00

PRICE AND PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Allowances and Alternates.
B. Lump Sum Prices.
C. Schedule of Values.
D. Stored Material.
E. Applications for Payment

1.2 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures.

1.3 ALLOWANCES AND ALTERNATES

A. The Allowances that are part of the Grand Total Bid Price (Refer to Bid Form) are Owner controlled Allowances. The Contractor must have an Allowance Drawdown Authorization approved by the Owner prior to requesting payment on any part of these Allowances requiring a Contract Amendment prior to project Closeout in addition to the Allowance Draw Authorization.

B. The Contractor must submit an estimate with a detail supporting documentation showing how the requested Allowance Draw value was determined to obtain an Allowance Draw Authorization and/or Contract Amendment. The Owner will evaluate this request and advise the Contractor if the value and documentation are acceptable. The owner may require additional documentation or remove unwarranted items from the request; Or, AC Transit may issue a Field Instruction to the Contractor to start work as soon as possible. The Contractor will then be required to submit daily work reports that are to be signed by the Owners Project Engineer/Construction Manager to confirm equipment used in the course of this work, work hours of all tradesmen, and for all materials used daily.

C. The Project has included Alternate Bid Components that must be priced out as a part of the Project Bid. These Alternate Bid Items will be under consideration with the Contractor providing this bid showing comprehensive pricing for equipment and installation and will include labor pricing for a full and complete system. Project Alternates will be considered during the early construction phase and are designed to be executed via an AC Transit Change Order process. Each shall be priced separately and will be considered in the Base Bid.

1.4 SCHEDULE OF VALUES

A. Submit Schedule of Values at the time of bid. The current Schedule of Values contained in the Contract Documents may be revised to reflect the Contractor’s work scope but must reflect the bid pricing submitted including Alternates which will be single line items.

B. Obtain the Engineer’s approval of the Schedule of Values before Notice to Proceed.
C. Format: Identify each line item with number and title of bid item along with an additional sub-number or letter and description.

D. Contractor must be responsible for accuracy of quantities and subtotals submitted for approval on the Schedule of Values.

E. No adjustment in will be made in the Contract lump sum prices paid due to any difference between the quantities shown in the Schedule of Values furnished by the Contractor and the quantities required to complete the Work.

F. The sum of the amounts (subtotals) of the units of work listed for each lump sum item must be equal to the Contract lump sum price bid for the work. Include a direct proportional amount of Contractor’s overhead, profit, and all other expenses in each individual unit listed in the Schedule of Values.

G. Approved Schedule of values will be used to determine partial payments during the progress of the Work.

H. Identify bonds and insurance.

I. Include in each line item, the amount of Allowances identified by AC Transit specified in this section.

J. Revise schedule to list approved Change Orders, with each Application for Payment.

1.3 STORED MATERIAL

A. Invoice for Stored Materials: Partial payments for Contractor-furnished materials not yet installed may be made only after such materials have been furnished and stored for use in the Work, provided they are stored in an area approved by the Engineer. All such material must be covered by insurance and once paid for must have a Contractor Letter identifying said materials as belonging to AC Transit. Said invoice may include the amount and value of such acceptable material as has been furnished and delivered to the site and such acceptable material as has been furnished and stored for use in the Work, provided it is stored within the San Francisco Bay Area and is segregated and designated for exclusive use of the Owner.

B. Invoices from suppliers and proof of payment by Contractor must be furnished to substantiate the cost.

1.4 APPLICATIONS FOR PAYMENT

A. Submit each application on the form provided by the Engineer.

B. Content and Format: Utilize Schedule of Values for listing items in Application for Payment. Contractor must meet with the Owner’s Engineer/Construction Manager prior to submittal of Applications for Payment to agree on percent of work complete with total dollar sums of each item of work being agreed upon before final submittal.

C. Payment Period: Submit application for payment monthly prior to the tenth day of the subsequent month.

D. Submit with transmittal letter in a form acceptable to the Engineer.

E. Substantiating Data: Submit substantiating information, as required by the Engineer, including the following with the application:
1. Current construction photographs specified in Section 01 33 00.

2. Conditional release of liens from major subcontractors and vendors.

3. Submit certification signed by the Contractor and verified by the Engineer that Record Documents, as specified in Section 01 70 00, are being kept current with construction activities.

4. Affidavits and invoices attesting to off-site stored products.

5. Construction progress schedules, revised and current as specified in Section 01 30 00, Administrative Requirements.

6. Certified payroll records to support compliance with Prevailing Wages requirements.

7. Copies of the following logs: Requests for Information; Quality and Non-Conformances; submittals and shop drawings, and Change Orders.

8. Copies of subcontractor and vendor invoices.


1.5 DEFECT ASSESSMENT

A. Replace the Work, or portions of the Work, not conforming to specified requirements as identified by the Engineer/Construction Manager.

B. If, in the opinion of the Engineer, it is not practical to remove and replace the work, the Engineer will direct an appropriate remedy or adjust payment.

C. If the Engineer determines that the defective work may remain or if, the Engineer allows defective work to remain and requires that the defective Work be partially repaired, the Contract Price will be adjusted to a new sum at the discretion of the Owner.

D. The individual specification sections may modify these options or may identify a specific formula or percentage sum reduction.

E. The authority of the Owner to assess the defect and identify payment adjustment is final.

F. Non-Payment for Rejected Products: Payment will not be made for rejected products for any of the following. Products are used in this paragraph include materials, products, and completed items of work.

1. Products wasted or disposed of in a manner that is not acceptable.

2. Products determined as unacceptable before or after placement.

3. Products not completely unloaded from the transporting vehicle.

4. Products placed beyond the lines and levels of the required Work.
5. Products remaining on hand after completion of the Work.


7. Work installed and not passing inspections.

8. Products with incomplete certifications (for which certifications are specified or otherwise required).

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Allowances as described on the Bid Form.
   1. Administrative and procedural requirements governing allowances.
   2. Certain items are specified in the contract documents by allowances. Allowances have been established in lieu of additional requirements.
   3. Types of allowances include the following:
      a. Lump-sum allowances.
      b. Unit-cost allowances.
      c. Contingency allowances.
      d. Testing and inspection allowances.

1.2 SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances, in the form specified for change orders in the General Conditions and in accordance with Section 01 26 00, Contract Modification Procedures.

B. Submit invoices to show actual costs incurred in fulfillment of each allowance.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the work.

1.3 GENERAL

A. Costs of services not required by the contract documents are not included in allowances.

B. At project closeout, credit unused amounts remaining in each allowance to AC TRANSIT by change order.

1.4 LUMP-SUM AND UNIT-COST ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials under allowance and shall include taxes, freight, and delivery to project site.
B. Unless otherwise indicated, Contractor's costs for receiving and handling at project site, labor, installation, overhead and profit, and similar costs related to products and materials under allowance shall be included as part of the contract sum and not part of the allowance.

1.5 CONTINGENCY ALLOWANCES

A. Use the contingency allowance only as directed by Engineer for AC Transit's purposes and only by change orders that indicate amounts to be charged to the allowance.

B. Contractor's overhead, profit, and related costs for work under the contingency allowance are part of the contract sum and not part of the allowance.

1.6 TESTING AND INSPECTING ALLOWANCES

A. Testing and inspecting allowances include the cost of engaging testing agencies, actual tests and inspections, and reporting results.

B. The allowance does not include incidental labor required to assist the testing agency or costs for retesting if previous tests and inspections result in failure. The cost for incidental labor to assist the testing agency shall be included in the contract sum.

C. Costs of services not required by the contract documents are not included in the allowance.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PERMITS AND FEES ALLOWANCE

A. The permits and fees allowance includes the costs of required permits and fees, in accordance with Section 01 41 00, Regulatory Requirements.

B. Type: Lump sum.

C. Amount:

3.2 REMOVAL OF UNSUITABLE MATERIAL ALLOWANCE

A. The removal of unsuitable material allowance includes the costs of earthwork, transportation, and disposal associated with unsuitable material in accordance with Section 31 20 00, Earth Moving.

B. Type: Contingency.

C. Amount:

PART 4 - MEASUREMENT AND PAYMENT (Not Used)

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Administrative and procedural requirements for handling and processing contract modifications.

B. Related Sections:

1. Section 01 60 00, Product Requirements, for procedures for approving comparable products.
2. Section 01 60 00 (1.7), Substitution Procedures, for procedures for proposing substitutions.

1.2 MINOR CHANGES IN THE WORK / FIELD ORDERS

A. Supplemental Instruction: Engineer will issue supplemental instructions authorizing minor changes in the work, not involving adjustment to the Contract Price or the Contract Time, in written form.

B. Field Order: Field Orders will be issued for the purpose of relaying information in a timely manner that directs a course of action to be taken immediately by the Contractor. Field Orders may or may not have cost impacts that will be negotiated after the direction of the Engineer is completed.

1.3 PROPOSAL REQUESTS

A. AC Transit-Initiated Proposal Requests: Engineer will issue a detailed description of proposed changes in the work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised drawings and specifications.

1. Proposal Requests issued by Engineer are not instructions either to stop work in progress or to execute the proposed change.

2. Within time specified in Proposal Request or 7 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

   a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.

   b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

   c. Include costs of labor and supervision directly attributable to the change.
d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

e. Quotation Form: Use forms acceptable to Engineer.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the contract, Contractor may initiate a claim by submitting a request for a change to Engineer.

1. Include a statement outlining reasons for the change and the effect of the change on the work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.

2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.

3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

4. Include costs of labor and supervision directly attributable to the change.

5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

6. Comply with requirements in Section 01 60 00 (1.7), Substitution Procedures, if the proposed change requires substitution of a product or system for product or system specified.

7. Proposal Request Form: Use form acceptable to Engineer.

1.4 ADMINISTRATIVE CHANGE ORDERS

A. Allowance Adjustment: Refer to Section 01 21 00, Allowances, for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

B. The Contractor shall not accept direction for additional work unless issued by the Construction Manager and/or Resident Engineer. Additional work will be issued via Field Order, Work Change Directive, or approved Change Orders that have been negotiated and executed. The Contractor will not be compensated for additional work without the formal Administrative Change Order procedure being followed as issued by the Construction Manager.

1.5 CHANGE ORDER PROCEDURES

A. Upon AC Transit approval of a Proposal Request, Engineer will issue a Change Order for signatures from AC TRANSIT and submitted to the Contractor for final processing.
1.6 WORK CHANGE DIRECTIVE

A. Work Change Directive: Engineer may issue a Work Change Directive. A Work Change Directive instructs Contractor to proceed with a change in the work, for subsequent inclusion in a Change Order.

1. Work Change Directive contains a complete description of change in the work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

2. Contractor is to proceed with Extra Work as directed by the Engineer on a Time and Material Basis until a Change Order can be approved. Contractor will submit a daily work record of Manpower, Equipment, and Materials for said Extra Work for the Engineer’s signature until a lump sum or unit price is agreed upon and a Change Order is issued.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Work Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

PART 4 - MEASUREMENT AND PAYMENT (Not Used)

END OF SECTION
(This page intentionally left blank)
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Submittals.
B. Coordination and Project Conditions.
C. Preconstruction Meeting.
D. Progress Meetings.
E. Pre-installation Meetings.
F. Construction Progress Documentation.

1.2 SUBMITTALS

A. Submit Traffic Control Plan where needed.
B. Submit progress photographs (electronic and hard copies) with application for payment.
C. Submit Baseline Schedule within 30 Calendar Days of Notice of Award.
D. Submit List and Schedule of Required Project Submittals. Refer to Section 01 33 00 for additional Submittal requirements.

1.3 COORDINATION AND PROJECT CONDITIONS

A. Coordinate scheduling, submittals, and Work of the various sections of the specifications to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
B. Verify utility requirements and characteristics of operating equipment are compatible. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
C. Coordinate space requirements, supports, and installation of work that are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with property lines. Note that there are possible unidentified utilities within the project site. Contractor will be responsible for any and all damage to these utilities and or infrastructure. Potholing operations will be required where excavation of below slab-on-grade work begins without exception.
D. Coordinate completion and clean-up of work of separate Sections in preparation for Substantial Completion.
E. Owner to occupancy of premises on or before Substantial Completion and Contractor must coordinate access to site as requested. For correction of defective Work and Work not in accordance with Contract Documents Contractor must minimize disruption of Owner’s activities.
F. Coordinate activities included in various Sections to assure efficient and orderly installation of each component. Coordinate operations included under different Sections that are dependent on each other for proper installation and operation.

1.4 PRECONSTRUCTION MEETING

A. The Engineer will schedule a meeting after Notice of Award, and after execution Owner-Contractor Agreement, and submission of executed bonds and insurance certificate.

B. Attendance Required: Engineer, Construction Manager, Architect/Engineer of Records, and Contractor.

C. Preconstruction Requirements:
   1. Introduce parties, roles, and responsibilities and review communications protocols.
   3. Submission of list of the final Subcontractors, list of all products, a final schedule of values, and baseline progress schedule.
   4. Designation of personnel representing the parties in Contract and the Engineer.
   5. Procedures and processing of field decisions, submittals, substitutions, RFI's, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
   6. Scheduling activities of Owner-hired testing laboratory.
   7. Environmental requirements and procedures:
      a. Waste Reduction and Recycling Plan (WRRP)

D. Engineer will prepare meeting report and distribute copies within five days after meeting to participants. Contractor must distribute copies to Contractor's team members affected by decisions made.

E. Engineer will issue Notice to Proceed.

F. Contractor must not mobilize on site until satisfying the Preconstruction Requirements listed herein.

1.5 PROGRESS MEETINGS

A. Attend progress meetings throughout progress of the Work at minimum weekly intervals or as required by the Engineer.

B. Attendance Required: Job superintendent, major subcontractors and suppliers, as appropriate to agenda topics for each meeting.

C. Agenda:
   1. Review minutes of previous meetings.
2. Review of Work progress.
3. Field observations, problems, and decisions.
4. Identification of problems which impede planned progress.
5. Review of Request for Information Log and Non-conformance Log.
7. Review of off-site fabrication and delivery schedules.
8. Review of Change Order Log and proposed changes.
9. Review of baseline progress schedule.
10. Corrective measures to regain projected schedule.
11. Planned progress during succeeding work period.
12. Coordination of projected progress.
14. Other business relating to Work.

D. Engineer will prepare meeting report and distribute copies within five days after meeting to participants. Contractor must distribute copies to Contractor’s team members affected by decisions made.

1.6 PREINSTALLATION MEETING

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

1.7 CONSTRUCTION PROGRESS DOCUMENTATION

A. Progress Photographs:
   1. Photographically document site conditions prior to start of construction operations.
2. Take weekly photographs throughout entire project. Photographs must be provided for unrestricted use by Owner. Indicate photographs demonstrating environmental procedures.

3. Submit minimum 20 photographs on CD and 5 by 7 inch hard copies with each application for payment. Organize photographs by date and description. Files are to be named “YYMDD_Location_Work Description”. Format CD to be compatible with Owner’s computer software.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION
SECTION 01 31 00

PROJECT MANAGEMENT AND COORDINATION

PART 5 - GENERAL

5.1 SUMMARY

A. Section Includes:

1. Administrative provisions for coordinating construction operations on project including, but not limited to, the following:
   a. General project coordination procedures.
   b. Administrative and supervisory personnel.
   c. Coordination drawings.
   d. Requests for Information (RFIs).
   e. Project meetings.

B. Contractor is responsible for coordination with goods contractors and other contractors involved in the project.

C. Related Sections:

1. Section 01 32 00, Construction Progress Documentation, for preparing and submitting Contractor’s construction schedule.
2. Section 01 71 23, Construction Surveying, for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Section 01 70 00, Execution and Closeout Procedures, for coordinating closeout of the contract.
4. Section 01 91 00, Demonstration and Training, for coordinating the work with AC Transit’s commissioning authority.
5. Individual specification sections for normal startup, testing, and adjusting procedures required independently of the commissioning process.

5.2 DEFINITIONS

A. RFI: Request from AC Transit, Engineer, or Contractor seeking information, specifically interpretation of the contract documents.

B. Construction Manager, Resident Engineer/Engineer, and Construction Management Team are all used interchangeably throughout the body of the project specifications.
5.3 **COORDINATION**

A. **Coordination:** Coordinate construction operations with those of other contractors and entities. Coordinate construction operations included in different sections of the specifications to ensure efficient and orderly installation of each part of the work. Coordinate construction operations, included in different sections that depend on each other for proper installation, connection, and operation. Contractor is responsible for progress and performance of the work, and shall provide direction to others as required to properly coordinate trades and processes.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the work depends on installation of other components, before or after its own installation.

2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.

3. Make adequate provisions to accommodate items scheduled for later installation.

4. Coordinate equipment installation requirements with equipment contractors to prevent delays and facilitate proper installation. Acknowledge, accommodate, and respect equipment contractors’ needs for access to the work for the periods required to complete equipment installation. Incorporate these periods into the construction progress schedule and work plan before commencing work.

B. Prepare memoranda for distribution to each party involved (including AC Transit and separate contractors) outlining special procedures required for coordination. Include such items as required notices, actions, reports, and list of attendees at meetings.

C. **Administrative Procedures:** Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor’s construction schedule.

2. Preparation of the schedule of values.

3. Installation and removal of temporary facilities and controls.

4. Delivery and processing of submittals.

5. Progress meetings.

6. Pre-installation conferences.

7. Startup and adjustment of systems.

8. Training activities.

9. Project closeout activities.

D. **Conservation:** Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the work. Refer to other sections for disposition of salvaged materials that are designated as AC TRANSIT’s property.

5.4 COORDINATION DRAWINGS

A. Coordination Drawings, General: Included in this contract are items that have Performance elements identified in the respective Specification Sections. Prepare coordination drawings in accordance with requirements in individual sections, where installation is not completely shown on shop drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
   a. Use applicable drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
   b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
   c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
   d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
   e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
   f. Indicate required installation sequences.
   g. Indicate dimensions shown on the drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Engineer indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the contract.

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

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire protection, fire alarm, and electrical work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the work.

2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire protection, fire alarm, and electrical equipment.

4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.

5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.

6. Mechanical and Plumbing Work: Show the following:
   a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
   b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
   c. Fire-rated enclosures around ductwork.

7. Electrical Work: Show the following:
   a. Runs of vertical and horizontal conduit 1-1/4 inch diameter and larger.
   b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire alarm locations.
   c. Panel board, switchboard, switchgear, transformer, busway, generator, and motor control center locations.
   d. Location of pull boxes and junction boxes dimensioned from column centerlines.

8. Fire Protection System: Show the following:
   a. Locations of fire alarm panels, standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.

9. Review: AC Transit Engineer will review coordination drawings to confirm that the work is being coordinated, but not for the details of the coordination, which are the Contractor’s responsibility. If the Engineer determines that the coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, the Engineer will so inform the Contractor, who shall make changes as directed and resubmit.

10. Coordination Drawing Prints: Prepare coordination drawing prints in accordance with requirements of Section 01 33 00, Submittal Procedures.

5.5 KEY PERSONNEL

A. Key Personnel Names: Following the Specification Sections, before starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and email addresses. Provide names, addresses, and telephone numbers.
numbers of individuals assigned as standbys in the absence of individuals assigned to project.

1. Post copies of list in project meeting room and in temporary field office. Keep list current at all times.

5.6 REQUESTS FOR INFORMATION (RFIs)

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

1. Engineer will return RFIs submitted to Engineer by other entities controlled by Contractor with no response.

2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Frivolous RFIs: Frivolous RFIs include requests for information shown in the contract documents or resulting from Contractor's failure to study and compare contract documents or to coordinate its own work; requests for approval of submittals, substitutions, changes in the work, or adjustment of the contract price or the contract time; and RFIs that are incomplete, contain errors, or include unrelated items. If reviewed, the cost in time and materials on the part of Engineer and related design professionals to review unnecessary or frivolous RFIs will be assessed to the Contractor.

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

1. Project name.

2. Project number.

3. Date.

4. Name of Contractor.

5. Name of Engineer.

6. RFI number, numbered sequentially.

7. RFI subject.

8. Specification section number, title, and related paragraphs, as appropriate.

9. Drawing number and detail references, as appropriate.

10. Field dimensions and conditions, as appropriate.

11. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Price, Contractor shall state impact in the RFI.

12. Contractor's signature.
13. Attachments: Include sketches, descriptions, measurements, photos, product data, shop drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
   a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

D. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Engineer.

E. Engineer's Response: Engineer will review each RFI, determine action required, and respond. Allow seven working days for Engineer's response for each RFI. RFIs received by Engineer after 1:00 p.m. will be considered as received the following working day.

1. The following RFIs will be returned without action:
   a. Requests for approval of submittals.
   b. Requests for approval of substitutions.
   c. Requests for coordination information already indicated in the contract documents.
   d. Requests for adjustments in the Contract Time or the Contract Price.
   e. Requests for interpretation of Engineer's actions on submittals.
   f. Incomplete RFIs or inaccurately prepared RFIs.

2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt of additional information.

3. Engineer's action on RFIs that may result in a change to the Contract Time or the Contract Price may be eligible for Contractor to submit a Change Proposal according to Section 01 26 00, Contract Modification Procedures.
   a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Price, notify Engineer in writing within 10 days of receipt of the RFI response.

F. On receipt of Engineer's response, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Engineer within seven days if Contractor disagrees with response.

G. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Use a software log with not less than the following:
   1. Project name.
   2. Name and address of Contractor.
   3. Name and address of Engineer.
   4. RFI number including RFIs that were dropped and not submitted.
5. RFI description.

6. Date the RFI was submitted.

7. Date Engineer's response was received.

8. Identification of related Minor Change in the Work/Field Order, Work Change Directive, and Proposal Request, as appropriate.

5.7 PROJECT MEETINGS

A. General: AC Transit and the Contractor shall schedule and conduct meetings and conferences at project site as needed or unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify AC Transit and Engineer of scheduled meeting dates and times.

2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.

3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including AC Transit, Contractor, and Engineer, within three days of the meeting.

B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to AC Transit and Engineer, but no later than 15 days after execution of the Agreement.

1. Conduct the conference to review responsibilities and personnel assignments.

2. Attendees: Authorized representatives of AC Transit, AC Transit's Commissioning Authority, Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with project and authorized to conclude matters relating to the work.

3. Agenda: Discuss items of significance that could affect progress, including the following:
   a. Tentative construction schedule.
   b. Phasing.
   c. Critical work sequencing and long-lead items.
   d. Designation of key personnel and their duties.
   e. Lines of communications.
   f. Procedures for processing field decisions and Change Orders.
   g. Procedures for RFIs.
   h. Procedures for testing and inspecting.
i. Procedures for processing Applications for Payment.

j. Distribution of the contract documents.

k. Submittal procedures.

l. Preparation of record documents.

m. Use of the premises.

n. Work restrictions.

o. Working hours.

p. AC Transit's occupancy requirements.

q. Responsibility for temporary facilities and controls.

r. Procedures for moisture and mold control.

s. Procedures for disruptions and shutdowns.

t. Construction waste management and recycling.

u. Parking availability.

v. Office, work, and storage areas.

w. Equipment deliveries and priorities.

x. First aid.

y. Security.

z. Progress cleaning.

4. Minutes: AC Transit and the Construction Management Team are responsible for conducting meeting will record and distribute meeting minutes.

C. Pre-installation Conferences: Conduct a pre-installation conference at Project site before each construction activity that requires coordination with other construction, as required in individual specification sections.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise the Construction Management Team, Engineer, and AC Transit's Commissioning Authority of scheduled meeting dates.

2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

   
   b. Options.
c. Related RFIs.
d. Related Change Orders.
e. Purchases.
f. Deliveries.
g. Submittals.
h. Review of mockups.
i. Possible conflicts.
j. Compatibility problems.
k. Time schedules.
l. Weather limitations.
m. Manufacturer's written recommendations.
n. Warranty requirements.
o. Compatibility of materials.
p. Acceptability of substrates.
q. Temporary facilities and controls.
r. Space and access limitations.
s. Regulations of authorities having jurisdiction.
t. Testing and inspecting requirements.
u. Installation procedures.
v. Coordination with other work.
w. Required performance results.
x. Protection of adjacent work.
y. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.

4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.

5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the work and reconvene the conference at earliest feasible date.
D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to AC TRANSIT and Engineer, but no later than 90 days prior to the scheduled date of Substantial Completion.

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

2. Attendees: Authorized representatives of AC Transit, AC Transit's Commissioning Authority, Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with project and authorized to conclude matters relating to the work.

3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
   a. Preparation of record documents.
   b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
   c. Submittal of written warranties.
   d. Requirements for preparing operations and maintenance data.
   e. Requirements for demonstration and training.
   f. Preparation of Contractor's punch list.
   g. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
   h. Submittal procedures.
   i. Coordination of separate contracts.
   j. AC Transit's partial occupancy requirements.
   k. Installation of AC Transit's furniture, fixtures, and equipment.
   l. Responsibility for removing temporary facilities and controls.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

E. Progress Meetings: Conduct progress meetings at biweekly intervals.

1. Coordinate dates of meetings with preparation of payment requests.

2. Attendees: In addition to representatives of AC Transit, AC Transit's Commissioning Authority, and Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with project and authorized to conclude matters relating to the work.
3. **Agenda:** Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of project.

   a. **Contractor’s Construction Schedule:** Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor’s construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

      1) Review schedule for next period.

   b. **Review present and future needs of each entity present, including the following:**

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

4. **Minutes:** Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

F. Coordination Meetings: Conduct multiple contract coordination meetings at monthly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and pre-installation conferences.

1. Attendees: In addition to representatives of AC Transit, AC Transit's Commissioning Authority and Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with project and authorized to conclude matters relating to the work.

2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of project.

a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

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

c. Review present and future needs of each contractor present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Status of submittals.
4) Deliveries.
5) Off-site fabrication.
6) Access.
7) Site utilization.
8) Temporary facilities and controls.
9) Work hours.
10) Hazards and risks.
11) Progress cleaning.
12) Quality and work standards.
13) Change Orders.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 6 - PRODUCTS (Not Used)

PART 7 - EXECUTION (Not Used)

PART 8 - MEASUREMENT AND PAYMENT (Not Used)

END OF SECTION
SECTION 01 32 00
CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Related Sections.
B. References.
C. Definitions.
D. General.
E. Contractor’s Scheduling Personnel and Their Qualifications.
F. Schedules.
G. Contractors Schedule Technical Requirements.
H. Four-Week Work Plan.

1.2 RELATED SECTIONS
A. Section 01 11 00 - Summary.
B. Section 01 30 00 - Administrative Requirements.
C. Section 01 33 00 - Submittal Procedures.

1.3 REFERENCES

1.4 DEFINITIONS
A. Activity: A task, event or other Contract element on a schedule that contributes to completing the Contract. Activities have a description, duration, and one or more logic ties.
B. Activity Duration: The total number of working days or calendar days required to perform that Activity. They may be planned or actual.
C. Actual Dates: The actual start or finish date of an Activity which occurs prior to the Data Date. Dates occurring after the Data Date are not Actual Dates.
D. Contract Schedule: A computer-produced schedule in the Critical Path Method (CPM) format. The Contract Schedule includes all activities necessary to clearly establish the Critical Path and to demonstrate complete and accurate planning and sequencing of the Contract and to permit monitoring and evaluation of progress time impacts. The Interim Contract Schedule, Baseline Contract Schedule, Contract Update Schedule, and Revised Baseline Contract Schedule are all versions of the Contract Schedules.
E. Critical Path Method (CPM) A network-based planning technique using Activity Durations and the relationships between activities to mathematically calculate a schedule for the entire Contract.

F. Current Schedule: The most recently AC Transit accepted Contract Schedule, (i.e. Interim Contract Schedule, Baseline Contract Schedule, Contract Update Schedule, or Revised Baseline Schedule) shall constitute the “Current Schedule”.

G. Data Date: The work date after the date through which a schedule is current. Everything occurring earlier than the Data Date is “actual” and everything on or after the Data Date is “planned”.

H. Early Completion Date: A Planned Completion Date for a scope of work that is earlier than the contractually required date.

I. Free Float: The amount of time an Activity can be delayed before affecting a successor Activity.

J. Level of Effort: Level of Effort (LOE) Activities represents tasks performed in support of other Work which do not lend themselves to measurement of a discrete accomplishment. Examples of LOE tasks include project accounting, customer liaison, project controls, maintaining traffic control etc. The durations of LOE Activities are defined by the work they support.

K. Milestone: A marker in a network which is typically used to mark a point in time or denote the beginning or end of a sequence of activities. A Milestone has zero duration, but will otherwise function in the network as if it is an Activity, including either a start or finish date.

L. Near Critical Path: A chain of activities with Total Float exceeding that of the Critical path but with Total Float not significantly greater than the Critical Path. The amount of Total Float in a path considered near critical is 14 calendar days or less.

M. Open-Ended Activity: An Activity without at least one predecessor or without at least one successor.

N. Out-of-Sequence Activity: Any activity that actually starts in a sequence other than shown in the Current Schedule. Any type of invalid sequencing will be deemed out of sequence.

O. Revision: A change in the schedule that modifies logics, adds or deletes activities, or alters activities, sequences, or durations.

P. Recovery Schedule: A modified Current Schedule prepared to show how delay can be recovered in the event that a delay to a Contract Milestone Date is projected in the Current Schedule.

Q. Total Float: The amount of time that an Activity can be delayed before delaying the Contract Milestone Dates.

1.5 GENERAL

A. Incorporation of Contract Requirements: Project Progress Schedules shall represent a practical plan to complete the Work within the Contract Milestone Dates, and shall convey the Contractor’s intent in the manner of prosecution and progress of Work. All Project Progress Schedules prepared by the Contractor shall meet the Contract requirements.
including, but not limited to access, sequencing, construction staging, and Contract Milestone Dates.

B. Contractor’s Representation: The submittal of Project Progress Schedules shall be understood to be the Contractor’s representation that the Project Progress Schedule meets the requirements of the Contract Documents and that the Work will be executed in the sequence and duration indicated.

C. Contractor Responsibility: The execution of the Work in accordance with the Contract Documents is the responsibility of the Contractor. Responsibility for developing the Contract Schedule and monitoring actual progress of the Work. The Contractor shall involve and coordinate all Subcontractors and Material Suppliers in the development and updating of Contract Schedules.

D. Schedule Adjustments: AC Transit reserves the right to require that the Contractor modify, adjust, add to, or clarify any portion of the Project Progress Schedules which may later be discovered to be insufficient or inaccurate for planning, monitoring, or executing the Work. The first of each type of schedule or report submitted by the Contractor will be reviewed for format, as well as content. Once the format has been approved, all subsequent Contract Schedules shall be submitted in the approved format. AC Transit may request format changes as the Contract progresses. No additional compensation shall be provided for such modifications, adjustments, additions, or clarifications.

E. Submittal Format: The Contractor shall submit one original and two additional copies of all Contract Schedule and report submittals described in this Technical Specifications Section; and an electronic copy file, including the Oracle Primavera 6 (P6) .xer file on compact disk or other AC Transit-approved electronic medium in a format acceptable to AC Transit.

F. Withholding Payment: AC Transit may withhold all or part of a monthly progress payment if the contractor does not submit or fails to get approval of a contractual schedule.

### 1.6 CONTRACTOR’S SCHEDULING PERSONNEL AND THEIR QUALIFICATIONS

A. Schedule must be prepared and maintained by personnel specializing in CPM scheduling.

B. Scheduler: A person specializing in CPM scheduling must possess a five years minimum experience in Primavera P6 scheduling construction work of a complexity comparable to this Project, and having use of computer facilities capable of delivering a detailed graphic printout within 48 hours of request. AC Transit must provide formal approval of the Scheduler before the Interim Contract Schedule (ICS) is approved.

### 1.7 SCHEDULES

A. Interim Contract Schedule

1. Submittal: Within 10 calendar days of the established Notice to Proceed (NTP), the Contractor shall submit an Interim Contract Schedule (ICS).

2. Content:

   a. The ICS shall detail the Contractor’s activities and planned sequence of Work for the first 60 calendar days of the Contract, and summarize the remainder of the Work.

   b. The initial Data Date shall be the NTP date.
c. The ICS is exempt from resource and cost loading requirements.
d. The initial ICS shall meet all Contract Milestone Dates.

3. Review, Acceptance, and Implementation:

a. AC Transit will review the ICS upon submittal by the Contractor.
b. AC Transit will notify the Contractor of either “No Exceptions Taken” (NET), “Make Corrections Noted” (MCN), or “Amend and Resubmit” (AR) of the ICS.
c. If notification from AC Transit indicates NET, no additional action by the Contractor is required for the submittal.
d. If notification from AC Transit indicates MCN or AR, the Contractor will have seven calendar days after the comment(s) are provided in writing to revise and resubmit the package for AC Transit’s review. Contract shall include with the re-submittal a line-by-line response to each AC Transit comment indicating how it has been addressed by the Contractor.
e. AC Transit will review re-submittals if AC Transit has further comments the Contractor will have an additional seven calendar days from the date the comments are returned by AC Transit to revise and resubmit for AC Transit’s review.
f. The ICS shall serve as the Current Schedule until the Baseline Contract Schedule is approved.

B. Baseline Contract Schedule

1. Submittal: Within 30 calendar days of the Effective Date, the Contract shall submit a detailed Baseline Contract Schedule (BCS) and report for review and acceptance.

2. Content:

a. The initial Data Date shall be the NTP date.
b. The initial version of the BCS shall meet all Contract Milestone Dates.
c. The sequencing of activities in the BCS may vary from the ICS.

3. Narrative Report: A narrative report shall be submitted with the BCS containing the following information:

a. A narrative report describing the basis (including Activity Duration basis), assumptions, Critical Path analysis, productivity and installation rates, crew sizes, shifts per day, shift hours, construction staging plans, planned sequence of work operations, and constraints used to develop the BCS.
b. Non-manual labor staffing plan shown as general conditions on one activity.
c. Manual labor staffing plan by craft (including Subcontractors) showing start and end date, crew sizes, shifts per day, shift hours, and number of each craft per month.

d. Equipment usage plan for major equipment by equipment type showing start and end date and number of each equipment type per month.

4. Review, Acceptance, and Implementation:
   a. AC Transit will review the BCS upon submittal by the Contractor.
   b. AC Transit will notify the Contractor of either “No Exceptions Taken” (NET), “Make Corrections Noted” (MCN), or “Amend and Resubmit” (AR) of the ICS.
   c. If notification from AC Transit indicates NET, no additional action by the Contractor is required for the submittal.
   d. If notification from AC Transit indicates MCN or AR, the Contractor will have seven calendar days after the comment are provided in writing to revise and resubmit the package for AC Transit’s review. Contract shall include with the re-submittal a line-by-line response to each AC Transit comment indicating how it has been addressed by the Contractor.
   e. AC Transit will review re-submittals if AC Transit has further comments the Contractor will have an additional seven calendar days from the date the comments are returned by AC Transit to revise and resubmit for AC Transit’s review.

C. Contract Update Schedule

1. Submittal: Following acceptance of the BCS, including acceptance with comments, Contractor shall prepare and submit each month a Contract Update Schedule (CUS) inclusive of the report described below. CUS shall be submitted by the 5th of month following the reporting month.

2. Content: Each CUS shall include all work activities including those already completed.
   a. The Data Date shall be the first working day of the month following the reporting month.
   b. Completed activities shall incorporate “As-Built” information including when activities were actually started and actually completed.
   c. In-progress activities shall be updated with remaining duration/projected finish.
   d. Minor schedule revisions shall be incorporated to reflect anticipated changes to planned activities such that the schedule reflects the Contractor’s current forecast of the reporting period cut-off date for the entirety of the Work.
e. All out-of-sequence activities shall be reviewed and their relationships either verified or changed.

f. AC Transit reserves the right to request a recovery schedule. Upon acceptance by AC Transit it shall be incorporated into the CUS including resource and cost loading changes.

3. Narrative Report: A report shall be submitted with the CUS containing the following information:

a. Description of the current Critical Path and Near Critical Paths, including for each:

   (1) Description of change in Critical Path and Near Critical Paths, if any.

   (2) Amount of Float associated with each, and progress made on each during the reporting period, including explanation for lack of progress on Critical Path activities that were planned to be performed.

   (3) Description of critical activities schedule to be performed in the next reporting period.

b. Status of major project components (including percent complete, amount of time ahead or behind schedule).

c. Listing of current and potential delays including cause of delay, actual/estimated impact of delay on Contract Milestones Dates or other Milestone completion dates, and discussion of current/potential corrective/mitigate action(s) to address the issues/delays.

d. Status of major material and equipment procurement.

e. Explanation for any schedule revisions organized by Work grouping, including identification of logic changes, Activity Duration changes, and Activity additions/deletions along with reasons for the changes.

f. List of approved Change Orders incorporated or pending incorporation into the Current Schedule and a report identifying the resultant changes in resource and/or cost loading.

g. Identification of unplanned restriction or conditions regarding labor, equipment or material. Update of manual labor staffing plan, crew sizes, shifts per day, shift hours, and major equipment usage plan showing actual “head count” and major equipment use for the reporting period versus the most recently approved BCS.

4. Review, Acceptance, and Implementation:

a. AC Transit will review the CUS upon submittal by the Contractor.
b. AC Transit will notify the Contractor of either “No Exceptions Taken” (NET), “Make Corrections Noted” (MCN), or “Amend and Resubmit” (AR) of the ICS.

c. If notification from AC Transit indicates NET, no additional action by the Contractor is required for the submittal.

d. If notification from AC Transit indicates MCN or AR, the Contractor will have seven calendar days after the comment are provided in writing to revise and resubmit the package for AC Transit’s review. Contract shall include with the re-submittal a line-by-line response to each AC Transit comment indicating how it has been addressed by the Contractor.

e. AC Transit will review re-submittals if AC Transit has further comments the Contractor will have an additional seven calendar days from the date the comments are returned by AC Transit to revise and resubmit for AC Transit’s review. Only one CUS re-submittal per month will be reviewed by AC Transit.

D. Revised Baseline Contract Schedule

1. Submittal: Revised Baseline Contract Schedule (Revised BCS) shall be prepared by Contractor, and submitted to AC Transit for its acceptance if one or more of the following conditions occur and AC Transit specifically requests, or approves Contractor requires to prepare such a revised schedule:

   a. A change or delay significantly affects the Critical Path for a Contract Milestone

   b. Contractor elects to change any sequence of activities affecting the Critical Path(s) for Contract Milestone Dates or to significantly change the previously approved work plan

   c. In the opinion of AC Transit, or at the request of the Contractor with AC Transit approval, the status of the Work is such that the network and supporting analyses no longer demonstrate complete and accurate planning and sequencing of the Work to permit monitoring and evaluation of progress and time impacts.

2. Content: Contractor shall submit any Revised BCS, including report, in the same form and detail as the BCS with the following clarifications:

   a. Revised BCS shall be based upon the actual progress for Work completed and shall reestablish a baseline for the Work yet to be performed.

   b. For a Revised BCS necessitated by Change Orders, the Data Date shall be the date mutually agreed by the Contractor and AC Transit, but shall generally be the date of the start of the Revised BCS development effort using the Current Schedule as a starting point for development.

3. Review, Acceptance, and Implementation:

   a. AC Transit will review the Revised BCS upon submittal by the Contractor.
b. AC Transit will notify the Contractor of either “No Exceptions Taken” (NET), “Make Corrections Noted” (MCN), or “Amend and Resubmit” (AR) of the ICS.

c. If notification from AC Transit indicates NET, no additional action by the Contractor is required for the submittal.

d. If notification from AC Transit indicates MCN or AR, the Contractor will have seven calendar days after the comment are provided in writing to revise and resubmit the package for AC Transit’s review. Contract shall include with the re-submittal a line-by-line response to each AC Transit comment indicating how it has been addressed by the Contractor.

e. AC Transit will review re-submittals if AC Transit has further comments the Contractor will have an additional seven calendar days from the date the comments are returned by AC Transit to revise and resubmit for AC Transit’s review.

f. Prior to AC Transit acceptance of the Revised BCS, the monthly Contract Update Schedule remains the Current Schedule.

g. After AC Transit acceptance of the Revised Baseline, it shall be used as the basis for the next monthly Contract Update Schedule and is the “Current Schedule”.

1.8 CONTRACT SCHEDULE TECHNICAL REQUIREMENTS

A. The Contract Schedules shall comply with the Technical requirements for content and scheduling principles as described below.

B. Content

1. The Schedule shall be comprehensive to include the entire scope of the contract. The Schedule shall include all activities necessary to clearly establish the Critical Path(s) and to demonstrate complete and accurate planning and sequencing of the Contract and to permit monitoring and evaluation of progress and time impacts.

2. Activity Durations shall not exceed 21 calendar days unless “Level of Effort” (LOE) or unless specifically approved by AC Transit upon Contractor request.

3. Include all Contract Milestone Dates.

4. Depict all internal and external interfaces that could impact Contractor progress, including dependencies.

5. Schedule activities shall be resource and cost loaded as follows:

   a. The budgeted cost loaded in the schedule must be consistent with the Schedule of Values and bid price.

   b. Labor loading shall be consistent with the Contractor’s overall planned workforce.
c. Actual resources and costs are not required to be incorporated in monthly Contract Update Schedules.

C. Scheduling Principles

1. The Contract Schedule shall be computer-produced utilizing the Critical Path Method (CPM), using the latest AC Transit approved version of Primavera P6 software.

2. Contractor’s Primavera Contract Schedule database shall comply with specific schedule set-up, data inclusion, technical standards, and formats requirements defined by AC Transit to ensure compatibility with the overall AC Transit Program Schedule. The details of these Contractor Schedule Development Requirements will be provided to AC Transit to the Contractor within fifteen calendar days of the NTP date. Requirements will include direction regarding, but not limited to, the following items:

   a. Schedule format/organization
   b. Calendars
   c. Activity Codes
   d. WBS: Includes application of AC Transit WBS to all schedule activities
   e. Resources
   f. Activity Types
   g. Activity Times
   h. Activity ID
   i. Schedule, Cost, and Resource Calculation Rules

3. The schedule shall contain activity coding such that activities can be grouped to correspond directly to the Schedule of Values.

4. Identify all activity to be performed by Subcontractors by name of Subcontractor through use of an activity code.

5. All activities in the Schedule, with the exception of the first and last activities, shall have a minimum of one predecessor and a minimum of one successor.

6. Activity Durations shall be expressed in whole days.

7. For activities in progress that are forecast to have durations different than planned, the remaining durations shall be revised. After acceptance of the BCS by AC Transit, the original durations of activities shall not be changed.

8. Lags shall not be used when the creation of an Activity will perform the same function (e.g., concrete cure time). Use of lag must be minimized and restricted to only those situations where it is not possible to properly define the start or finish of an Activity by the use of a normal relationship. Negative
lulls will not be permitted. Contractor shall identify any lag proposed and provide an explanation for the purpose of the lag in the narrative report.

9. Include the number of abnormal weather days identified in Section 00700-Part 8.01F. These abnormal weather delays shall be shown as the next-to-last activity in the schedule as an allowance. In the event that the project experiences favorable weather for a particular month, the additional float resulting from the favorable weather becomes a project owned float.

10. Include the Holidays listed in Section 01 11 00 (1.7).

1.9 FOUR-WEEK WORK PLAN

A. Submittal: The Contractor shall submit a Four-Week Work Plan (FWWP) due one day prior to the Weekly Progress Meeting. Failure to submit and update an acceptable FWWP will be cause for AC Transit to withhold all or part of a Progress Payment.

B. Content: The FWWP shall show the actual progress for the previous week and planned activities for the upcoming three weeks. It is a more detailed subset of the activities contained within the Contract Schedule. The activities in the FWWP shall be based upon and correlated by Activity ID to the Contract Schedule. The Plan shall provide sufficient detail to address all activities being performed on a daily basis, generally be prepared by work discipline/crew, identify issues requiring AC Transit action or input, highlighted critical work (activities on the critical path and note any pending labor, material, or equipment constraints to performing the Work planned in the next three weeks. The actual progress data incorporated into the Contract Update Schedule shall be consistent with the actual data previously shown in the FWWP.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION
SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Submittal Procedures.
B. Submittal Review.
C. Progress Schedules.
D. Submittal Schedule.
E. Proposed Products List.
F. Product Data.
G. Shop Drawings.
H. Samples.
I. Design data.
J. Test reports.
K. Certificates.
L. Manufacturer's instructions.
M. Manufacturer's field reports.

1.2 RELATED SECTIONS

A. Section 01 70 00 - Execution and Closeout Requirements.

1.3 SUBMITTAL PROCEDURES

A. Submittals to the Engineer: The Contractor must prepare a list of submittals for the Engineer's review/approval. Submittals of product data, shop drawings, and samples are for approval unless otherwise noted; submittal of manufacturer's instructions, qualifications, certifications, and test reports are for the Engineer's information unless otherwise noted.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit a submittal log that specifies when all transmittals will be provided within 20 working days of the Notice to Proceed and sufficiently in advance of performance of related construction activities to avoid delay.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, or other submittals and related activities that require sequential activity.
2. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.

   a. The Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Transmit each submittal with form included at the end of this Section.

D. Number the transmittal form in the following format: XXXXX-#A, as follows:

   1. XXXXX: Five or six-digit number reflecting section to which submittal belongs.
   2. #: Numerical sequence number for submittals received in that section. Begin serial order with # 01.
   3. A: Revise submittals with original number and a sequential alphabetic suffix for how many times this submittal has been resubmitted, with “A” indicating the first resubmittal.
   4. Assign individual number to each submittal. Do not combine several items from one trade or subcontractor into one submittal without prior approval of Engineer.

E. Identify Project, Contractor, subcontractor, supplier; manufacturer; pertinent drawing number, detail references, and specification section number, as appropriate.

F. Apply Contractor’s stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, work of other trades, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents. Submittals without Contractor’s stamp will be returned without action.

G. Schedule submittals to expedite the Project, and deliver to address indicated in the Preconstruction Meeting. Coordinate submission of related items.

H. For each submittal for review, allow 21 days for initial review excluding delivery time to and from Contractor. Allow additional time if processing must be delayed to permit coordination with subsequent submittals.

I. Identify variations and deviations from Contract Documents and identify product or system limitations which may be detrimental to successful performance of the completed Work.

J. Provide space for Contractor and Engineer review stamps.

K. When revised for resubmission, identify all changes made since previous submission.

L. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.

M. Submittals not requested will not be recognized or processed. Duplication of Contract Documents or portions of Contract Documents for purpose of submittals will not be recognized or processed.
N. Where a submittal involves engineering computations or original design work is depicted, show the name, the California state registration number, seal, and signature of the Professional Engineer hired by the Contractor certifying that such computations or design work are correct and in conformance with standards, codes, and acceptable engineering practice.

1.4 SUBMITTAL REVIEW

A. Submittals will be reviewed for conformance with requirements of the Contract Documents. Review of a separate item will not constitute review of an assembly in which the item functions. Review will not relieve the Contractor from Contractor’s responsibility for accuracy of submittals; for conformity of submittals to requirements of Contract Documents; for coordinating Work with that of other trades; for compatibility of described product with contiguous products and the rest of the system; for conforming and correlating quantities and dimensions; for selecting fabrication processes and techniques of construction; for performing Work in a safe and satisfactory manner; and for prosecution and completion of the Contract in accordance with the Contract Documents.

B. It must be understood that the provisions herein apply to Engineer’s review, A/E’s review, Owner review, and review by other Owner representatives.

C. Review is only for the limited purpose of checking for general conformance with the information given and the design concept expressed in the Contract Documents.

1. Review is not conducted for the purpose of determining the accuracy and completeness of details such as dimensions and quantities, or for substantiating instructions of installation or performance. Compliance with specified characteristics is the Contractor’s responsibility. Submittals which do not include the Contractor’s certification that the information complies with the Contract Documents will be returned without action.

2. Review of submittals does not authorize variation from Contract Documents unless approval of proposed variation has been expressly requested and specifically noted as a variation on the submittal.

3. Review is only for items to be furnished by the submitting supplier and does not constitute approval of any assemblage of which the submitted item is a component nor approval of construction sequence or method.

D. The Engineer will indicate its reviews of submittals and the action taken by means of its review stamp. The review stamp will be affixed by the Engineer, the action block will be marked, and the stamp will be signed and dated. The review-stamp action-block marks will have the following meanings:

1. The mark FURNISH AS SUBMITTED – NO EXCEPTIONS TAKEN is an acceptance, and means that every illustration and description appears to conform to the respective requirements of the Contract Documents; that fabrication, assembly, manufacture, installation, application, and erection of the illustrated and described product may proceed; and that the submittal need not be resubmitted.

2. The mark FURNISH AS CORRECTED - RESUBMISSION NOT REQUIRED is an acceptance, and means that every illustration and description appears to conform to the respective requirements of the Contract Documents upon incorporation of the reviewer’s corrections, and that fabrication, assembly,
manufacture, installation, application, and erection of the illustrated and described product may proceed. Submittals so marked need not be resubmitted unless the Contractor challenges the reviewer’s exception.

3. The mark REVISE AND RESUBMIT - RESUBMISSION REQUIRED WITHIN ___ DAYS is an acceptance, and means that every illustration and description appears to conform to the respective requirements of the Contract Documents, and that fabrication, assembly, manufacture, installation, application, and erection of the illustrated and described product may proceed after incorporation of the reviewer’s corrections and verification by the Engineer that the reviewer’s corrections have been properly incorporated in the submittal. Resubmission within the time period specified is also required if the Contractor challenges the reviewer’s corrections.

4. The mark SUBMIT SPECIFIED ITEM or REJECTED is a disapproval, and means that the submittal does not comply with Contract Documents or is deficient to the degree that the reviewer cannot correct the submittal with a reasonable degree of effort, has not made a thorough review of the submittal, and that the submittal needs revision and is to be corrected and resubmitted. Do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Contractor must make a new submittal. Submittals stamped SUBMIT SPECIFIED ITEM or REJECTED are not to be used and not permitted on the job site.

1.5 PROGRESS SCHEDULE
A. Submit progress schedules in accordance with Section 01 32 00, Construction Progress Documentation.
B. Submit Update Schedule monthly with Narrative Report.

1.6 SUBMITTAL SCHEDULE
A. In conjunction with the development of the Contractor’s construction schedule, prepare a complete schedule of submittals. The schedule of submittals must be submitted to the Engineer at the pre-construction meeting.
   1. Coordinate submittal schedule with the list of subcontracts, and the list of products, as well as the Contractor’s construction schedule.
   2. Prepare the schedule in chronological order. Provide the following information:
      a. Scheduled date for the first submittal.
      b. Related Section number.
      c. Submittal category.
      d. Name of subcontractor.
      e. Description of the part of the Work covered.
f. Scheduled date for resubmittal.

g. Scheduled date the Engineer's final release or approval.

B. Distribution: Following response to initial submittal, print and distribute copies to the Engineer, subcontractors, and other parties required to comply with submittal dates indicated.

C. Update submittal schedule, if necessary.

D. The contractor must provide a Short Interval Schedule showing the work planned for at least three weeks in advance and the completed activities for the preceding week. The Short Interval Schedule must indicate each working and non-working day for the period shown in the schedule. The Short Interval Schedule will have activity durations not longer than 5 working days and not less than one working day. The short interval schedule must indicate the planned time of performance of the various activities for the period covered by the schedule. It must also have a brief description of the activity. The Short Interval Schedule must indicate the Activity ID of the Progress Schedule Activity that encompasses the Short Interval Schedule activity. The short interval schedule may be in bar chart format.

The Short Interval Schedule must be updated every week and submitted one day prior to the Weekly Progress Meeting. Failure to submit and update an acceptable Short Interval Schedule will be cause for the Engineer to withhold all or part of a Progress Payment.

1.7 PRODUCT DATA

A. Submit for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents. Provide copies and distribute in accordance with Article entitled “Submittal Procedures” herein and for record documents purposes described in Section 01 70 00, Execution and Closeout Requirements.

B. Submit PDF formatted product data documents for digital review.

C. Product data that includes finish or color selection information shall be submitted separately as described for samples.

D. Mark each copy to identify applicable products, models, options, and other data. Cross out provisions that are not applicable. Supplement manufacturers’ standard data to provide information specific to this Project.

E. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

F. When specified in individual specification sections, submit printed instructions (manufacturer’s instructions or installation instructions) for delivery, storage, assembly, installation, start-up, adjusting, and finishing, in quantities specified for Product Data. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

G. After review distribute in accordance with the Submittal Procedures article above and provide copies for record documents described in Section 01 70 00 – Execution and Closeout Requirements.
1.8 SHOP DRAWINGS

A. Submit for review for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. Produce copies and distribute in accordance with Article entitled “Submittal Procedures” herein and for record documents purposes described in Section 01 70 00.

B. Submit PDF formatted shop drawings for digital review.

C. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

D. Submit newly prepared information, drawn to accurate scale. Do not reproduce Contract Documents or copy standard information as the basis for shop drawings. Standard information prepared without specific reference to the Project is not considered shop drawings.

E. Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates, and similar drawings. Include the following information:

1. Shop drawings must be drawn to scale sufficient for clarity and coordination, must show necessary working and erection dimensions and necessary details, section, plans and elevations, must be properly cross-referenced, as necessary, by specific reference to the appropriate Section, paragraphs and pages of the Specifications and Drawings to clearly delineate arrangement, construction and connection with other work and must illustrate work contiguous to and having a bearing on work shown.

2. Identification of products and materials included.

3. Compliance with specified standards.

4. Notation of coordination requirements.

5. Notation of dimensions established by field measurement.

6. Highlight, encircle, or otherwise clearly indicate deviations from the Contract Documents.

7. Sheet Size: Except for templates, patterns and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2” x 11” but no larger than 30” x 42”.

8. Initial Submittal: Unless otherwise indicated, submit opaque reproductions for the Engineer’s review; if one of the copies is submitted as a reproducible transparency, it will be one of the copies returned to the Contractor.

9. Do not use shop drawings without an appropriate final submittal review stamp indicating action taken in connection with construction.

10. Final Submittal: From the reproducible print returned with the initial or intermediate submittals, make prints for the Final Submittal. Mark the prints “Final Submittal”. Produce copies and distribute in accordance with Article entitled “Submittal Procedures” herein and for record documents purposes described in Section 01 70 00.
1.9 SAMPLES

A. Submit for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents. Produce duplicates and distribute in accordance with Article entitled “Submittal Procedures” herein and for record documents purposes described in Section 01 70 00.

B. Samples for Selection as Specified in Product Sections:

1. Submit for aesthetic, color, or finish selection.

2. For Color Selection: Submit samples of finishes from the full range of manufacturers’ standard colors, textures, and patterns for Engineer selection.

3. For Engineer Approval of Specified Color: Submit samples of finish in selected standard or custom color as specified for Engineer review and approval.

4. After review, produce duplicates and distribute in accordance with Article entitled “Submittal Procedures” herein and for record documents purposes described in Section 01 70 00.

C. Submit samples to illustrate functional and aesthetic characteristics of product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

D. Include identification on each sample, with full Project information.

E. Submit number of samples (no fewer than two) specified in individual specification sections; one of which will be retained by Engineer.

F. Reviewed samples which may be used in the Work are indicated in individual specification sections.

G. Samples will not be used for testing purposes unless specifically stated in specification section.

1.10 DESIGN DATA

A. Submit design data for information for the limited purpose of assessing conformance with information given and the design concept expressed in the Contract Documents.

B. Submit PDF formatted data for digital review and record keeping.

1.11 TEST REPORTS

A. Submit test reports for information for the limited purpose of assessing conformance with information given and the design concept expressed in the Contract Documents.

B. Submit PDF formatted reports for digital review and record keeping.
1.12 CERTIFICATES

A. When specified in individual specification sections, submit certification by the manufacturer, installation/application subcontractor, or Contractor to Engineer, in quantities specified for Product Data.

B. Submit certificates for information for the limited purpose of assessing conformance with information given and the design concept expressed in the Contract Documents.

C. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

D. Submit PDF formatted certificates for digital review and record keeping.

E. Certificates may be recent or previous test results on material or product, but must be acceptable to Engineer.

1.13 MANUFACTURER’S INSTRUCTIONS

A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to Engineer for delivery to Owner in quantities specified for Product Data.

B. Submit manufacturer’s instructions for information for the limited purpose of assessing conformance with information given and the design concept expressed in the Contract Documents.

C. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.14 MANUFACTURER’S FIELD REPORTS

A. Submit report in duplicate within 15 days of observation to Engineer for information.

B. Submit manufacturer’s field reports for information for the limited purpose of assessing conformance with information given and the design concept expressed in Contract Documents.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION
### SUBMITTAL REVIEW TRANSMITTAL

<table>
<thead>
<tr>
<th>TO:</th>
<th>RECEIVED BY DISTRICT: (stamp here)</th>
<th>SUBMITTAL NO: (filled in by Contractor)</th>
<th>PREVIOUS SUB. NO: (filled in by Contractor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attn:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### PROJECT NUMBER AND NAME:

<table>
<thead>
<tr>
<th>CONTRACTOR/SUPPLIER: (Name/address/phone &amp; fax no.)</th>
<th>REVIEWED BY: (CM or designee)</th>
<th>ACTION:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1 For Information Only</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 Approved</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 Approved As Noted</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 Revise and Resubmit - Resubmission Required Within ______ Days</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 Submit Specified Item</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6 Rejected</td>
</tr>
</tbody>
</table>

#### DATE SENT: | DATE RETURNED: (assigned by construction admin dept after review)

#### SIGNATURE: | REVIEWED BY: (CM or designee) | ACTION: |

We are sending you these items via:

#### SPECIFICATION SECTION NUMBER AND TITLE:

<table>
<thead>
<tr>
<th>ITEM NO: (based on sub. schedule)</th>
<th>NO. OF COPIES</th>
<th>DESCRIPTION:</th>
<th>ACTION: (assigned by CM)</th>
<th>IDENTIFICATION NO: (CM log no.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### REMARKS:

Corrections and comments made on the shop drawings during this review do not relieve Contractor from compliance with requirements of the Drawings and Specifications. This check is only for review of general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. The Contractor is responsible for: conforming and correlating quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating Work with that of other trades; and performing Work in a safe and satisfactory manner.

Shaded areas reserved for Engineer’s use
SECTION 01 40 00
QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Quality Control and Control of Installation.
B. Tolerances.
C. Testing and Inspection Services.
D. Manufacturers’ Field Services.
E. Examination.
F. Preparation.

1.2 RELATED SECTIONS

A. Section 01 20 00 - Price and Payment Procedures.
B. Section 01 33 00 - Submittal Procedures.

1.3 REFERENCED STANDARDS

A. Section 6, “Control of Materials” of the State Standard Specifications must apply to work within the State right of way and City of Richmond and modifications as provided in Division 2.2.
B. Section 4, “Control of Materials” of the 2009 Edition of the Standard Specifications for Public Works Construction (Greenbook) must apply to work within the City of Richmond and modifications as provided in Division 2.1.
C. ASTM E329 Standard Specifications for Agencies Engaged in the Testing and/or Inspection of Materials used in Construction

1.4 QUALITY CONTROL AND CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality. Material and equipment to be incorporated into the Work must be new and unused unless otherwise approved and must bear the manufacturer’s stamp or marking. In case a reference is not clear as to which of several grades is desired, the highest quality material must be used.
B. Where articles or materials are specified by brand or trade name, alternate materials or articles equal to those specified may be approved provided the request for approval is in writing accompanied by supporting data, in ample time as determined by the Engineer to permit investigations without delaying the Work. Unless substitutions are approved, no deviation from the standards will be allowed.
C. Comply with manufacturers’ instructions, including each step in sequence.
D. Should manufacturers’ instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

E. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

F. Perform Work by persons qualified to produce required and specified quality, under competent supervision and in a manner to the Engineer’s complete satisfaction as specified in Section 00 72 00 - General Conditions, “Superintendence by the Contractor” in these Specifications and Section 5-1.17, “Character of Workers,” of the State Standard Specifications.

G. Verify that field measurements are as indicated on Shop Drawings or as instructed by the manufacturer.

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

I. Make arrangements with permitting agencies and special inspections agency for required inspections and tests. Inform Engineer at least 24 hours before event to allow witnessing of inspection or test.

1.5 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers’ tolerances. Should manufacturers’ tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.6 TESTING AND INSPECTION SERVICES – OWNER-HIRED TESTING AGENCY

A. Owner will employ and pay an independent firm to perform testing and inspection services where such testing and inspections are specified to be performed by testing agency under the employ of the Owner.

B. Cooperate with Owner-hired testing agency; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.

1. Notify Engineer and Owner-hired testing agency 48 hours prior to expected time for operations requiring services.

2. Make arrangements with the Owner-hired testing agency.

C. Testing and employment of testing agency or laboratory must not relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

D. Payment for re-testing or re-inspection required because of non-conformance to specified requirements by the Owner-hired testing agency will be charged to the Contractor by deducting testing charges from the Contract Price.
1.7 TESTING AND INSPECTION SERVICES – CONTRACTOR-HIRED TESTING AGENCY

A. Contractor must employ and pay for services of an independent testing agency or laboratory acceptable to the Owner to perform all other testing and inspections including inspections and tests which are required as conditions for permits. Wherever testing is required, it must be performed by Contractor-Hired Testing Agency unless specifically specified as performed by Owner-Hired Testing Agency. The Contractor-Hired Testing Agency must be deemed included in the price paid for other items of work, and no additional payment should be made therefor.

1. Prior to start of Work, submit testing laboratory name, address, and telephone number, and names agency contacts.

2. Submit evidence that testing agency complies with the recommended requirements of ASTM E329. Testing agency must be acceptable to Owner and permitting agency.

B. The independent firm must perform tests, inspections and other services specified in individual specification sections and as required by the Engineer and jurisdictional authority. Tests and special inspections must be paid for by the CONTRACTOR for the associated contract bid items, and no additional payment must be made therefor.

C. Testing, inspections and source quality control may occur on or off the project site. Perform off-site testing as required by the Engineer or the Owner.

D. Four copies of reports must be submitted by the independent firm to the Engineer, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents. Copies of reports must be wet stamped by authorized representative of testing agency.

E. Testing and employment of testing agency or laboratory must not relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

F. Notify the Engineer or notify the Engineer and permitting agency, if applicable, prior to each scheduled test.

G. Re-testing or re-inspection required because of non-conformance to specified requirements must be performed by the same independent firm on instructions by the Engineer.

H. Testing Agency Responsibilities:

1. Test samples of mixes submitted by Contractor.

2. Provide qualified personnel at site. Cooperate with Engineer and Contractor in performance of services.

3. Perform specified sampling and testing of products in accordance with specified standards.

4. Ascertaining compliance of materials and mixes with requirements of Contract Documents.

5. Promptly notify Engineer and Contractor of observed irregularities or non-conformance of Work or products.
6. Perform additional tests required by Engineer.

7. Attend pre-construction meetings and progress meetings.

I. Testing Agency Reports: After each test, promptly submit copies of report to Engineer, as specified herein. When requested by Engineer, provide interpretation of test results. At minimum, include the following in reports:

1. Date issued.
2. Project title and number.
3. Name of inspector.
4. Date and time of sampling or inspection.
5. Identification of product and specifications section.
6. Location in the Project.
7. Type of inspection or test.
8. Date of test.
9. Results of tests.
10. Conformance or Non-Conformance with Contract Documents.

J. Limits On Testing Agency’s Authority:

1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
2. Agency or laboratory may not approve or accept any portion of the Work.
3. Agency or laboratory may not assume any duties of Contractor.
4. Agency or laboratory has no authority to stop the Work.

1.8 MANUFACTURERS’ FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, and adjust and balance of equipment as applicable, and to initiate instructions when necessary.

B. Submit qualifications of observer to Engineer 30 days in advance of required observations. Observer subject to approval of Owner.

C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers’ written instructions.

D. Refer to Section 01 33 00 - Submittal Procedures
PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new Work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Verify that utility services are available, of the correct characteristics, and in the correct locations.

3.2 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

END OF SECTION
(This page intentionally left blank)
SECTION 01 42 00

REFERENCES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Specifications for construction industry standards of industry associations, trade associations, societies, organizations, and regulatory agencies as they are invoked and used in these Specifications.

1.2 REFERENCE STANDARDS

A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. The effective date of referenced standards is stated in Section 00 72 00, General Conditions.

C. Contractor must have access to the reference standards. Referenced standards must be made readily available, when requested, for use by the Engineer or designated Owner representative in carrying out the quality assurance and quality control programs specified in the Contract Documents, and to assure compliance with the requirements of the codes, specifications, test methods, practices, and other standards referenced in the Contract Documents.

D. Should specified reference standards conflict with other Contract Document requirements, request clarification from the Engineer before proceeding.

E. References are made to the 2010 State Standard Specifications (STATE), except as noted otherwise, the City of Richmond Standard Details for Public Works Construction and these special provisions. Where the State or City are referenced, Engineer must be understood to mean the Owner’s Engineer.

1.3 ABBREVIATIONS

A. Wherever in the Contract Documents an organization’s abbreviation or acronym is used, it must be understood to mean the full name of the respective organization. Abbreviations of the State Standard Specifications., and as follows:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>AASHTO</td>
<td>American Association of State Highway and Transportation Officials</td>
</tr>
<tr>
<td>ADA</td>
<td>Americans with Disability Act</td>
</tr>
<tr>
<td>ABAG</td>
<td>Association of Bay Area Governments</td>
</tr>
<tr>
<td>ACI</td>
<td>American Concrete Institute</td>
</tr>
<tr>
<td>ACP</td>
<td>Asbestos Cement Pipe</td>
</tr>
<tr>
<td>AISC</td>
<td>American Institute of Steel Construction</td>
</tr>
<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>ASA</td>
<td>American Standards Association</td>
</tr>
<tr>
<td>ASTM</td>
<td>American Society for Testing and Materials (Also known as ASTM International)</td>
</tr>
<tr>
<td>AWWA</td>
<td>American Water Works Association</td>
</tr>
<tr>
<td>BASMAA</td>
<td>Bay Area Storm Water Management Agencies Association</td>
</tr>
<tr>
<td>BMP</td>
<td>Best Management Practices</td>
</tr>
<tr>
<td>CEDA</td>
<td>Community and Economic Development Agency, Department of Development of the City of Richmond</td>
</tr>
<tr>
<td>CSA</td>
<td>Canadian Testing Association</td>
</tr>
<tr>
<td>C</td>
<td>Celsius (temperature)</td>
</tr>
<tr>
<td>Caltrans</td>
<td>State of California, Department of Transportation</td>
</tr>
<tr>
<td>CCRM</td>
<td>Construction Community Relations Manager</td>
</tr>
<tr>
<td>CPM</td>
<td>Critical Path Method</td>
</tr>
<tr>
<td>CTC</td>
<td>Copper Tube Size</td>
</tr>
<tr>
<td>DOHS</td>
<td>Department of Health Services</td>
</tr>
<tr>
<td>DOT</td>
<td>United States Department of Transportation</td>
</tr>
<tr>
<td>EBMUD</td>
<td>East Bay Municipal Utility District</td>
</tr>
<tr>
<td>EDA</td>
<td>Economic Development Administration</td>
</tr>
<tr>
<td>F</td>
<td>Fahrenheit (temperature)</td>
</tr>
<tr>
<td>FTA</td>
<td>Federal Transit Administration</td>
</tr>
<tr>
<td>HR</td>
<td>Hour</td>
</tr>
<tr>
<td>HUD</td>
<td>United States Department of Housing and Urban Development</td>
</tr>
<tr>
<td>IEEE</td>
<td>Institute of Electrical and Electronics' Engineers</td>
</tr>
<tr>
<td>ISA</td>
<td>International Society of Arboriculture</td>
</tr>
<tr>
<td>ITE</td>
<td>Institute of Traffic Engineers</td>
</tr>
<tr>
<td>MSDS</td>
<td>Material Safety Data Sheets</td>
</tr>
<tr>
<td>NEC</td>
<td>National Electrical Code</td>
</tr>
<tr>
<td>NEMA</td>
<td>National Electrical Manufacturers Association</td>
</tr>
<tr>
<td>OSHA</td>
<td>Occupational Safety and Health Administration</td>
</tr>
</tbody>
</table>
OMC  Oakland Municipal Code
PAV  Pressure Aging Vessel
PCA  Portland Cement Association
PG   Performance Graded
PG&E Pacific Gas and Electric Company
PS   U. S. Product Standard
PSI  Pounds per Square Inch
PVC  Polyvinyl Chloride
PWA  Public Works Agency of the City of Richmond
QJ   Queue Jump
RTFO Rolling Thin Film Oven
RWQCB Regional Water Quality Control Board – State of California
SDR  Standard Dimension Ratio
SFRWQCB San Francisco Regional Water Quality Control Board
TSP  Transit Signal Priority
UBC  Uniform Building Code of the International Conference of Building Officials
UL   Underwriters Laboratories
USA  Underground Service Alert
VCP  Vitrified Clay Pipe
Zone 7 Alameda County Flood Control and Water Conservation District, Drainage Area 7-1

PART 2 - PRODUCTS
Not Used.

PART 3 - EXECUTION
Not Used.

END OF SECTION
(This page intentionally left blank)
SECTION 01 48 00

CONTROL OF WORK

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Authority of the Engineer.
   2. Responsibilities of the Contractor.
   3. Inspection and testing by the Engineer.

B. Related Sections:
   1. Section 01 40 00, Quality Requirements.

1.2 AUTHORITY OF CONSTRUCTION MANAGER AND RESIDENT ENGINEER

A. The Construction Manager and Resident Engineer/Engineer will determine whether the work is completed in accordance with the contract documents. The Construction Management Team will decide any questions that may arise as to the quality or acceptability of materials furnished and work performed, and interpretations of the contract documents.

B. Under special conditions the Construction Manager/Resident Engineer may require the Contractor to finish a section on which work is in progress before work is started on any additional section.

1.3 RESPONSIBILITIES OF THE CONTRACTOR

A. Cooperate with the Construction Management Team and with others.

B. Perform the work to achieve the level of quality prescribed in the contract documents.

C. Perform the work in the proper sequence in relation to the requirements of the AC Transit and other contractors.

D. Contractor shall be responsible for any damage done by the Contractor or its agents to the work performed by the AC Transit or another contractor.

1.4 SUPERVISION AND CONSTRUCTION PROCEDURES

A. Contractor shall give the work the constant attention necessary to facilitate the progress of the work.

B. Contractor shall have present and available on the worksite a competent Construction Project Manager capable of supervising the work and reading and thoroughly understanding the drawings and specifications. See Sections 00 21 13 & 00 11 00.
C. Be solely responsible for all construction means, methods, techniques, and procedures and for coordinating all portions of the work under the contract. Permission given by the Engineer to use any particular methods, equipment, or appliances shall not be construed to relieve the Contractor from furnishing other equipment or other appliances or adopting other methods when those in use prove unsatisfactory or as to bind the Engineer to accept work which does not comply with the contract.

D. Immediately remove from the work, when so ordered by the Engineer, and not re-employ on any of the work, without written permission from the Engineer, any contractor or subcontractor employee doing unsafe, improper, or defective work; who, in the Engineer’s judgment, refuses or neglects the direction of the Engineer given to the Contractor; who is deemed incompetent or disorderly; or who commits trespassing on public or private property in the vicinity of the work.

E. Be responsible for securing all work areas by barricade in accordance with local and State requirements as applicable at the end of each day.

1.5 INSPECTION AND TESTING

A. The work is to be completed in accordance with the specifications, the drawings, and such instructions or directions as the Construction Manager and/or Resident Engineer may give to supplement drawings and specifications. Wherever the words “directed,” “permitted,” “approved,” “acceptable,” “satisfactory to,” or similar words or phrases occur in the contract documents, they shall be understood to be functions of the Engineer to be exercised at his discretion.

B. AC Transit shall not be responsible for and shall not have control or charge over the acts or omissions of the Contractor, subcontractors, or any of their agents or employees, or any other persons performing any of the work.

C. Contractor shall provide the Engineer with full access to the work and reasonable time for inspection for ascertaining whether or not the work is performed in accordance with the requirements and intent of the contract. No work shall be covered or materials used without making the work or materials available for inspection by the Construction Manager and/or Resident Engineer. If the Construction Manager and/or Resident Engineer so requests, the Contractor shall, at any time before acceptance of the work, remove or uncover such portions of the finished work as may be directed.

D. After examination, Contractor shall restore the work to the standard required by the contract documents. If the work examined proves acceptable, uncovering, removal, and replacement of the work in question shall be paid for by change order; but if the work proves unacceptable, the uncovering or removal and replacement of the work in question shall be at the Contractor’s expense. Inspection will not relieve the Contractor from the responsibility for the quality of this work and to perform the work in accordance with the requirements of the contract documents.

E. All materials and every process of manufacture and construction shall be subject to inspection at all times. The Construction Manager and/or Resident Engineer and his designated representatives shall have free access to all operations. Contractor shall provide necessary materials and the Engineer shall have the right to select suitable samples of materials for testing or examination which the contractor shall supply without charge. In case such samples must be shipped to some other point for inspection or testing, Contractor shall box or crate samples as necessary and shall deliver them at points designated for shipment without charge. Omission of inspection shall not relieve the Contractor of its obligations to produce the work required by the contract documents.
Materials not in compliance with contract requirements shall be removed promptly from the vicinity of the work, and the Contractor, at its expense, shall promptly remove, reconstruct, replace, and make good any defective work as directed in writing by the Engineer. Oversight or error in judgment of inspectors, or previous acceptance of the work, shall not relieve Contractor from the obligation to correct defects whenever discovered.

F. If the Contractor does not correct nonconforming work or remove rejected materials within a reasonable time fixed by written notice, the Construction Manager and/or Resident Engineer may direct that removals and corrections be performed by other contractors. Charges for such removals and corrections shall be deducted from the Contractor's payment due under this contract or may be paid for by the Contractor's bonds held for this contract.

G. All inspection by the Construction Manager and/or Resident Engineer is for the protection of AC Transit and its interest and shall not relieve the Contractor of responsibility for providing work in accordance with the contract documents. After completion of the work, a final inspection will be made and any previous inspection or acceptance will not preclude rejection at the final inspection of any item that is not satisfactory to the Engineer or not in accordance with the contract documents.

H. If, within the period of time prescribed by law or by the terms of any applicable special warranty required by the contract documents, whichever is longer, any of the work is found to be defective or not in accordance with the contract documents, the Contractor shall correct it promptly after receipt of a written notice from the Engineer. This obligation shall survive acceptance of the work or termination of the contract. In the event AC Transit prefers to accept or not require correction of defective or nonconforming work, AC Transit may do so instead of requiring its removal and correction, in which case the Construction Manager and/or Resident Engineer shall determine an appropriate sum to be deducted from the contract price or otherwise charged against the Contractor, which determination shall be final and binding upon the parties. Such adjustment shall be effected whether or not final payment has been made.

I. All defective work which has been rejected shall be remedied or removed and replaced by the Contractor at its own expense as accepted by the Engineer.

J. Whenever all of the work provided for in the contract or authorized as force account work has been completed and the final cleaning-up performed, the Construction Manager and/or Resident Engineer will make the final inspection, and, if the work is found to be satisfactory, Contractor will be notified in writing of the acceptance. All portions of the work shall be maintained by the Contractor at the standards required by the contract documents until final acceptance.

K. At the Engineer's discretion, portions of the work that are determined to be substantially complete may be accepted before all the project work is completed. After acceptance of substantially completed work, Contractor shall not use the finished product for any purpose without permission of the Engineer.

PART 2 – PRODUCTS
Not Used

PART 3 – EXECUTION
Not Used
PART 4 – MEASUREMENT AND PAYMENT

No separate measurement or payment shall be made under this section.

END OF SECTION
SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Construction Facilities:
   1. Progress cleaning and waste removal; cleaning requirements during construction operations.
   2. Contractor will be allotted construction offices in the existing facility. Contractor will be responsible for network connections, copier/printer, phone, computers and office furniture.

B. Temporary Controls:
   1. Water Quality Control Plan
   2. Water Pollution Control
   3. Dust, Erosion, and Sediment Control
   4. Air Quality Specific Measures
   5. Noise Control

C. Removal of temporary facilities, and controls.

D. Bird Protection.

E. Hazardous Materials.

1.2 RELATED SECTIONS

A. Traffic Control System in the Division 1 Section 01 55 26.

1.3 REGULATORY REQUIREMENTS

A. Refer to the requirements for Water Quality Control Plan and implementation in this Section

B. Refer to requirements for Water Pollution Control and implementation in this Section.

C. Refer to the City of Richmond requirement for waste reduction and recycling. The Contractor is required to prepare a project Waste Reduction and Recycling Plan (WRRP).

1.4 SUBMITTALS

A. Waste Reduction and Recycling Plan (WRRP).
1.5 PROGRESS CLEANING AND WASTE REMOVAL

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Collect and remove waste materials, debris, and rubbish from site daily and dispose off-site and as specified elsewhere in these special provisions.

C. For work within the City of Richmond, the Contractor must comply with the city requirements.

D. For work within the State right of way, refer to Section 14-10 Solid Waste Disposal and Recycling of the State Standard Specifications

E. Excess excavated material from trenches, structures, general excavation and manholes and similar structures must be removed from the site immediately.

1.6 WATER QUALITY CONTROL PLAN

A. The Contractor must comply with all appropriate BMP’s and applicable design recommendations of the State Water Quality Control Board (SWQCB) for preventing and removing pollutants, specifying erosion control measures, including sedimentation basins, infiltration basins, and re-vegetation of graded slopes.

   1. The Contractor must submit a Water Quality Control Plan (also referred to as the Stormwater Pollution Prevention Plan (SWPPP)) that identifies the specific facilities and slopes to be protected, BMP’s to be implemented, and meets all NPDES requirements. The cost associated with preparation and submittal of the Water Quality Control Plan, installation, maintenance and removal of WQCP facilities and materials must be included in the price paid for various items of work, and no additional payment will be allowed therefor.

B. Construction water quality control measures must include the following:

   1. Existing vegetation must be retained where possible,

   2. Grading activities will be limited to the immediate area required for construction,

   3. Erosion control measures such as silt fences, staked straw bales, temporary inlet protection and temporary re-vegetation must be employed for disturbed areas to prevent soil, dirt and debris from entering the storm drain system;

   4. No disturbed surfaces must be left without erosion control measures in place during the winter and spring months; Sediment must be retained onsite by a system of sediment basins, traps, or other appropriate measures;

   5. Measures must be taken to ensure proper collection and disposal of all pollutants handled or produced on the site during construction, including sanitary wastes, cement, and petroleum products;

   6. All storm water conveyance and discharge facilities that will be the responsibility of the City of Richmond must be designed and constructed in accordance with City of Richmond Standard Specifications and Details.
7. Inspect earthwork to detect evidence of erosion and sedimentation as directed by the Engineer; promptly apply corrective measures.

C. If groundwater is encountered during construction activity, the Contractor must comply with the provisions of the RWQCB’s General Permit for Dewatering and Other Low Threat Discharges to Surface Waters. Compliance must include preparation of a monitoring and reporting program and implementation of Best Management Practices associated with the dewatering activities.

1.7 WATER POLLUTION CONTROL

A. For the construction work within the City of Richmond, the Contractor must comply with the city requirements.

B. For construction work within the State of California right of way and the City of Richmond, the contractor must comply with the requirements in Section 13, Water Pollution Control of the State Standard Specifications and the special provisions.

1.8 DUST, EROSION, AND SEDIMENT CONTROL

A. Dust control measures must be implemented in accordance with Bay Area Air Quality Management District (BAAQMD) standards and city requirements.

B. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment, as required.

C. Protect site from puddling or running water.

D. Materials must be stockpiled off the jobsite.

AIR QUALITY SPECIFIC MEASURES

Construction contractors must implement the Bay Area Air Quality Management District (BAAQMD) Basic Construction Mitigation Measures, and the applicable Additional Construction Mitigation Measures. The following controls should be implemented at all construction sites:

- All exposed surfaces (e.g., parking areas, staging areas, soil piles, graded areas, and unpaved access roads) must be watered two times per day.
- All haul trucks transporting soil, sand, or other loose material off-site must be covered.
- All visible mud or dirt track-out onto adjacent public roads must be removed using wet power vacuum street sweepers at least once per day. The use of dry power sweeping is prohibited.
- All vehicle speeds on unpaved roads must be limited to 15 mph.
- All roadways, driveways, and sidewalks to be paved must be completed as soon as possible.
- Building pads must be laid as soon as possible after grading unless seeding or soil binders are used.
- Idling times must be minimized either by shutting equipment off when not in use or reducing the maximum idling time to 5 minutes (as required by the California airborne toxics control measure Title 13, Section 2485 of California Code of Regulations [CCR]).
- Clear signage must be provided for construction workers at all access points.
- All construction equipment must be maintained and properly tuned in accordance with manufacturer’s specifications. All equipment must be checked by a certified mechanic and determined to be running in proper condition prior to operation.
- Post a publicly visible sign with the telephone number and person to contact at the lead agency regarding dust complaints. This person must respond and take corrective action.
within 48 hours. The Air District’s phone number also must be visible to ensure compliance with applicable regulations.

The following measures are recommended for projects with construction emissions above the threshold:

- All exposed surfaces must be watered at a frequency adequate to maintain minimum soil moisture of 12 percent. Moisture content can be verified by lab samples or moisture probe.
- All excavation, grading, and/or demolition activities must be suspended when average wind speeds exceed 20 mph.
- Wind breaks (e.g., trees and fences) must be installed on the windward side(s) of actively disturbed areas of construction. Wind breaks should have at maximum 50 percent air porosity.
- Vegetative ground cover (e.g., fast-germinating native grass seed) must be planted in disturbed areas as soon as possible and watered appropriately until vegetation is established.
- The simultaneous occurrence of excavation, grading, and ground-disturbing construction activities on the same area at any one time must be limited. Activities must be phased to reduce the amount of disturbed surfaces at any one time.
- All trucks and equipment, including their tires, must be washed off prior to leaving the site.
- Site accesses to a distance of 100 feet from the paved road must be treated with a 6 inch to 12 inch compacted layer of wood chips, mulch, or gravel.
- Sandbags or other erosion control measures must be installed to prevent silt runoff to public roadways from sites with a slope greater than 1 percent.
- Minimize the idling time of diesel powered construction equipment to two minutes.
- The project must develop a plan demonstrating that the off-road equipment (more than 50 horse-power) to be used in the construction project (e.g., owned, leased, and subcontractor vehicles) would achieve a project wide fleet-average 20 percent NOx reduction and 45 percent PM reduction compared to the most recent ARB fleet average. Acceptable options for reducing emissions include the use of late model engines, low-emission diesel products, alternative fuels, engine retrofit technology, after-treatment products, add-on devices such as particulate filters, and/or other options as such become available.
- Use low volatile organic compound (VOC) (i.e., reactive organic gases) coatings beyond the local requirements (i.e., Regulation 8, Rule 3: Architectural Coatings).
- All construction equipment, diesel trucks, and generators must be equipped with best available control technology for emission reductions of NOx and PM.

All contractors must use equipment that meets California Air Resources Board’s most recent certification standard for off-road heavy duty diesel engines.

Construction contractors must comply with BAAQMD Regulation 11 (Hazardous Pollutants) Rule 2 (Asbestos Demolition, Renovation, and Manufacturing). The requirements for demolition activities include removal standards, reporting requirements, and mandatory monitoring and record keeping. The following avoidance, minimization and control measures to reduce air emissions associated with project construction:

- All active construction areas must be watered at least twice daily;
- All trucks hauling soil, sand, and other loose materials must be covered and must maintain at least two feet of freeboard.
- All unpaved access roads, parking areas, and staging areas in the construction area must be watered at least three times daily or must be applied with non-toxic soil stabilizers.
- All paved access roads, parking areas, and staging areas in the construction area must be swept daily with water sweepers.
• Streets must be swept daily with water sweepers if visible soil material is carried onto adjacent public streets.
• Non-toxic soil stabilizers must be applied to inactive construction areas (previously graded areas that are inactive for 10 days or more).
• Exposed stockpiles of dirt, sand, or debris must be enclosed, covered, watered at least twice daily, or applied with non-toxic soil binders.
• Traffic speeds on unpaved roads must be limited to 15 mph.
• Wheel washers must be installed on all trucks or tires/tracks of all trucks, and equipment leaving the construction area must be washed.
• Excavation and grading activities must be suspended when winds exceed 25 mph.
• Construction equipment must use cool exhaust gas recirculation.
• Construction equipment must use aqueous diesel fuel.
• Construction contracts must explicitly stipulate that all construction equipment must be properly tuned and maintained.

1.9 NOISE CONTROL

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

1. Conduct noise and vibration testing, and monitor and inspect equipment to ensure they meet noise standards.

2. Place temporary noise barriers for asphalt cutting and other noisy activities.

3. Turn off idling equipment.

4. Choose haul routes and conduct loading and unloading operations to minimize noise in residential and other sensitive areas.

5. Use newer equipment with improved noise muffling and ensure that all equipment items have the manufacturers’ recommended noise abatement measures, such as mufflers, engine covers, and engine vibration isolators intact and operational. All construction equipment should be inspected at periodic intervals to ensure proper maintenance and presence of noise control devices (e.g., mufflers, shrouding, etc.).

6. Perform all construction in a manner to minimize noise and vibration. Use construction methods or equipment that will provide the lowest level of noise and ground vibration impact.

7. During asphalt cutting, a temporary noise barrier should be placed between the cutting area and noise sensitive sites.

8. Conduct truck loading, unloading and hauling operations so that noise is kept to a minimum by carefully selecting routes to avoid going through residential neighborhoods to the greatest possible extent.

9. Construction lay-down or staging areas should be selected in industrially zoned districts. If industrially zoned areas are not available, commercially zoned areas may be used, or locations that are at least 90 feet from any noise sensitive land use such as residences, hotels, and motels. Ingress and egress to and from the staging areas should be on collector streets or greater (higher street designations are preferred).
10. Turn off idling equipment.

11. Minimize construction activities during evening, nighttime, week-end, and holiday periods.

12. Limit the use of construction equipment that creates high vibration levels, such as vibratory rollers and hammers, operating within 130 feet of residential structures.

13. Require vibration monitoring during vibration-intensive activities.

14. Restrict the hours of vibration-intensive equipment or activities such as vibratory rollers so that impacts to residents are minimal (e.g., weekdays during daytime hours only when as many residents as possible are away from home).

B. Comply with the following noise regulations.

1. In the City of Richmond, the Contractor shall comply with following noise regulations:

   a. Construction related noise which is adjacent to or across a street or right of way from a residential use shall not be permitted between 7:00 PM to 7:00 AM on weekdays, between 7:00 PM to 8:00 AM on weekends, or on holidays.

2. In the City of Richmond, the Contractor shall comply with following noise regulations:

   a. Maximum allowable receiving noise level standards in residential and civic area shall be 70 dB for five minutes within a one hour period between 7:00 AM to 10:00 PM and shall be 55 Db for five minutes within a one hour period between 10:00 PM to 7:00 AM.

   b. Maximum allowable receiving noise level standards in commercial area shall be 75 dB for five minutes within a one hour period anytime.

   c. Maximum allowable receiving noise level standards for construction operations less than 10 days shall be 80 dB in residential areas and 85 dB in commercial and industrial areas between 7:00 AM to 7:00 PM on weekdays.

   d. Maximum allowable receiving noise level standards for construction operations less than 10 days shall be 65 dB in residential areas and 70 dB in commercial and industrial areas between 8:00 AM to 8:00 PM on weekend.

   e. Maximum allowable receiving noise level standards for construction operations 10 days or more shall be 65 dB in residential areas and 70 dB in commercial and industrial areas between 7:00 AM to 7:00 PM on weekdays.

   f. Maximum allowable receiving noise level standards for construction operations 10 days or more shall be 55 dB in residential areas and 60 dB in commercial and industrial areas between 8:00 AM to 8:00 PM on weekend.
1.10 PUBLIC INFORMATION

A. General

1. The Contractor must conduct all work necessary to meet the requirements of public information when needed.

B. Administrative Requirements

1. When needed the District’s Media Affairs Manager and the Director of Legislative Affairs & Community Relations will lead the development and implementation of the Public Information Plan through the consultant Community Construction Relations Manager (CCRM). The District staff will oversee the preparation of the various components of the plan including:

   a. Brochures and mailers
   b. Public service ads to the general public

2. The duties of the Outreach Team Manager (OTM) and the CCRM will include assisting the District’s Media Affairs Manager and the Director of Legislative Affairs & Community Relations in managing periodic press releases that will keep the public informed about the status of the construction.

3. The Public Information Plan may also include placing public service ads on the air or other media to announce project updates. The ads would remind the users of this corridor to consider alternate means of transportation or alternate routes to the construction zones. The OTM and CCRM, with assistance from the Contractor, will lead pre-construction information meetings in specific neighborhoods to present upcoming construction activity and illustrate methods for minimizing impacts to congestion and parking.

C. Contractor Requirements

1. The Contractor must maintain a system to ensure a flow of information from the Contractor to the AC Transit. The Resident Engineer and the CCRM (PMCM) will supervise public information efforts.

2. The Contractor must be accessible 24 hours a day, seven days a week and must respond within two hours of contact to address project issues. The Contractor’s Representative must provide contact information, including home, fax, and mobile phone numbers to the District.

3. The Contractor, CCRM and PMCM must meet weekly, or as deemed necessary by the PMCM, and must communicate regularly by phone and e-mail.

D. Crisis Communications

1. The Contractor must be available to assist the CCRM and PMCM in addressing issues that may include the following:

   a. Formulating approaches to address specific emergencies
b. Identifying cause of specific disruptions (i.e., whether construction-related or not)

c. Providing information on:
   1. Actions being taken to alleviate the problem
   2. Impact to the public and notification procedures
   3. Anticipated duration of the disruption

d. Notifying the CHP, BART, City of Richmond Police and Fire and City of Richmond Police and Fire of crises or emergency closures in the Project area

E. Construction Schedule

1. The Contactor shall communicate to Engineer and CCRM construction events that must occur at least seven days before beginning in any discrete area and include the following:
   a. Description of the activity
   b. Start of the activity
   c. End of the activity

2. The Contractor must provide current construction information to the Engineer and CCRM as an input to incident management strategies to prevent traffic from being rerouted into areas of construction-related congestion.

F. Traffic Conditions

1. The Contractor must inform the Engineer and CCRM of any unusual traffic conditions, such as road obstructions, and likely duration within 15 minutes of detection.

G. Bicycle, Pedestrian, Handicapped Mobility, and Access

1. The Contractor must clearly define and communicate to Engineer, PMCM and CCRM accommodations for access by bicycles, pedestrians, and handicapped persons, including alternate routes and detours, where access currently exists. The Contractor must make every effort to accommodate and maintain accessibility throughout the duration of the project.

H. Utility Shut-Offs

1. The Contractor must provide start time and duration of utility shut-offs early enough so the AC Transit may provide written notice to the affected parties at least 72 hours in advance of any outages.

2. The Contractor must be responsible for keeping the emergency utility contact list updated on at least a quarterly basis.
3. The Contractor must develop contingency plans in coordination with utility providers to address unanticipated encounters with buried utilities and/or unscheduled interruptions in service.

I. Construction Noise due to Nighttime work Approved by Engineer

1. The Contractor must continually inform PMCM of planned and potential nighttime construction noise impacts to enable the AC Transit to notify affected residents in writing at least seven days in advance. The Contractor must communicate to PMCM any changes in planned noise impacts early enough that residents may be notified one day in advance.

J. Public Contact

1. The AC Transit will be the primary contact with all members of the public, with the Contractor available to assist, as needed. The PMCM will work closely with Contractor to facilitate coordinated and consistent efforts when contacting and disseminating information to the public.

K. Public Meetings and Open Houses

1. The PMCM will conduct public meetings to update affected audiences, resolve complaints, etc. The Contractor must attend meetings at the request of PMCM. The Contractor must meet with PMCM in advance to assist in planning meetings at the PMCM’s request.

L. Noise

1. Should any of the Contractor’s operations generate complaints by the public about noise, CCRM will investigate the complaints and attempt to address the problem. At minimum, Contractor shall explain the necessity, schedule, and duration of the noise generating activities to the CCRM.

M. Payment for public information coordination is included in the payment for traffic control systems.

1.11 REMOVAL OF TEMPORARY FACILITIES, AND CONTROLS

A. Remove temporary equipment, facilities, and materials, prior to Substantial Completion inspection.

B. Remove underground installations as required. Grade site as indicated.

C. Clean and repair damage caused by installation or use of temporary work.

D. Restore existing and permanent facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

1.12 BIRD PROTECTION

A. Protect migratory and nongame birds, their occupied nests, and their eggs.

The Owner anticipates nesting or attempted nesting from March 15 to August 15. A nesting survey is required for any tree removals that occur during this time frame. The survey is
considered incidental to the tree removal bid item and must be completed no earlier than 72 hours prior to tree removal.

The federal Migratory Bird Treaty Act, 16 USC § 703–711, and 50 CFR Pt 10 and Fish & Game Code §§ 3503, 3513, and 3800 protect migratory and nongame birds, their occupied nests, and their eggs.

The federal Endangered Species Act of 1973, 16 USC § 1531 and § 1543, and the California Endangered Species Act, Fish & Game Code §§ 2050–2115.5, prohibit the take of listed species and protect occupied and unoccupied nests of threatened and endangered bird species.

The Bald and Golden Eagle Protection Act, 16 USC § 668, prohibits the destruction of bald and golden eagles and their occupied and unoccupied nests.

If migratory or nongame bird nests are discovered that may be adversely affected by construction activities or an injured or killed bird is found, immediately:

1. Stop all work within a 100-foot radius of the discovery.

2. Notify the Engineer.

The Owner investigates. Do not resume work within the specified radius of the discovery until authorized.

1.13 HAZARDS AND HAZARDOUS MATERIALS

A. The Contractor must develop and implement a Worker Health and Safety Plan (WH&SP) to address the handling and storage of hazardous construction materials.

1. Walk-through level site reconnaissance must be conducted at sites where contamination is possible in order to determine if contamination is present or likely.

2. Site evaluation must be made of any known or suspected contaminated sites before soil is removed.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This Section sets forth the minimum requirements for traffic routing and traffic control for work within the right of way under Contract Documents.

C. The Contractor shall submit traffic control plan for all phase and zones to the Engineer for Approval.

1.2 SCOPE OF WORK

A. Work outside the Facility on all City Streets requires the Contractor to prepare Traffic Control Plans, construct, operate and maintain traffic control in conformance with the requirements in this section and in accordance with Division 2.

B. The traffic control plans must clearly depict the complete and exact sequence of the construction operations, the construction to be performed and the traveled way that will be utilized by all movement of traffic (including vehicles, parking, bicycles, and pedestrians) during each phase of construction. Multiple phases of construction will require a separate traffic control plan for each different construction phase or operation. The duration of these phases shall be noted on Traffic Control Plans.

C. The Contractor must endeavor to minimize the time in which any parking space/loading zone is displaced in order to reduce the impact on local businesses. The Traffic Control Plans must show the location of existing parking spaces/loading zones to be displaced with the duration associated with the displacement.

D. The Contractor must maintain access to all businesses, building, parking lots, and parcels including driveway and pedestrian access. The Traffic Control Plans must identify how the Contractor will maintain access to each business, building, parking lot, and parcel through each phase of construction including use of Flagger and other means.

E. The Contractor must provide and maintain protection for the traveling public, pedestrians, bicyclists, and workers within the area covered by the limits of construction, at all times when the area is affected by construction facilities or activities. In the event that truck routes are obstructed by any construction activity the Contractor must submit Traffic Control Plans including a proposed alternate route.

   1. Construction staging must address the relocation of existing bicycle routes.

      a. The shifted travel lanes should be 14 feet wide where feasible, so that the lane can accommodate both motor vehicles and bicycles.

1.3 APPLICABLE STANDARDS

A. In addition to compliance with this specification, the Contractor and all traffic control devices must comply with all applicable requirements of the latest editions of the following:


5. Section 2; Traffic Control of the Standard Specifications for the City of Richmond (where applicable).

6. Division 2.1, Section 10-1.05; Maintain Existing and Temporary Electrical Systems of the Standard Specifications for the City of Richmond (where applicable).


8. Other Applicable Government Regulations.

1.4 SUBMITTALS

A. The Contractor must make the following submittals, in accordance with typical Stage Construction configurations provided in the project drawings (where applicable) to the Engineer for acceptance prior to submitting the plans to the appropriate jurisdictional agency Engineer who is assigned this responsibility, by the Engineering Department of the City of Richmond, City of Richmond, or Caltrans:

1. Traffic Control Plans, Detour Plans and Pedestrian Access Plans

2. Incident Management Plan

3. Contractor Storage, Staging, and Parking Plans

4. Schedule of Traffic Diversion and Control

5. Certification of Flaggers

6. Truck Routes

7. Traffic Signal Operation and Maintenance Plan

B. Traffic Control Plans, Detour Plans and Pedestrian Access Plans:

1. Where required the traffic control plans, detour plans and pedestrian access plans must be prepared by a third-party State of California licensed civil engineer and attest that he/she has personal knowledge of the traffic conditions in the work areas, understands the impacts the work will have on vehicular, pedestrian, and other modes of transportation, and that the traffic plans comply fully with all ADA requirements and all requirements related to providing path of travel through construction zones.

2. A separate set of traffic control plans, detour plans and pedestrian access plans must be required for working and non-working hours.
3. The Traffic Control Plans must include the types of parking loss during construction, requirements for temporary replacement, and directional signage to alternate parking. Penalties will be for exceeding the number of parking spaces lost beyond those approved for deletion and for the delay in restoration of lost parking spaces based upon the temporary parking prohibition permits issued by the agency.

4. A submittal must consist of four (4) copies on white paper, and one (1) electronic copy. Maximum drawing size must be 24" X 36". The traffic control plans must be drawn to a scale of 1 inch = 40 feet.

5. No work must be allowed on the streets without the approved traffic control plans and an encroachment permit.

6. The Contractor must request from the Engineer base plans to prepare the traffic control plans prior to Notice to Proceed.

7. The Engineer will have 21 days to review the traffic handling plans. The agency with jurisdictional authority will need 21 days to review the traffic handling plans after the Engineer has accepted the traffic handling plans as complete.

8. Each traffic control and pedestrian access plan must show the following minimum applicable information, as required by the Engineer:
   a. Street and traffic lane layout (width of sidewalk, street and lanes etc.); outline of the work under construction (i.e., limits of excavation), location of construction barricades, location of trench protection devices, location of major construction equipment and the ingress and egress routes of trucks hauling materials to and from the construction site.
   b. Sequence of construction and traffic lane transitions; labeling all taper/transition lengths and widths, delineator spacing and sign spacing.
   c. Crosswalk and sidewalk closures; provide at least 5 ft. wide safe path of travel for pedestrians on sidewalks and provide at least 10 ft. wide safe path of travel for pedestrians on crosswalks, in addition to signs and barricades to direct pedestrians through or around the construction work zone in accordance with CA MUTCD, WATCH Manual, and State Standard Plans.
   d. Existing striping, pavement markings and traffic signs, and description of what is to be removed prior to installation of temporary striping and signage, and what will be restored after the construction is completed.
   e. Location and spacing of "Tow Away No Stopping" signs.
   f. Location and description of temporary striping, pavement markings, signs, and other traffic control devices necessary to provide and maintain the adequate number and width of traffic lanes specified herein, and to provide and maintain passage and protection for cyclist and pedestrians.
   g. Location and description of traffic control devices proposed for the protection of the work area, excavation, workers, equipment, pedestrians, vehicles, bicyclists, and property.
h. Other proposed changes and provisions for removal, relocation, or temporary installation of:

   (1) Traffic signs

   (2) Transit stops

   (3) Barricades, chain link fence, plywood fence, temporary K-rail, crash cushions (sand barrels), etc.

   (4) Type II flashing arrow signs (required for each lane closure).

   (5) Lighting

   (6) Traffic Signals

i. Safe path of travel for passengers using public transit, from/to loading platform to/from sidewalk.

j. The Contractor must make their own arrangements to find a location for their office/trailers. AC Transit will not provide a location. The trailer(s) shall be located away from intersections in order to not block traffic control devices (STOP signs, signals etc.), hydrants, bus stops, or driveways.

k. Location of detour signs for vehicular, truck, bicycle, and pedestrian traffic.

l. Contractor must submit truck routes for the approval by the Engineer

9. The Contractor must determine and submit temporary detour plans and an alternative route plan for any closures on the project to Engineer for approval. The Contractor must obtain acceptance from Engineer prior to submitting the plans to the agencies with jurisdictional authority of the proposed detour route and local emergency service providers for approval. The Contractor must not implement any temporary closures or detours unless Engineer, agencies with jurisdictional authority of the detour route, and local emergency service providers approve the temporary detour plans. Detours that are not approved by the Engineer must not be implemented.

   The Contractor must provide local emergency service providers advance notice of full street closure, lane closures, and alternative detour plans.

10. Traffic control plans shall index plans that specify each stages and sub-stages. The index shall include the following for each stage and sub-stage:

   a. Duration in days

   b. Contractor parking space allowances and duration of contractor parking space allowances in days

   c. Lane Closures and duration of each lane closure in days

   d. Order of work

C. Schedule of Traffic Diversion and Control.
1. The Contractor must submit a written schedule of planned Traffic Diversion and Control to the Engineer for review and approval 7 days before the anticipated start of any operation that will:

PART 2 - PRODUCTS

2.1 GENERAL

A. All traffic signs, barricades, delineators, flashing arrow signs (arrow board display), channelizes, temporary barrier, and other traffic control devices must conform to the requirements of the CA MUTCD (Part 6, Temporary Traffic Control), State Standard Plans, and State Standard Specifications for traffic control systems, except as specified herein. The CA MUTCD is available on the internet at the following website:

http://www.dot.ca.gov/hq/traffops/engineering/

B. All special construction traffic signs must be reflectorized with black messages/symbols having 6", 8" high series D letters on orange colored aluminum plate. The message and size of the letters must be determined by the civil engineer responsible for developing the Traffic Control Plans. Any changes on any signs must be made with appropriate decals.

C. All barricades must have flashers. The flashers must be maintained in good operating condition at all times by the Contractor.

D. Temporary Asphalt, Temporary Wood Ramp, minimum 5-foot wide clear walking surface with running slope not to exceed eight (8) percent compliant with applicable Americans with Disabilities Act Accessibility Guidelines (ADAAG) and Americans with Disabilities Act (ADA) regulations.

E. Barricade materials: Delineators, A-Frames, Barrier Caution Tape, Fencing Material

F. Any equipment that does not operate properly or any device that is not in good operating condition must be removed from the job site immediately at the contractor’s expense.

2.2 DELINEATORS

A. Delineators for lane taper areas for the separation of traffic from other work, must be either reflectorized traffic cones minimum 28 inches high, or reflectorized portable tubular delineators minimum 36 inches high, with orange posts and yellow/white reflectors. Reflector units must be 3”x 12” minimum.

2.3 NON-SKID METAL PLATING

A. Metal plating and any metal bridging must be coated with non-skid and rust-inhibitive product. Plating must be installed and maintained in such a manner as to provide a non-skid surface with no edges or corners sticking up, and with no bouncing or shifting.

2.4 CHANNELIZERS

A. Channelizers must comply with Section 12-3.07 of the State Standard Specifications.

2.5 BARRICADES TYPE III

A. Barricades Type III must comply with Section 12-3.02 of the State Standard Specifications.
2.6 TEMPORARY FENCES

A. A temporary fence must comply with specifications for a permanent fence of the same type except:

1. You may use used materials if the used materials are good, sound, and suitable for the purpose intended.

2. Materials may be commercial quality if the dimensions and sizes of the materials are equal to or greater than sizes shown on the plans or specified in section 80 of the State Standard Specifications.

3. Post must be either metal or wood.

4. The Owner does not require:
   a. Galvanizing or painting of steel elements.
   b. Treating wood with a wood preservative.
   c. Concrete footings for metal post.

PART 3 - EXECUTION

3.1 VEHICULAR, BICYCLE, AND PEDESTRIAN TRAFFIC.

A. Traffic Control System for Lane Closure

1. A traffic control system must consist of temporary closures of traffic lanes and driveways in accordance with the details shown on State Standard Plans RSP T-11, RSP T-12, and the provisions of Section 12, "Temporary Traffic Control," of the State Standard Specifications and these Special Provisions.

2. The provisions in this section will not relieve the Contractor from the responsibility to provide additional devices or take measures as may be necessary to comply with the provisions in Section 7-10, "Public Convenience and Safety," of the Greenbook, Section 7-1.04, “Public Safety”, of the State Standard Specifications and Section 7-1.03, “Public Convenience”, of the State Standard Specifications.

B. Maintaining Pedestrian Access.

The Contractor must provide a continuous, accessible and safe path of travel around or through construction work zones with a minimum clear width of 5 feet for pedestrians. The Contractor must use temporary asphalt or wood ramps, signs, cones, barricades, flashers, and flaggers to direct and channel pedestrians during construction. Advance warning must be provided to pedestrians of the present sidewalk construction site. Means for temporary access for pedestrians with disabilities, such as temporary ramps, boardwalks, barriers, etc., must be in compliance with applicable Americans with Disabilities Act Accessibility Guidelines (ADAAG) and Americans with Disabilities Act (ADA) regulations.

1. Placement:

   a. Temporary ramps must be constructed so installation and removal will not damage existing pavement, curb, gutter, or combination thereof.
b. Ramps must have a minimum 4-foot wide walking surface and a running slope not to exceed 8 percent.

c. Ramps must meet existing surfaces without gaps. When required for drainage, a Schedule 40 PVC pipe minimum 2-inch diameter must be installed under or through ramp in gutter or flow line.

d. Transitions between ramps and the street or sidewalk surfaces must be smooth.

e. Sides of the ramp must be protected where drop-offs exceed 6 inches.

f. Maintenance of a Clear and Accessible Pedestrian Corridor:

g. The Contractor must maintain an accessible corridor that provides at least one safe path of travel for all pedestrians at all times for the duration of the project. Conversely, if a safe path of travel including crosswalks is not available, after the approval of the Engineer, the Contractor must post the sidewalk as being closed. Signage must be placed at the location of closure as well as the next intersection in both directions.

2. Installation of Barricades and temporary fencing:

a. Barricades, which will provide protection for pedestrians from traffic or construction operations, must be installed in the following locations:

(1) Between the pedestrian access route and any adjacent construction site.

(2) Between the alternate circulation path and any adjacent construction site.

(3) Between the alternate circulation path and the vehicular way, if the alternate circulation path is diverted into the street.

(4) Between the alternate circulation path and any protruding objects, drop-offs, or other hazards to pedestrians.

(5) Temporary fencing must also be placed to separate the pedestrian from the construction work as directed by the Engineer.

(6) At the down curb ramp of an intersection, if opposite up curb ramp is temporarily or completely blocked, and no adjacent alternative circulation path is provided.

b. Temporary fencing must also be placed to separate the pedestrian from the construction work as directed by the Engineer.

3. Surfacing of Pedestrian Corridors:

a. During construction, tripping hazards and barriers for people with mobility impairments must be removed to maintain an accessible pedestrian corridor.

4. Identification of Safe Path of Travel:
a. If alternate circulation routes are provided for pedestrians to bypass the construction site, the route must be clearly defined and advance warning must be provided to clearly delineate the alternate circulation route. Any change of level in a path of travel that is over 1/4 inch (1/2” maximum) height must be beveled a 45 degrees to provide a smooth, non-tripping transition. The Engineer must review and approve any pedestrian access limitations and notification requirements for pedestrians with mobility or vision impairments.

5. Public Convenience and Safety:

a. All trenches must be backfilled at the end of the day or temporary covers must be maintained during non-working hours to avoid any safety issues for pedestrians walking on the project areas.

6. Warning Signs:

a. The Contractor must provide warning signs for temporary pedestrian ramps and barricades. Warning signs must be located at both the near side and the far side of the intersection preceding a temporarily completely blocked pedestrian way.

7. Restoration of Pedestrian Routes:

a. After construction, the site must be restored to its former condition, or new condition as required.

3.2 CROSSWALKS AND SIDEWALKS

A. All crosswalks must be kept open at all times, unless a substitute temporary cross walk is provided or otherwise approved by the Engineer.

B. R9-3A and R9-3B, “NO PED CROSSING, USE CROSSWALK” and “USE CROSSWALK (L/R)” signs must be placed at each end of a temporarily closed crosswalk.

C. Whenever a temporary crosswalk is provided outside of the existing crosswalk, such temporary crosswalks must be clearly defined by signs, striping, pedestrian bridges or plates. The minimum width of the temporary crosswalk must be 10 feet measured between the outside edges of the striping tape. The Contractor must provide access to mobility and visually impaired persons at all temporary and permanent crosswalks at all times by providing accessible temporary curb ramps.
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Furnishing, fabricating, installing, and removing the following Project signs:
   a. Federal Transit Administration signboards with a message describing the federal funding assistance Project.
   b. Agency Project signboards indicating Project and Contract name and description.
   c. Engineer's Field Office signboard listing the Project's Consultants.

B. Related Sections:

1. Section 01 33 00 - Submittal Procedures
2. Section 01 71 13 - Mobilization

1.2 SUBMITTALS

A. Submittals must be in accordance with the requirements of Section 01 33 00, Submittal Procedures, except as modified herein:

1. Shop Drawings of signboard layouts.

PART 2 - PRODUCTS

2.1 SIGN TYPES

A. Provide two 4-foot by 8 foot multicolored signboards with a message describing the sponsoring agencies providing funding for the Project as shown on Exhibit A. The Engineer will provide Agency Logo information and phone number for the FTA Signs. Furnish and install a sign overlay for the Agency Logo information and phone number within 10 working days of notification.

B. Agency Construction Project Signs: Provide two 4-feet by 8-foot multicolored supplemental signboards, indicating AC Transit construction project name and description, and listing the names of the Consultants and the General Contractor as shown on Exhibit B. The Engineer will provide phone number for the Agency Construction Project Signs. Furnish and install a sign overlay for the phone number and General Contractor's name within 10 working days of notification.

C. Artwork will be provided by the Owner upon Contractor's request.

2.2 SIGN CONSTRUCTION

A. Submit the final layouts of two (2) FTA signs and two (2) Agency construction project signs, for approval by the Engineer.

C. Frame and Cleats: New construction-grade lumber.


E. Hardware:
   1. Material: Brass, aluminum, or galvanized steel.
   2. Provide sizes and types capable of resisting a wind velocity of 85 mph when signs are assembled and erected.
   3. Removable Number Tags: Either aluminum or galvanized steel with 3-inch high blue numerals.
   4. Tag Hooks: Steel.

F. Paint: Primer-sealer and exterior semi-gloss alkyd enamel.

PART 3 - EXECUTION

3.1 GENERAL

A. Submit Shop Drawings of signboard layouts showing the FTA Signs, the Agency's Project signboards, and the Engineer's field office signboard to the Engineer for final approval.

B. Fabricate, furnish, and install the project signs at each end of the active phase of work.
   1. Erect project signs in prominent locations as directed by the Engineer within 30 days after the effective date of the Notice to Proceed.

C. Maintain project signs in good condition until completion of this Contract. The Contractor must be aware the signs must be relocated throughout construction to locations and at intervals as directed by the Engineer. No additional compensation will be provided for relocation of Project Information Signs. The Contractor must be aware that graffiti, theft, and/or vandalism of signs and traffic control devices will occur while in use. Contractor must replace and/or repair all vandalized items, as a result of graffiti, theft, or any other actions, within 24 hours of detection, as directed by the Engineer, and no additional compensation will be provided.

D. Remove project signs at project completion as specified herein.

E. Do not allow commercial or advertising signs on the Work Site.

3.2 SIGN MAINTENANCE

A. Maintain the signs in a neat and clean condition.
   1. Repaint painted sign surfaces that exhibit flaking, cracking, or fading.
   2. Either repaint or remove and replace damaged signs with new signs.
3. Clean graffiti from signs within a 24 hour period.

B. Remove signs and post when ordered by the Engineer.
   1. Fill empty signpost holes with earth.
   2. Properly dispose of signs as directed by the Engineer.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT
   A. Project information sign must be measured by each unit.

4.2 PAYMENT
   A. Project information sign will be paid by each unit in place.
   B. The contract unit price for each **Project Information Sign** must include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in constructing, erecting and maintaining Project Information Sign, as shown on the plans, as specified in the Standard Specifications and these Special Provisions, or as directed by the Engineer.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES
   A. Products.
   B. Product Delivery Requirements.
   C. Product Storage and Handling Requirements.
   D. Product Warranties.
   E. Product Options.
   F. Product Substitution Procedures.

1.2 PRODUCTS
   A. Provide products of qualified manufacturers suitable for intended use. Provide products of each type by a single manufacturer unless specified otherwise.
   B. Provide items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects will not be considered new products.

1.3 PRODUCT DELIVERY REQUIREMENTS
   A. Transport and handle products in accordance with manufacturer’s instructions.
   B. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
   C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS
   A. Store and protect products in accordance with manufacturers’ instructions.
   B. Store with seals and labels intact and legible.
   C. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
   D. For exterior storage of fabricated products, place on sloped supports above ground.
   E. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.
   F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
G. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

H. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.5 PRODUCT WARRANTIES

A. Warranties specified in other Sections must be in addition to, and run concurrent with, other warranties required by Contract Documents. Manufacturer’s disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of Contract Documents.

1. Manufacturer’s Warranty: Preprinted written warranty published by individual manufacturer for particular product and specifically endorsed by manufacturer to Owner.

2. Special Warranty: Written warranty required by or incorporated into Contract Documents, either to extend time limit provided by manufacturer’s warranty or to provide more rights for Owner.

B. Special Warranties: Prepare written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.

1. Manufacturer’s Standard Form: Modified to include Project-specific information and properly executed.

2. Specified Form: When specified forms are included with Specifications, prepare written document using appropriate form properly executed.

3. Refer to Divisions 2 through 16 for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 01 70 00, Execution and Closeout Requirements.

1.6 PRODUCT OPTIONS

A. Products specified by reference standards or by description only: Any product meeting those standards or description, by any manufacturer.

B. Products specified by naming one or more trade names of products or the names of manufacturer with catalog information and not qualified by the words “Designated Matching Product”: One of the products named which meets the specifications or an equal approved under the Product Substitution Procedures specified herein.

C. Products specified by naming one product or manufacturer followed by the words “Designated Matching Product”. There is no option.
1.7 PRODUCT SUBSTITUTION PROCEDURES

A. Comply with the following procedures to obtain approval of a proposed “equal” product and under other circumstances such as when a product becomes unavailable through no fault of the Contractor.

B. The Engineer will consider requests for Substitutions only within 30 days after date of Notice to Proceed. Substitutions may be considered later than 30 days after the date of the Notice to Proceed when a product becomes unavailable through no fault of the Contractor.

C. Failure to propose the substitution of any article or service within 30 days after date of Notice to Proceed will be deemed sufficient cause for denial of request for substitution.

D. A Request for Substitution constitutes a representation that the Contractor:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
   2. Has determined that proposed product has proof of operation in similar application.
   3. Will provide the same warranty for the Substitution as for the specified product.
   4. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
   5. Waives claims for additional costs or time extension which may subsequently become apparent.
   6. Will reimburse Owner for review or redesign services associated with re-approval by authorities.

E. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

F. Approval of any substitute indicates only that the product apparently meets the requirements of the Drawings and Specifications on the basis of the information or samples submitted. The Contractor must assume full responsibility for the performance of any substitutions.

G. Substitution Submittal Procedure:
   1. Submit five copies of Request for Substitution included at the end of this Section. Limit each Request form to one proposed Substitution.
   2. Submit Shop Drawings, Product Data, and certified test results attesting to the proposed product equivalence.
   3. Engineer will notify Contractor in writing of decision to accept or reject request.
PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used

END OF SECTION
REQUEST FOR SUBSTITUTION FORM FOLLOWS
REQUEST FOR SUBSTITUTION

<table>
<thead>
<tr>
<th>Project: ____________________________</th>
<th>Substitution Request Number: ____________________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>To: ________________________________</td>
<td>From: ________________________________________________</td>
</tr>
<tr>
<td>Re: ________________________________</td>
<td>Date: _________________________________________________</td>
</tr>
<tr>
<td>CM Project Number: __________________</td>
<td>Contract For: ________________________________________</td>
</tr>
</tbody>
</table>

Specification Title: __________________ Description: __________________
Section: _______ Page: _______ Article/Paragraph: __________________

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

□ Point-by-point comparative data attached - REQUIRED BY ENGINEER

Reason for not providing specified item: __________________

Similar Installation:
Project: ____________________________ Architect: ____________________________
Address: ____________________________ Owner: ____________________________
Date Installed: ______________________
Proposed substitution affects other parts of Work: □ No □ Yes; explain ______________

Savings to Owner for accepting substitution: _________________________ ($_______________)
Proposed substitution changes Contract Time: □ No □ Yes [Add] [Deduct] _____ days

Supporting Data Attached: □ Drawings □ Product Data □ Samples □ Tests □ Reports
□ Evidence of Proven Operation
SUBSTITUTION REQUEST
(Continued)

The Undersigned certifies:
PART 4 - PROPOSED SUBSTITUTE HAS BEEN FULLY INVESTIGATED AND DETERMINED TO BE EQUAL OR SUPERIOR IN ALL RESPECTS TO SPECIFIED PRODUCT.
PART 5 - SAME WARRANTY WILL BE FURNISHED FOR PROPOSED SUBSTITUTE AS FOR SPECIFIED PRODUCT.
PART 6 - SAME MAINTENANCE SERVICE AND SOURCE OF REPLACEMENT PARTS, AS APPLICABLE, IS AVAILABLE.
PART 7 - PROPOSED SUBSTITUTE WILL HAVE NO ADVERSE EFFECT ON OTHER TRADES AND WILL NOT AFFECT OR DELAY PROGRESS SCHEDULE.
PART 8 - COST DATA AS STATED ABOVE IS COMPLETE. CLAIMS FOR ADDITIONAL COSTS RELATED TO ACCEPTED SUBSTITUTE WHICH MAY SUBSEQUENTLY BECOME APPARENT ARE TO BE WAIVED.
PART 9 - PROPOSED SUBSTITUTE DOES NOT AFFECT DIMENSIONS AND FUNCTIONAL CLEARANCES.
PART 10 - PAYMENT WILL BE MADE FOR CHANGES TO BUILDING DESIGN, INCLUDING A/E DESIGN, DETAILING, AND CONSTRUCTION COSTS CAUSED BY THE SUBSTITUTE.
PART 11 - COORDINATION, INSTALLATION, AND CHANGES IN THE WORK AS NECESSARY FOR ACCEPTED SUBSTITUTE WILL BE COMPLETE IN ALL RESPECTS.

Submitted by: ____________________________
Signed by: ________________________________
Firm: ___________________________________
Address: __________________________________
Telephone: ________________________________
Attachments: ______________________________

ENGINEER REVIEW AND ACTION
□ Substitution approved - Make submittals in accordance with Section 01 33 00.
□ Substitution approved as noted - Make submittals in accordance with Section 01 33 00.
□ Substitution rejected - Use specified materials.
□ Substitution Request received too late - Use specified materials.

Signed by: ________________________________ Date: ________________________________

Additional Comments: □ Contractor □ Subcontractor □ Supplier □ Manufacturer □ A/E □ Engineer

NOVEMBER 2015
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Cutting and patching.
B. Final cleaning prior to turning project over to Owner.
C. Starting of systems.
D. Demonstration and instructions.
E. Protecting installed construction.
F. Closeout procedures.
G. Maintenance service.
H. Operations and Maintenance Manual and Data.
I. Product warranties and product bonds.
J. Record Documents.
K. Spare parts and maintenance products.

1.2 CUTTING AND PATCHING

A. Coordinate work through shop drawings and through proper sequencing of installation to ensure that cutting and patching specified herein is prevented. In case cutting and patching is required, submit written request in advance of cutting or altering any element.

B. Employ skilled and experienced installer to perform cutting and patching.

C. Execute cutting, fitting, and patching including excavation and fill, to complete Work, and to:

1. Fit the several parts together, to integrate with other Work.
2. Uncover Work to install or correct ill-timed Work.
3. Remove and replace defective and non-conforming Work.
4. Remove samples of installed Work for testing.
5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.

D. Execute work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.
E. Cut masonry and concrete materials using masonry saw or core drill.

F. Restore Work with new products in accordance with requirements of Contract Documents.

G. Fit Work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

H. Maintain integrity of construction; completely seal voids.

I. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit.

1.3 FINAL CLEANING

A. Execute final cleaning prior to final project assessment.

B. At completion of Work, remove remaining waste materials, rubbish, tools, equipment, machinery and surplus materials, and clean exposed surfaces; leave Project clean and ready for occupancy.

C. Clean surfaces exposed to view; remove temporary labels, stains and foreign substances, and polish transparent and glossy surfaces.

D. Clean debris from drainage systems.

E. Clean site; sweep paved areas, rake clean landscaped surfaces.

F. Remove waste and surplus materials, rubbish, and construction facilities from the site.

1.4 STARTING OF SYSTEMS

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Engineer seven days prior to start-up of each item.

C. Verify that each piece of equipment or system has been checked for proper lubrication, if applicable, and for conditions that may cause damage.

D. Verify that wiring and support components for equipment are complete and tested.

1.5 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of products to Owner’s personnel no later than 30 days prior to Final Completion at an agreed upon time.

B. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner’s personnel in detail to explain all aspects of operation and maintenance.

C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment.

1.6 PROTECTING INSTALLED CONSTRUCTION

A. Protect installed Work and provide special protection where specified in individual specification sections.
B. Prohibit traffic from landscaped areas.

1.7 CLOSEOUT PROCEDURES

A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer’s review.

B. Provide submittals that are required by governing or other authorities to Engineer.

C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

1.8 MAINTENANCE SERVICE

A. Maintenance service, if applicable, must not be assigned or transferred to any agent or Subcontractor without prior written consent of the Owner.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit data bound in 8-1/2 by 11 inch (A4) text pages, three D side ring binders with durable plastic covers in addition to electronic copies.

B. Prepare binder cover with printed title “OPERATION AND MAINTENANCE INSTRUCTIONS”, title of project, and subject matter of binder when multiple binders are required.

C. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

D. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

E. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:

   1. Part 1: Directory, listing names, addresses, and telephone numbers of A/E, Contractor, Subcontractors, and major equipment suppliers.

   2. Part 2: Operation and maintenance instructions. Identify the following:

      a. List of equipment.

      b. Parts list for each component.

      c. Operating instructions.

      d. Maintenance instructions for equipment and systems.

      e. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.

   3. Part 3: Project documents and certificates, including the following, as applicable:
a. Shop drawings and product data.

b. Certificates.

c. Photocopies of warranties and bonds.

F. Submit draft copy of completed volumes 30 days prior to Final Inspection. This copy will be reviewed and returned after Final Inspection, with Engineer comments. Revise content of all document sets as required prior to final submission.

G. Submit two sets of revised final volumes, within 15 days after Final Inspection.

1.10 PRODUCT WARRANTIES AND PRODUCT BONDS

A. Obtain warranties and bonds executed in duplicate by responsible subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work.

B. Execute and assemble transferable warranty documents and bonds from subcontractors, suppliers, and manufacturers.

C. Verify that documents are in proper form, contain full information, and are notarized.

D. Co-execute submittals when required.

E. Provide Table of Contents and assemble in three D-side ring binder with durable plastic cover in addition to electronic copies.

F. Submit prior to final Application for Payment.

G. Time Of Submittals:

1. For equipment or component parts of equipment put into service during construction with Owner’s permission, submit documents within 15 days after acceptance.

2. Make other submittals within 15 days after Date of Substantial Completion, prior to final Application for Payment.

3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 15 days after acceptance, listing the date of acceptance as the beginning of the warranty or bond period.

1.11 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:

1. Drawings.

2. Specifications.

3. Addenda.

4. Change Orders and other modifications to the Contract.
5. Reviewed Shop Drawings, Product Data, and Samples.
6. Manufacturer’s instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress, not less than weekly.

E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
   1. Manufacturer’s name and product model and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by Addenda and modifications.

F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
   1. Measured depths of foundations in relation to permanent surface improvements.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Field changes of dimension and detail.
   4. Details not on original Contract drawings.

G. Submit all aforementioned documents to Engineer, two (2) copies, with request for final Application for Payment.

1.12 SPARE PARTS AND MAINTENANCE PRODUCTS

A. Provide spare parts, maintenance, and extra products in quantities specified in individual specification sections prior to Substantial Completion.

B. Deliver to and place in location as directed by the Engineer; obtain receipt prior to final payment.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.
(This page intentionally left blank)
SECTION 01 71 13

MOBILIZATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The work under this Bid Item consists of preparatory work including, but not limited to, work necessary for the mobilizing and furnishing at the site, equipment, materials, supplies and incidentals; for the establishment of all offices, buildings and other temporary facilities necessary for work on the project; cost for pre-paid bonds and insurances; and for all other work and operations which must be performed or costs incurred to begin work on the various Bid Items at the project site. Compensation for mobilization includes, but is not limited to, the following principal items:

1. Moving onto the site of all Contractors’ equipment required for operations.
2. Installing temporary construction power and wiring.
3. Providing all on-site communication devices, as necessary.
4. Obtaining and paying for all required bonds and insurances including the bond required by Article 2.4 of the Public Works Code.
5. Posting all OSHA-required notices and establishing safety programs.
6. Having the Contractor’s superintendent at the job site full time, whenever construction is in progress.
7. Preparing, updating, and submitting preconstruction submittals, including
   a. Construction Schedule as specified in Section 01 32 16, Network Analysis Schedules.

B. Owner will not approve a Schedule of Values that indicates a value for Mobilization that exceeds 1% of the Grand Total Bid Price, excluding the Mobilization and Allowance Bid Items themselves. Should the Mobilization amount exceed 1% of the Grand Total Bid Price, less the allowance items and mobilization items. Owner’s maximum payment for Mobilization will be 1% of the grand total bid price less the Allowance items and Mobilization items. 75% will be paid after mobilization, the remaining 25% will be paid after demobilization.

1.2 RELATED SECTIONS

A. Division 0 – General Conditions and Supplemental General Conditions
B. Section 01 33 00 – Submittals
C. Section 01 50 00 – Temporary Facilities and Controls
1.3 PAYMENT PROCEDURES

A. The Bid Item "Mobilization" will be paid as a Lump Sum after Mobilization is complete. Any extension of the contract time that may be granted will not of itself constitute grounds for a claim for additional payment under the Bid Item "Mobilization."

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION
SECTION 01 71 23
CONSTRUCTION SURVEYING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The work under this bid item consists of survey work including, but not limited to construction staking, and construction survey.

1.2 REQUIREMENTS

A. Contractor must perform all corner record, construction staking, and construction survey and the corner record survey using a land surveyor licensed in the State of California.

B. Corner Records must be developed and approved by the County Surveyor before requesting construction encroachment permits from the City of Richmond, City of Richmond, and State of California Department of Transportation. The Contractor must be aware that corner record and record of survey will take 6 weeks or more to record.

C. Contractor must provide a staking plan prior to commencement of work for Owner’s review.

D. Contractor must maintain monuments, stakes, and marks, and must update the plan as necessary.

1.3 NOT USED

1.4 LINE AND GRADE

Three consecutive points shown on the same rate of slope must be used in common, in order to detect any variation from a straight grade, and in case any such discrepancy exists, it must be reported to the Engineer. If such a discrepancy is not reported to the Engineer, the Contractor must be responsible for any error in the finished work.

The Owner’s Designated Representative may verify the field condition. Errors or inconsistencies in the contract documents discovered by the Contractor must be reported to the Owner’s Designated Representative within 24 hours and prior to constructing forms or related improvements. Any work installed with this requirement must be subject to removal and replacement at the Contractor’s expense.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION
SECTION 01 71 25

UTILITY POTHOLING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The work under this bid item consists of utility pothole as shown on the plans and at locations where Fuel Systems, Sewer, Gas, Water, Storm Drainage, Communications, Site Electrical and Lighting is shown on the plans as existing and/or to be installed.

1.2 REQUIREMENTS

A. The Contractor shall be responsible for identifying potential conflicts existing subsurface utilities and infrastructure prior to start of any excavations. Contractor shall provide the Engineer the locations of all underground infrastructure. Contractor shall receive written permission to pothole prior to starting pothole operations. Contractor shall identify all underground conflicts prior to the start of construction, and shall resolve all conflicts prior to installation of any and all underground work.

1.3 POTHOLING

A. Contractor shall pothole at the direction of the engineer on pothole for each of these locations confirmed by the Engineer. Based upon an inspection, verified by the Engineer, the contractor shall identify each potential utility conflict. Potholing shall be performed and the location of the utility in three planes shall be identified in size, material type and location recorded. Potholing should be performed to a depth of one foot below the bottom of the equipment’s foundation. The engineer shall determine the course of action for potential conflicts.

B. Plan notes specify that existing underground infrastructure locations are approximate. If there is a utility conflict that cannot be avoided, the utility shall be relocated on a force account basis.

C. Restoration of the pothole shall be made on a temporary hard surface in that case; the restoration shall be in like kind to the surface that prevailed prior to the potholing. If the area is concrete sidewalk, then the contractor shall remove pavement surface to the nearest score line and dowel #4 bars with 4-inch penetration 18-inches on center to the nearest undisturbed concrete for the perimeter of the restoration. Replacement concrete shall conform in thickness and material design strength as the City of Richmond standard.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

NOVEMBER 2015
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Administrative and procedural requirements for instructing AC TRANSIT’s personnel, including the following:
   a. Demonstration of operation of systems, subsystems, and equipment.
   b. Training in operation and maintenance of systems, subsystems, and equipment.
   c. Demonstration and training video recordings.

B. Related Sections:

1. Divisions 02 through 45 sections for specific requirements for demonstration and training for products in those sections.

1.2 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules utilizing manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Qualification Data: For facilitator and instructor.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.3 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.

1. Identification: On each copy, provide an applied label with the following information:
   a. Name of Project.
b. Name and address of videographer.

c. Name of Engineer.

d. Name of Contractor.

e. Date of video recording.

2. Transcript: Prepared on 8-1/2-by-11-inch paper, punched and bound in heavy-duty, three-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of project and date of video recording on each page.

3. At completion of training, submit complete training manual(s) for AC TRANSIT’s use.

1.4 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 40 00, Quality Requirements, experienced in operation and maintenance procedures and training.

C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.

D. Preinstruction Conference: Conduct conference at project site to comply with requirements in Section 01 31 00, Project Management and Coordination. Review methods and procedures related to demonstration and training including, but not limited to, the following:

1. Inspect and discuss locations and other facilities required for instruction.

2. Review and finalize instruction schedule and verify availability of educational materials, instructors’ personnel, audiovisual equipment, and facilities needed to avoid delays.

3. Review required content of instruction.

4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.5 COORDINATION

A. Coordinate instruction schedule with AC Transit operations. Adjust schedule as required to minimize disrupting AC Transit’s operations.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Engineer.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual specification sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
   a. System, subsystem, and equipment descriptions.
   b. Performance and design criteria if Contractor is delegated design responsibility.
   c. Operating standards.
   d. Regulatory requirements.
   e. Equipment function.
   f. Operating characteristics.
   g. Limiting conditions.
   h. Performance curves.

2. Documentation: Review the following items in detail:
   a. Emergency manuals.
   b. Operations manuals.
   c. Maintenance manuals.
   d. Project record documents.
   e. Identification systems.
   f. Warranties and bonds.
   g. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
   a. Instructions on meaning of warnings, trouble indications, and error messages.
   b. Instructions on stopping.
   c. Shutdown instructions for each type of emergency.
   d. Operating instructions for conditions outside of normal operating limits.
   e. Sequences for electric or electronic systems.
   f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:
   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Control sequences.
   f. Safety procedures.
   g. Instructions on stopping.
   h. Normal shutdown instructions.
   i. Operating procedures for emergencies.
   j. Operating procedures for system, subsystem, or equipment failure.
   k. Seasonal and weekend operating instructions.
   l. Required sequences for electric or electronic systems.
   m. Special operating instructions and procedures.

5. Adjustments: Include the following:
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.

7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.

8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 70 00, Execution and Closeout Requirements.

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and AC TRANSIT for number of participants, instruction times, and location.
B. Engage qualified instructors to instruct AC TRANSIT’s personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. AC Transit will furnish Contractor with names and positions of participants.

C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with AC Transit, through Engineer, with at least seven days’ advance notice.

D. Evaluation: At conclusion of each training module, assess and document each participant’s mastery of module by use of [an oral] [a written] [a demonstration] performance-based test.

E. Cleanup: Collect used and leftover educational materials and remove from project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Video Recording Format: Provide high-quality color video recordings with menu navigation in format acceptable to Engineer.

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.

D. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.

E. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

F. Pre-Produced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

PART 4 - MEASUREMENT AND PAYMENT (Not Used)

END OF SECTION
SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT

PART 1 – GENERAL

1.01 DESCRIPTION

A. This Section includes administrative and procedural requirements for the following:

2. Salvaging nonhazardous demolition and construction waste.
3. Recycling nonhazardous demolition and construction waste.
4. Disposing of nonhazardous demolition and construction waste.

1.02 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Disposal: Removal off-site of construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

C. Recycle: Recovery of construction waste for subsequent processing in preparation for reuse.

D. Salvage: Recovery of construction waste and subsequent sale or reuse in another facility.

E. Salvage and Reuse: Recovery of construction waste and subsequent incorporation into the Work.

1.03 PERFORMANCE REQUIREMENTS


B. Recycled and/or salvage for reuse a minimum of 50-percent of the nonhazardous construction and demolition waste or meet a local construction and demolition waste management ordinance, whichever is more stringent.

C. Utilize a waste management company that can provide verifiable documentation that the percentage of construction and demolition waste material diverted from the landfill complies with CALGreen Section 5.408.1.2.

D. Documentation shall be provided to the enforcing agency which demonstrated compliance with CALGreen Section 5.408.1.4.

F. 100-percent of trees, stumps, rocks and associated vegetation and soils resulting from land clearing shall be reused or recycled in compliance with CALGreen Section 5.408.3.

1.04 SUBMITTALS

A. Waste Management Plan: Submit a construction waste management plan and update as necessary. Identify the applicable jurisdiction and their requirements to regulate construction waste. Where the local jurisdiction does not have a construction and demolition waste management ordinance that is more stringent, furnish a construction waste management plan that meets the minimum requirements of the 2013 California Green Building Code and includes the following:
1. Identify the construction and demolition waste materials to be diverted from disposal by recycling, reuse on the project or salvage for future use or sale.

2. Note whether construction and demolition waste materials will be sorted on-site (source-separated) or bulk mixed (single stream).

3. Identify diversion facilities where the construction and demolition waste material will be taken.

4. Identify construction methods employed to reduce the amount of construction and demolition waste generated.

5. Specify if the amount of construction and demolition waste materials diverted shall be calculated by weight or volume, but not by both.

B. Waste Management Documentation: Provide copies of all waste management documentation submitted to the enforcing Authority Having Jurisdiction and any project correspondence or compliance documentation originating enforcing authority.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

3.01 SALVAGING DEMOLITION WASTE

A. Salvaged Items to the extent possible.

B. Salvaged Items for Sale and Donation: Resale or donation must occur off site, and is not permitted on the Project site.

C. Salvaged Items for Owner's Use: No items are identified to be salvage for Owner retention.

3.02 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. Recycle paper and beverage containers used by on-site workers.

B. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Manage waste to avoid mixing or contamination of recyclable materials with hazardous waste or other unsuitable materials.

D. Separate recyclable waste by type at Project site to the maximum extent practical.

1. Provide appropriately sized and marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

2. Inspect containers and bins for contamination and remove contaminated materials if found.

3. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

4. Stockpile materials away from construction area. Do not store within drip line of trees.

5. Store components off the ground and protect from the weather.

5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor at appropriate intervals. Do not allow materials to accumulate until the end of the project.
3.03 RECYCLING DEMOLITION WASTE
A. Recycle demolition waste to the maximum extent possible.
B. Segregate recyclable materials to the extent required by waste management facility.

3.04 RECYCLING CONSTRUCTION WASTE
A. Packaging:
   1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
   3. Wood Pallets and Crating: As much as possible, require deliveries using pallets or crates to remove pallets or crates from Project site. For pallets and crates that remain on-site, recycle whole if possible. Damaged or non-recyclable pallets or crates shall be recycled to comply with requirements for recycling wood.

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

END OF SECTION
PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Requirements of Division 1 apply to all Work in the Section.

1.02 SCOPE

A. Work Included:
   1. This section provides guidelines and limitations for supporting all mechanical, electrical, plumbing or architectural items from the building structure, and for seismic bracing for all such items.
   2. Design and install all support and bracing systems except as noted. Provide for attachment to portions of the building structure capable of bearing the loads imposed. Design systems to not overstress the building structure.

B. Work Not Included:
   1. The Contractor is not required to design support and bracing for items for which the contract documents provide specific attachment, support, and bracing. Items specifically noted in the CBC as not requiring bracing may be exempt from seismic bracing if all conditions of attachment in the CBC are compliant. Seismic bracing is not typically required for the following items:
      a. Gas piping less than 1 inch inside diameter.
      b. Piping for boilers and mechanical equipment less than 1.25 inches inside diameter.
      c. All other piping less than 2.5 inches inside diameter, unless racked together.
      d. All piping and duct suspended by individual hangers 12 inches or less in length with flexible connections.
      e. All rectangular air handling ducts less than 6 square feet in cross sectional area.
      f. All round air handling ducts less than 28 inches in diameter.
      g. All electrical conduits less than 2.5 inches inside diameter, unless racked together.

1.03 RELATED WORK (See also Table of Contents)

A. Structural Steel: Section 05 12 00.

B. Metal Fabrications: Section 05 50 00.

C. Information relating solely to mechanical or electrical work is included under those divisions, except as specifically indicated herein.

1.04 QUALITY ASSURANCE

A. General:
   1. Design and install all support systems to comply with the requirements of the 2013 California Building Code Chapter 16.
   2. For seismic bracing design of mechanical, electrical and plumbing systems engage the services of a structural engineer licensed in California.
   3. For guidelines regarding seismic bracing for mechanical, electrical and plumbing systems, refer to the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA), "Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems". Where SMACNA guidelines deviate from CBC requirements, CBC requirements shall govern.

B. Standards and References: (Latest Edition unless specified otherwise)
   1. The General Conditions, Supplementary Conditions, and applicable portions of Division 1 apply to the work of this Section as if printed herein.
2. If the year of the adoption or latest revision is omitted from the designation, it shall mean the specification, manual or test designation in effect the date of Notice to Proceed with the Work given.

C. Submittals: (submit under provisions of Section 01 33 00):
1. Submit shop drawings for all substructures and attachment methods.
2. Submit proposed alternative methods of attachment for review by the Architect, prior to deviating from the requirements given below.
3. For all seismic bracing systems of mechanical, electrical and plumbing systems, submit structural calculations and details prepared and signed by the Contractor's licensed engineer which include all resultant forces applied to the building structure. Do not overstress building structure. Calculations will be reviewed for compliance with design criteria, not for arithmetic.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Furnish all substructures and fasteners required to comply with the limitations given below. Use materials as specified in the various sections and as appropriate to the use.

B. All exterior materials: hot dipped galvanized or stainless steel.

PART 3 - EXECUTION

3.01 GUIDELINES AND LIMITATIONS

A. The General Contractor shall coordinate the load requirements from all sub-contractors so that no combination of loads exceeds the limitations given below without written approval.

B. Maximum Loading: Attach no loads greater than the following without specific approval of the Structural Engineer.
   3. Steel beams and girders: water and gas piping, electrical conduits, ducting and trapeze of same not to exceed 3.0 psf. Maximum load on a single span = 600#. Mechanical units hung from beams shall not exceed 1000# unless specifically indicated on structural plans.
   4. Cast-In-Place concrete slabs - ceilings, piping, conduit and ducts shall not exceed 10 psf. Maximum hanger load 600#. Mechanical units hung from slabs shall not exceed 800#.

3.02 SEISMIC BRACING

A. In applying formulas from Chapter 16 of the 2013 CBC the value for Ip (importance factor) shall be assumed to be no less than 1.0. See structural drawings for other seismic factors.

B. Design and install seismic bracing so as not to ground out vibration and sound isolation items.

END OF SECTION 01 84 15
PART 1 – GENERAL

1.01 DESCRIPTION

A. This Section includes administrative and procedural requirements and a detailed description of the commissioning process. Commissioning is intended to achieve the following objectives:

1. Verify the submittals for commissioned systems meet the requirements defined in the Specifications, and Construction Documents.
2. Verify that applicable equipment and systems are installed according to the manufacturer’s recommendations and that they receive adequate operational checkout by installers.
3. Verify and document that performance of equipment and systems is proper for the application and meets the Owner’s operational requirements.
4. Verify that Operations and Maintenance (O&M) Manuals are complete.
5. Verify that the Owner’s operating personnel are trained in accordance with the Specifications.

1.02 COORDINATION

A. The Commissioning Team includes, as applicable to the Project:

1. The Owner (or owner’s representative)
2. Commissioning Authority (CA). Not used for this project.
3. Architect and Design Engineers (A/E Team)
4. Construction Manager (CM). The Owner’s representative and designated administrator of the construction contract.
5. General Contractor (GC)
6. Sub-contractors (Subs)
7. Building operator (Operator), Owner’s Facility Maintenance Superintendent

B. Items listed below require coordination between members of the Commissioning Team. Details regarding these items are specified elsewhere in this Section. The activities listed below shall be successfully completed prior to Substantial Completion. Seasonal Tests deemed to be required shall not be a reason to delay Substantial Completion.

1. Integrate commissioning activities into the master schedule. Work with the CM to ensure that commissioning activities are properly shown.
2. Equipment Startup: Utilize Startup Plans to coordinate equipment startup, manufacturers’ testing, and other required testing to minimize duplication of work. Notify CM 10-days prior to Startup.
3. Prefunctional Tests: Utilize Prefunctional Tests provided by the CM, making note of any incomplete and deficit tests. Notify CM 10-days prior to Prefunctional Tests. Submit to the CM as soon as complete.
4. Testing, Adjusting, and Balancing (TAB): TAB work shall begin by the appropriate contractor after completion of and approval of Startup Plan and Prefunctional Tests by the CM. Notify CM 10-days prior to testing, adjusting, and balancing so that the CM may witness the processes. Submit TAB report to the CM as soon as it is completed.

5. Submittal of Operations and Maintenance Documentation: O&M Manuals, sequence of operations, suggested maintenance and preventative maintenance activities, and list of recommended spare parts shall be submitted to CM for approval prior to Functional Testing.

6. Functional Testing: Coordinate Functional Testing with the CM to witness and document testing. Completion and acceptance by CM of Prefunctional Tests, TAB reports, and Operations and Maintenance Manuals are required prior to scheduling Functional Testing. Submit these reports to the CM a minimum of 14-days prior to scheduling Functional Tests.

7. Training of building users and operations personnel: Submit training agenda(s) to CM for review and approval. Provide training to building users and operations personnel at the level necessary to impart the operational knowledge relevant to each group.

1.03 OWNER'S RESPONSIBILITIES

A. Provide the operational requirements to the CM and Contractor for information and use.

B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.

C. Provide the applicable basis of design documentation from the AE team and approved by Owner, to the CM and Contractor for use in developing the Commissioning Plan, systems manual, and operation and maintenance training plan.

1.04 CONTRACTOR'S RESPONSIBILITIES

A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:

1. Preparation of a project specific commissioning plan that list each system requiring commissioning and detailing specific commissioning requirements and activities.

2. Attend commissioning team meetings held on a variable frequency basis.

2. Integrate and coordinate commissioning process activities with construction schedule.

3. Review and accept construction checklists as work is completed and provide to the CM as soon as completed.

4. Review and accept commissioning process test procedures provided by the CM.

5. Complete commissioning process test procedures.

6. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.

7. Cooperate with the CM for resolution of issues recorded in the Issues Log.

8. Provide O&M Manuals and other supporting documentation described in other sections and compile a Systems Manual for Owner.

9. Provide Training Agenda to CM covering topics necessary to impart information to the building users, maintenance staff, and Owner.
10. Provide training to building users, maintenance staff, and Owner.

1.05 DEFINITIONS

A. OPR: Owner’s Project Requirements. A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

B. BoD: Basis of Design. A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

C. Commissioning (Cx) Process: A systematic process which verifies that the building systems perform as intended. The commissioning process coordinates system documentation, equipment startup, control system calibration, testing and balancing, and performance testing and training. Cx also assists in the coordination process to assure design, construction, and post-construction (warranty period) integration proceeds with intentional sequencing and scheduling of Cx requirements.

D. Components, Subsystems, Equipment, and Systems: Where these terms are used together or separately, they shall mean “as-built” components, subsystems, equipment, and systems.

E. Commissioning Authority (CA): A separate and independent commissioning authority will not be utilized for this project.

F. Startup Plan: A written program that documents the equipment’s readiness to be completed prior to the equipment’s Functional Tests. Manufacturer’s startup checklist is part of each Startup Plan. The Startup Plan is prepared by the Contractor and approved by CM. The Checklists are completed by the Contractor and verified by the Commissioning Authority through site visits, inspections, and review of the completed Startup Plan.

G. Prefunctional Tests (PT): A documented set of calibrations and tests designed to verify the systems are configured according to manufacturers’ requirements, specifications, and owner’s requirements. These tests provide the contractors’ assurance that the components and systems are ready for Functional Testing. TAB work is to be completed after all Prefunctional Tests and prior to Functional Testing. Prefunctional Tests are often completed at the same time as the Startup Plan.

H. Functional Test (FT): A documented test of the dynamic functioning and operation of equipment and systems with the goal of verifying that the Design Intent is met. Test procedures are developed and results documented by the Commissioning Authority. Test procedures are completed by the Contractor. Functional Testing generally begins with component calibration and proceeds through verification of equipment and systems integration.

1.06 COMMISSIONING PLAN

A. The Commissioning Plan is a project specific plan prepared by the Contractor. Where there is a conflict, the Specifications and Contract Documents take precedence over the Commissioning Plan.

B. The Commissioning Plan outlines the requirements commissioning process and integrates commissioning with the project schedule. The Commissioning plan shall include a checklist of each of the specific inspections, tests, documentation, training requirements, and CM acceptance of full system commissioning that shall be performed as part of the commissioning process for the project and assigns roles and responsibilities. A preliminary copy shall be issued for use during the initial Commissioning Kick-off Meeting. After the Kick-off Meeting, the Contractor shall log activities on the checklist, update and reissue the Commissioning Plan as needed and to the satisfaction of the CM. The checklist portion of the plan shall be updated and issued to the CM on a weekly basis during commissioning activities as a means of monitoring status.
PART 2 – PRODUCTS

2.01 TEST EQUIPMENT

A. Provide testing equipment, tools, and instruments required by the Commissioning.

B. Provide CM with a list of test equipment, serial numbers, and calibration certificates expected to be used in the testing process. Calibration certificates shall be dated within 12-months of when equipment is expected to be used. Lists shall be submitted for approval 30-days prior to Startup and Prefunctional Tests.

C. List of equipment and approved options, means of control and control sequencing, and setpoints shall be provided to CM by each subcontractor responsible for commissioned systems. Lists shall be submitted to Contractor 45-days from Submittal acceptance. Contractor shall submit completed list to CM within 10-days of receipt of lists.

PART 3 – EXECUTION

3.01 MEETINGS

A. Commissioning Kick-off Meeting: A commissioning scoping meeting shall be held within 60-working days after the Notice to Proceed. Attendance is mandatory for the entire Commissioning Team.

B. Other Meetings. The CM shall schedule other meetings, generally in conjunction with regularly scheduled site meetings. Meetings shall cover coordination, deficiency resolution, and planning issues.

3.02 SITE INSPECTIONS

A. Relevant subcontractors shall accompany the CM on up to 3 construction site visits prior to Functional Testing.

B. The Contractor shall correct deficiencies found during site visits within 7 days of receiving a Corrective Action Report (Issues Logs).

3.03 STARTUP PLANS

A. Undertake a full startup checkout of each piece of equipment. The Startup testing must be successfully completed prior to formal Functional Testing of that system.

B. Equipment shall not be “temporarily” started until it has been started up in accordance with the manufacturer’s written startup procedures as per the Startup plan.

C. Startup Plans: Prepare a Startup Plan for each piece of equipment listed in this Section and submit it for approval by the CM within 45-days of receiving approved equipment submittals (and at least 30-days prior to scheduled Startup). Startup Plans shall consist of:

1. The manufacturer’s standard written startup procedures per the manufacturer’s installation manuals, with check boxes by each procedure and a signature block at the end.

2. Equipment Manufacturer’s Installation, Operating & Maintenance instructions.

3. A schedule for the equipment installation, contractor startup, manufacturer’s startup, and other tests required by the specifications. Schedule shall state when Startup and completion is expected.

4. Field checkout sheets normally used by the sub-contractor.

5. Forms used by the sub-contractor to document tests required in the specifications.

6. The checklists for mechanical systems include sensor and actuator calibration.
D. The subcontractors shall complete the documentation per paragraph C during the startup of the equipment and submit the completed documentation to the CM prior to the scheduled Functional Testing. The CM shall accept or reject each Startup Plan submittal, noting each item with one of the following:

1. NO EXCEPTIONS NOTED
2. IMPLEMENT EXCEPTIONS NOTED
3. REVISE AND RESUBMIT
4. REJECTED

3.04 PREFUNCTIONAL TESTING REQUIREMENTS

A. Notify the CM 14-days prior to beginning Prefunctional Testing.
B. Complete checklist of Prefunctional Tests, noting any deficits in writing.
C. Submit the completed Prefunctional Tests to the CM.
D. Prefunctional tests may be done in conjunction with Startup procedures, though not to the exclusion of either the Startup procedure or the Prefunctional Tests.

3.05 TEST AND BALANCE REQUIREMENTS

A. Test and Balance (TAB) work shall start after Startup and Prefunctional Tests are completed and accepted by CM.
B. Notify CM 10-days prior to scheduled TAB work.
C. TAB work shall be conducted with “loaded” filters that are specified for occupancy.
D. Submit TAB report to CM for approval as soon as completed.

3.06 FUNCTIONAL TESTING REQUIREMENTS

A. Complete the following prior to Functional Testing:
   1. Coordinate with the Commissioning Authority to be present during Functional Testing.
   2. A minimum of 14-day notice to the CM is required prior to the scheduling of the Functional Testing.
   3. Completion and acceptance of the Startup Plan and Prefunctional Tests by CM.
   4. Correction of deficiencies identified during Startup and Prefunctional Tests. These will be identified through Issues Logs provided by CM.
B. Provide CM with access to the record documents.
C. Recording of pretest and final set points.
D. Use only the certified testing equipment provided in the list given to the CM.
E. Undertake Functional Testing after the listed activities are completed.
F. Perform Functional Testing under the observation of the Commissioning Authority who shall record the results of the Functional Test procedures.
G. Perform specified tests according to approved testing procedures and the following Control Signal Manipulation requirements:

1. Verify and test performance using actual conditions whenever possible.

2. Simulate conditions by imposing an artificial load when it is not practical to test under actual conditions and when written approval for simulated conditions is received from Commissioning Authority. Before simulating conditions, calibrate testing instruments. Set and document simulated conditions and methods of simulation. After test, return settings to normal operating conditions.

3. Alter set points when simulating conditions is not practical and when written approval to do so is received from Commissioning Authority.

4. Overwrite sensor values with a signal generator when actual or simulated conditions and altering set points are not practical. Do not use the sensor to act as the signal generator to simulate conditions or overwrite values.

H. The Commissioning Authority shall review and approve Functional Testing results. Deficiencies found during testing shall be corrected by the Contractor within 7-days of receiving an Issues Log from the CM. Deficiencies shall be retested without cost to the owner until accepted by the Commissioning Authority. Where there is a dispute over a deficiency, the Engineer shall be the final authority.

I. Problem Solving: The CM may recommend solutions to problems found, however the burden of responsibility to solve, correct, and retest problems is with the contractor.

J. All testing, retesting, and acceptance of Functional Testing shall be completed prior to Substantial Completion.

3.07 OPERATIONS AND MAINTENANCE DOCUMENTATION

A. Furnish a completed copy of the Operations and Maintenance Instructions to the CM. Follow the normal submittal procedure for this submittal. The CM shall accept or reject the submittal, noting it as one of the following:

1. NO EXCEPTIONS TAKEN

2. REVISE, NO RESUBMISSION REQUIRED

3. REVISE AND RESUBMIT

4. REJECTED

B. Finalize and make corrections to Record Documents as noted by the CM prior to Functional Testing.

3.08 OPERATIONS AND MAINTENANCE TRAINING

A. Coordinate and schedule demonstration & training for all commissioned systems.

B. Provide written agenda for targeted audience for approval by CM. Agenda to be submittal a minimum of 7-days prior to scheduled training.

C. Coordinate training of commissioned equipment with the CM who shall oversee and approve its content and adequacy.

D. Coordinate training with the owner who may provide videotaping services.

E. Separate training may be required for building users, maintenance staff, and owners.
F. In addition to these general requirements, specific training requirements for commissioned equipment may be specified other specification sections.

3.09 COST OF RETESTING

A. Costs for retesting beyond one retest shall be the responsibility of the Contractor if the CM determines that the Contractor is responsible for the deficiency. Where disputes occur, the Engineer shall make the final determination.

B. For a deficiency identified during functional retesting but not included in the approved Startup Plan, the Engineer shall direct and the Contractor shall retest the equipment until the CM accepts test results.

C. Retesting shall not be considered a reason for a claim of delay or for a time extension by the contractor.

D. Additional costs incurred by the CM for retesting systems which used unapproved Startup procedures or completed inadequately during Prefunctional Tests may be charged to the Contractor.

3.10 DEFERRED TESTING

A. Equipment requiring seasonal testing to properly assure equipment operations, as determined by the CM, shall require the Contractor to perform Functional Testing at a later time. At no time shall the testing extend beyond the warranty period.

B. Unforeseen Deferred Tests: Checks or tests not completed due to the required occupancy condition, or other condition may be delayed upon approval of the Engineer.

C. Warranty Review: CM may require contractor to perform additional testing when results from the Warranty Review suggest components, systems, or system's integration is failing during the warranty period.

3.11 COMMISSIONED SYSTEMS

<table>
<thead>
<tr>
<th>System</th>
<th>Equipment</th>
<th>Cx Level</th>
<th>O&amp;M Documentation</th>
<th>Owner Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVAC</td>
<td>Packaged Rooftop AC Units</td>
<td>5</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>HVAC</td>
<td>Exhaust Fans</td>
<td>5</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>HVAC</td>
<td>Split System Dx Cooling Units</td>
<td>5</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>HVAC</td>
<td>Ductwork Systems</td>
<td>3</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>HVAC</td>
<td>Variable Speed Drives</td>
<td>2</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>HVAC</td>
<td>Fire Smoke Dampers</td>
<td>2</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>HVAC</td>
<td>Duct Smoke Detectors</td>
<td>2</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>HVAC</td>
<td>Automatic Temperature Controls</td>
<td>5</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>HVAC</td>
<td>Demand Control Ventilation</td>
<td>3</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>HVAC</td>
<td>Testing, Adjusting and Balancing Air Handling Systems</td>
<td>3</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>HVAC</td>
<td>Ductwork</td>
<td>2</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Plumbing Systems</td>
<td>Domestic Hot Water Heating</td>
<td>3</td>
<td>v</td>
<td>Y</td>
</tr>
<tr>
<td>Plumbing Systems</td>
<td>Plumbing Fixtures</td>
<td>3</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Fuel Systems</td>
<td>Fuel Pumps</td>
<td>5</td>
<td>Yes</td>
<td>v</td>
</tr>
</tbody>
</table>
### Cx LEVELS DEFINED:

Level 1 - The CM will periodically observe and inspect the installation of equipment and systems and review project documentation (test reports) to verify operational requirements meet the contract documents.

Level 2 - The CM will periodically observe and inspect the installation of equipment and systems and review project documentation (test reports). The CM may spot check some of the system functions verify operational requirements are met.

Level 3 - The CM will periodically observe and inspect the installation of equipment and systems and review project documentation (test reports) and will witness contractor performance testing of the system. Contractor shall test up to 20% of the system to prove operational requirements are met. The test sections shall be chosen at random by the CM. Failure of any test section shall require retesting of that section and an additional test section equivalent in scope.

Level 4 - The CM will periodically observe and inspect the installation of equipment and systems and review project documentation (test reports) and will witness contractor performance testing of the system. Contractor shall test up to 20% of the system to prove operational requirements are met. The test sections shall be chosen at random by the CM. Failure of any test section shall require retesting of that section and an additional test section equivalent in scope.

### Table: AC Transit General Commissioning Requirements

<table>
<thead>
<tr>
<th>System</th>
<th>Equipment</th>
<th>Cx Level</th>
<th>O&amp;M Documentation</th>
<th>Owner Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Maint. Equipment</td>
<td>Operating and Powered Equipment</td>
<td>6</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Vehicle Maint. Equipment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conveying Equipment</td>
<td>Elevators</td>
<td>5</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Conveying Equipment</td>
<td>In-Ground Lifts</td>
<td>5</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Conveying Equipment</td>
<td>Mobile Column Lifts</td>
<td>5</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Electrical</td>
<td>Grounding and Bonding</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical</td>
<td>Lighting and Control Systems</td>
<td>4</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Electrical</td>
<td>Emergency Lighting</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical</td>
<td>Overcurrent Protective Devices</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical</td>
<td>Panel boards</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical</td>
<td>Transformers</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical</td>
<td>Generator</td>
<td>5</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Electrical</td>
<td>Automatic Transfer Switch</td>
<td>5</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Electrical</td>
<td>Fire Alarm System</td>
<td>5</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Communications</td>
<td>Telecom data cabling</td>
<td>5</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Communications</td>
<td>Security access control</td>
<td>5</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Communications</td>
<td>Security surveillance systems</td>
<td>5</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Communications</td>
<td>Paging system</td>
<td>5</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Storm Water Treatment</td>
<td>Stormwater treatment system</td>
<td>2</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

AC Transit
D3 Richmond Yard Reactivation P2095

GENERAL COMMISSIONING REQUIREMENTS
01 91 13- 8
50% of the system to prove operational requirements are met. The test sections shall be chosen at random by the CM. Failure of any test section shall require retesting of that section and an additional test section equivalent in scope.

Level 5 - The CM will periodically observe and inspect the installation of equipment and systems and review project documentation (test reports) and will witness contractor performance testing of the system. Contractor shall test up to 100% of the system to prove operational requirements are met. The test sections shall be chosen at random by the CM. Failure of any test section shall require retesting of that section and an additional test section equivalent in scope.

3.13 PROJECT CLOSEOUT

A. The commissioning process shall be completed when the systems operate according to the design Intent and the Contract Documents, as determined by the CM.

B. The commissioning process may continue past Substantial Completion of the Project, until all non-compliance issues have been resolved. Testing, retesting, and acceptance of Functional Testing (with exception of seasonal and warranty-period tests as identified in the Commissioning Plan) shall be completed prior to Final Completion.

END OF SECTION
PART 1 - GENERAL

1.01 SUMMARY
   A. Removing above-grade site improvements within limits indicated.
   B. Disconnecting, capping or sealing, and abandoning site utilities in place.
   C. Disconnecting, capping or sealing, and removing site utilities.
   D. Disposing of objectionable material.

1.02 RELATED SECTIONS
   A. Section 31 23 00 – Excavation and Fill.

1.03 DEFINITIONS
   B. CAL-OSHA: California Occupational Safety and Health Administration.

1.04 SUBMITTALS
   A. Follow Submittal procedure outlined in Section 01 33 00 – Submittal Procedures.

1.05 PROJECT CONDITIONS
   A. Except for materials indicated to be stockpiled or to remain the Owner's property, cleared materials are the Contractor's property. Remove cleared materials from site and dispose of in lawful manner.
   B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store where indicated on plans or where designated by the Owner. Avoid damaging materials designated for salvage.
   C. Unidentified Materials: If unidentified materials are discovered, including hazardous materials that will require additional removal other than is required by the Contract Documents, immediately report the discovery to the Owner. If necessary, the Owner will arrange for any testing or analysis of the discovered materials and will provide instructions regarding the removal and disposal of the unidentified materials.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS
   A. Backfill excavations resulting from demolition operations with on-site or import materials conforming to structural backfill defined in Section 31 23 00 Excavation and Fill.

PART 3 - EXECUTION

3.01 PREPARATION
   A. Protect and maintain benchmarks and survey control points during construction.
   B. Protect existing site improvements to remain during construction.

3.02 RESTORATION
   A. Restore damaged improvements to their original condition, as acceptable to the Owner.
3.03 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed or abandoned.

B. Arrange to shut off indicated utilities with utility companies or verify that utilities have been shut off.

C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless authorized in writing by the Owner, and then only after arranging to provide temporary utility services according to requirements indicated.

D. Coordinate utility interruptions with utility company affected.

E. Do not proceed with utility interruptions without the permission of the Owner and utility company affected. Notify Owner and utility company affected two working days prior to utility interruptions.

F. Excavate and remove underground utilities that are indicated to be removed.

G. Securely close ends of abandoned piping with tight fitting plug or wall of concrete minimum 6-inches thick.

3.04 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, and gutters, as indicated. Where concrete slabs, curb, gutter and asphalt pavements are designated to be removed, remove bases and subbase to surface of underlying, undisturbed soil.

C. Unless the existing full-depth joints coincide with line of pavement demolition, neatly saw-cut to full depth the length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.

D. Remove driveways, curbs, gutters and sidewalks by saw cutting to full depth. If saw cut falls within 30-inches of a construction joint, expansions joint, score mark or edge, remove material to joint, mark or edge.

3.05 BACKFILL

A. Place and compact material in excavations and depressions remaining after site clearing in conformance with Section 31 23 00 Excavation.

3.06 DISPOSAL

A. Remove surplus obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off the Owner’s property.

END OF SECTION
SECTION 02 41 19
SELECTIVE STRUCTURE DEMOLITION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Selective demolition and removal of portions of the existing building, as indicated and as required to perform the work.

1.02 DEFINITIONS

A. Remove: Remove and legally dispose of items except those indicated to be salvaged or to remain the Owner's property.

B. Remove and Salvage: Items indicated to be removed and salvaged remain the Owner's property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and bring to Owner's designated storage area within the building.

C. Remove and Reinstall: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Reinstall items in locations indicated.

D. Existing to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by the Architect, items may be removed to a suitable, protected storage location during selective demolition and then reinstalled in their original locations.

1.03 MATERIALS OWNERSHIP

A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain the Owner's property, demolished materials shall become the Contractor's property and shall be removed from the Project site.

1.04 SUBMITTALS

A. General: Comply with Division 01.

B. Proposed dust control measures.

C. Proposed noise control measures.

D. Schedule of selective demolition activities indicating the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.

2. Interruption of utility services.

3. Coordination for cutoff, capping, and continuation of utility services.

4. Use of elevator and stairs.

E. Inventory of items to be removed and salvaged, if any.

F. Inventory of items to be removed by Owner, if any.

G. Photographs or video, sufficiently detailed, of existing conditions, of adjoining construction and site improvements that might be misconstrued as damage caused by selective demolition operations.

H. Record drawings at Project closeout. Identify and accurately locate capped utilities and other subsurface structural, electrical, or mechanical conditions.
1.05 QUALITY ASSURANCE

A. Demolition Firm Qualifications: Engage an experienced firm that has successfully completed selective demolition work similar to that required for this Project.

B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction. Comply with noise and dust regulations of authorities having jurisdiction.

C. Pre-Demolition Conference: Conduct conference at the Project site. Review methods and procedures related to building demolition including, but not limited to, the following:
   1. Inspect and discuss condition of building to be demolished.
   2. Review structural load limitations of existing structure.
   3. Review and finalize schedule and verify availability of equipment, personnel, and facilities required.
   4. Review areas where existing construction is to remain and requires protection.
   5. Review methods for removing materials from the site.
   6. Review staging area for materials on the site.

1.06 PROJECT CONDITIONS

A. Owner assumes no responsibility for actual condition of buildings to be selectively demolished. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

B. Hazardous Materials: It is not expected that asbestos or other hazardous materials will be encountered in the demolition work. If any materials suspected of containing asbestos or other hazardous materials are encountered, do not disturb the materials. Immediately notify the Architect and the Owner. The Owner will arrange to have hazardous materials removed under a separate contract.

C. Storage or sale of removed items or materials on-site will not be permitted.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that utilities not to be re-used have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. When unanticipated mechanical, electrical, or structural elements that conflict with the intended function or design are encountered, investigate and measure the nature and extent of the conflict. Promptly submit a written report to the Architect.

E. Survey the condition of the building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of the structure or adjacent structures during selective demolition.

F. Perform surveys as the demolition work progresses to detect hazards resulting from selective demolition activities.

3.02 UTILITY SERVICES
A. Maintain existing utilities indicated to remain in service and protect them against damage during selective
demolition operations.

B. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services serving building to
be selectively demolished.

1. Arrange to shut off indicated utilities with utility companies.

2. Where utility services are required to be removed, relocated, or abandoned, provide bypass connections
to maintain continuity of service to other parts of the building before proceeding with selective demolition.

3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal the remaining
portion of pipe or conduit after bypassing.

3.03 PREPARATION

A. Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or
other dangerous materials before proceeding with selective demolition operations.

B. Conduct demolition operations and remove debris to ensure minimum interference with streets, walks, and other
adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission
from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed
traffic ways if required by governing regulations.

C. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to
remain. Ensure safe passage of people around selective demolition area.

1. Protect walls, ceilings, floors and other existing finish work that are to remain and are exposed during
selective demolition operations.

D. Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate
areas from fumes and noise.

E. Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent
movement, settlement, or collapse of building to be selectively demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

3.04 POLLUTION CONTROLS

A. Use water mist, temporary enclosures, and other suitable methods to limit the spread of dust and dirt. Comply with
governing environmental protection regulations.

1. Do not use water when it may damage existing construction or create hazardous or objectionable
conditions.

B. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris
to grade level.

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

3.05 SELECTIVE DEMOLITION

A. Demolish and remove existing construction only to the extent required by new construction and as indicated. Use
methods required to complete work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically. Complete selective demolition work above each floor or
tier before disturbing supporting members on lower levels.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. To minimize disturbance of adjacent surfaces, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.

3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.

5. Maintain adequate ventilation when using cutting torches.

6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.

8. Locate selective demolition equipment throughout the structure and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

9. Dispose of demolished items and materials promptly. On-site storage of removed items is prohibited.

10. Return elements of construction and surfaces to remain to condition existing before start of selective demolition operations.

B. Salvaged Items:

1. Sort and organize salvaged materials as they are removed from the structure.

2. Pack, crate or band materials to keep them contained and organized.

3. Store items in a secure and weather protected area until removed from the site or transferred to Owner.

4. Transport items to Owner’s storage area designated by the Owner.

5. Protect items from damage during transport and storage.

C. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition activities. When permitted by the Architect, items may be removed to a suitable, protected storage location during demolition and cleaned and reinstalled in their original locations after demolition operations are complete.

D. Demolish concrete and masonry in small sections. Cut concrete and masonry at junctures with construction to remain, using power-driven masonry saw or hand tools; do not use power-driven impact tools.

E. Remove air-conditioning equipment without releasing refrigerants.

3.06 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled or otherwise indicated to remain Owner’s property, remove demolished materials from the Project site and legally dispose of them.

1. Do not allow demolished materials to accumulate on site.

2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

3. Remove debris from elevated portions of building by chute, hoist or other device that will convey debris to grade level in a controlled descent.
3.07 CLEANING

A. Sweep the building broom clean on completion of selective demolition operation.

B. Change filters on air-handling equipment on completion of selective demolition operations.

END OF SECTION
PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Hazardous materials reports, drawings, and general provisions of the Contract, including Division 0, 1, and other related Specification Sections, Drawings, addenda and clarifications, apply to this Section.

1.02 SCOPE OF WORK

A. The work includes all removal, storage, transportation, and disposal of all asbestos-containing materials (ACM) and/or asbestos contaminated building materials, articles, and items as specified, shown or reasonably implied in the contract documents or discovered during work activities.

B. For a listing of asbestos identified at the Project Site refer to Vista Environmental Consulting's report titled “Pre-Renovation Hazardous Materials Survey Report, AC Transit Division 3 – Bus Maintenance Facility, 2016 MacDonald Avenue, Richmond, California” dated February 13, 2015.

C. The contractor is to review all contract documents and reports, and field verify quantities and locations of asbestos related work. Any discrepancies between the contractual bid set documentation and site visits must be submitted in writing to the Owner or Owner's representative, prior to bidding.

D. The contractor shall make sure that asbestos does not contaminate areas outside the regulated work areas. These areas include, but are not limited to, the interior of the building or the environment outside the building. If such contamination occurs, the contractor shall incur all costs associated with the decontamination of the areas. These costs include, but are not limited to, the Owner's Environmental Consultant fees and analytical fees deemed necessary by the Owner.

E. It is not the responsibility of the Owner's Environmental Consultant to supervise the Contractor; nor to direct the Contractor's work effort; nor to assume the management of, or responsibility for, the Contractor's health and/or safety practices, nor its waste management, nor its regulatory compliance. At all times, the Contractor shall be solely responsible for the quality and execution of all phases and aspects of the work.

1.03 REFERENCES

A. The following references are not an exhaustive list of all applicable federal, state, and local regulations, standards, laws, ordinances, and codes applicable to asbestos abatement work. The contractor shall perform all asbestos related work in accordance with the most recent edition of all applicable federal, state, and local regulations, standards, laws, ordinances, and codes and, where conflicts occur, the most stringent requirements shall be adhered to.

1. Code of Federal Regulations (CFR);

   a. 29 CFR 1910.12 - Construction Work

   b. 29 CFR 1910.134 – Respiratory Protection

   c. 29 CFR 1910.145 - Specifications for Accident Prevention Signs and Tags

   d. 29 CFR 1910.1001 - Asbestos – General Industry
1.04 DEFINITIONS

A. Definitions specific to Work of this Section:

1. Abatement: Procedures to control fiber release from asbestos containing building materials. Includes removal, repair, encapsulation, and enclosure.

2. Air Filtration Equipment: A portable air recirculation system equipped with HEPA filtration and used to cleanse air of particulate matter within an abatement area. Air filtration equipment is essentially the same as differential pressure equipment except it recirculates air instead of exhausting it.
3. Airlock: A system for permitting ingress and egress with minimum air movement between a contaminated area and an uncontaminated area.

4. Air Monitoring: The process of measuring the fiber content of a specific volume of air in a stated period of time.

5. Air Sampling Professional: The professional contracted or employed to conduct air monitoring and analysis schemes. This individual is also responsible for recognition of technical deficiencies in worker protection equipment and procedures during both planning and on-site phases of an abatement project.

6. Amended Water: Water to which a surfactant has been added.

7. Area Monitoring: Sampling of asbestos fiber concentrations within the asbestos Work Area and outside the asbestos Work Area that is representative of the airborne concentrations of asbestos fibers, which may reach the breathing zone.

8. Asbestos: The term asbestos includes chrysotile, amosite, crocidolite, tremolite, anthophyllite, and actinolite.

9. Asbestos-Containing Construction Material (ACCM): Any manufactured construction material that contains more than one tenth of one (>0.1%) percent asbestos by weight.

10. Asbestos Fibers: This expression refers to asbestos fibers longer than 5 micrometers with an aspect ratio of 3:1 or larger under PCM analytical procedures.

11. Asbestos Structure: The type of asbestos morphology that is counted during an analysis. The four types of asbestos structures are: Fiber, Bundle, Matrix, and Cluster.

12. Authorized Visitor: The Owner, Owner’s Representative, or a person of any regulatory or other agency having jurisdiction over the project.


14. Category II Non-Friable Asbestos Containing Material: Asbestos-containing material, excluding Category I non-friable asbestos-containing material, that, when dry, and in its present form, cannot be crumbled, pulverized, or reduced to powder by hand pressure.

15. Class I Asbestos Work: Activities involving the removal of thermal system insulation and surfacing asbestos-containing materials.

16. Class II Asbestos Work: Activities involving the removal of ACM, which is not thermal system insulation, or surfacing material. This includes, but is not limited to, the removal of asbestos-containing wallboard, floor tile and sheathing, roofing and siding shingles, and construction mastics.

17. Clean Room: An uncontaminated area or room, which is a part of the Worker decontamination enclosure with provisions for storage of Workers’ street clothes and personal protective equipment.

18. Critical Barrier: A temporary air tight and impermeable barrier that separates an asbestos work area from an adjacent potentially occupied area.

19. Decontamination Enclosure System: A series of connected rooms with airlocks between any two adjacent rooms for the decontamination of Workers, materials, and equipment. A decontamination enclosure system always contains at least one chamber.
20. **Differential Pressure Equipment**: A portable local exhaust system equipped with HEPA filtration and capable of maintaining constant, low velocity airflow into contaminated areas from adjacent uncontaminated areas.

21. **Encapsulant (sealant)**: A liquid material which can be applied to asbestos containing material and which controls the possible release of asbestos fiber from the material either by creating a membrane over the surface (bridging encapsulant) or by penetrating into the material and binding its components together (penetrating encapsulant).

22. **Encapsulation**: Procedures necessary to apply an encapsulant to asbestos containing building materials to control the possible release of asbestos fibers into the ambient air.

23. **Enclosure**: Procedures necessary to enclose completely asbestos containing material behind airtight, impermeable, permanent barriers.

24. **Equipment Room**: A contaminated area or room, which is part of the Worker Decontamination Enclosure with provisions for storage of contaminated clothing and equipment.

25. **Equipment Decontamination Enclosure**: That portion of a decontamination enclosure system designed for controlled transfer of materials and equipment typically consisting of an equipment room, a washroom, and a holding area.

26. **Excursion Limit**: A limit of 1.0 f/cc over a 30-minute sampling period to which employees may not be exposed in excess of.

27. **Friable Asbestos-Containing Material**: Material that contains more than one percent asbestos by weight and that can be crumbled, pulverized, or reduced to powder by hand pressure when dry.

28. **Fixed Louver**: A non-operable type louver equipped with a HEPA filter and mounted in the rigid doors or walls of a decontamination enclosure system.

29. **Fixed Object**: A unit of equipment or furniture in the Work Area, which cannot be removed from the Work Area.

30. **HEPA Filter**: A filter capable of trapping and retaining at least 99.97 percent of all mono-dispersed particles of 0.3 micrometers in diameter.

31. **HEPA Vacuum Equipment**: Vacuuming equipment with a HEPA filter system.

32. **Holding Area**: A chamber in the equipment decontamination enclosure located between the washroom and an uncontaminated area. The holding area includes an airlock.

33. **Movable Object**: A unit of equipment or furniture in the Work Area, which can be removed from the Work Area.

34. **Naturally-Occurring Asbestos - Asbestos that has not been processed in an asbestos mill.**

35. **Non-Friable Asbestos-Containing Material**: Material that contains asbestos in which the fibers have been locked in by a bonding agent, coating, binder, or other material so that the asbestos is well bound and will not release fibers in excess of the asbestos control limit during any appropriate use, handling, demolition, storage, transportation, processing or disposal.

36. **Permissible Exposure Limit**: An exposure of airborne concentrations of asbestos fibers in excess of 0.10 fibers per cubic centimeter of air as calculated over an 8-hour TWA.
37. Personnel Monitoring: Sampling of airborne asbestos fiber concentrations within the breathing zone of an asbestos worker.

38. Plasticize: To cover building surfaces with plastic sheeting as herein specified.

39. Regulated Asbestos-Containing Material (RACM): Friable asbestos-containing material; or, Category I nonfriable asbestos-containing material that has or will become friable, or subjected to sanding, drilling, grinding, cutting, or abrading; or Category II nonfriable asbestos-containing material that has a high probability of becoming crumbled, pulverized, or reduced to powder by the forces expected to act on the material in the course of demolition or renovation.

40. Removal: Procedures necessary to remove asbestos-containing materials from designated areas and to dispose of these materials at an acceptable waste disposal site or treatment facility.

41. Rigid Doorway: A device to allow ingress or egress from one room to another while permitting minimal air movement between the rooms. A rigid doorway typically consists of a solid panel door, gasketed to prevent air leakage, attached by hinges to a rigid doorframe. A lockset is required to secure door in the closed position.

42. Shower Room: A room between the clean room and the equipment room in the worker decontamination enclosure with hot and cold running water adjustable by the Worker and suitably arranged for complete showering during decontamination. The shower room includes an airlock between contaminated and clean areas.

43. Surfactant: A chemical wetting agent added to water to improve penetration and improve control of airborne fiber concentration.

44. Washroom: A room between the Work Area and the holding area in the equipment decontamination enclosure system. The washroom comprises an airlock.

45. Wet Cleaning: The process of eliminating asbestos contamination from building surfaces and objects by using cloths, mops, or other cleaning tools which have been dampened with water, and by afterwards disposing of these cleaning tools as asbestos-contaminated waste.

46. Work Area: Designated rooms, spaces, or areas of the project in which asbestos abatement actions are to be undertaken or which may become contaminated as a result of such abatement actions. A contained Work Area is a Work Area, which has been sealed and equipped with a decontamination enclosure system. A non-contained Work Area is an isolated or controlled-access Work Area, which has not been sealed nor equipped with a decontamination enclosure system.

47. Worker Decontamination Enclosure System: That portion of a decontamination enclosure system designed for controlled passage of Workers, other personnel, and authorized visitors. It typically consists of a clean room, a shower room, and an equipment room.

48. Work Shift: A crew or crews at a contiguous contained or contiguous demarcated work site performing work items for a continuous period of time excluding work breaks.

1.05 SUBMITTALS

A. Requirements are as set forth in Division 1 Specification Sections for items required to be submitted under this section.

B. Product data shall include manufacturer's product data, specifications, samples and application instructions and other pertinent information as necessary.
C. Quality Assurance Submittals: Refer to Article 1.06.

D. Alternatives: Product substitution submittal shall be in accordance with the Division 0 and 1.

E. A detailed site specific work plan based on scope of work. Include diagrams showing containment set-up, decontamination unit(s), location of negative air machine(s), and exhaust placement.

F. Master schedule, showing phasing, number of shifts, time for air clearances, tear down and manpower loading to be utilized for the duration of the project.

1.06 QUALITY ASSURANCE

A. Qualification: In order to meet with the Contract Time set forth in Division 1, submit the following documents.

1. Registration: Submit copy of the registration for Asbestos-Related Work from the Division of Occupational Safety and Health in accordance with Title 8, Chapter 3.2, Subchapter 2, Article 2.5 of the California Code of Regulations.

2. License: Submit copy of State of California, Contractors State License Board license with C-22 and ASB classifications.

3. Personnel Training for Abatement Superintendent and Foreman: Submit copy of current certificates which verifies that each superintendent and foreman has successfully completed an EPA approved Asbestos Abatement Contractor/Supervisor Course.

4. Personnel Training for Abatement Workers: Submit copy of the asbestos abatement employee training program, and current certificates which verify that each employee has successfully completed an EPA approved Asbestos Abatement Worker Course.

5. Personnel Training for all Non-Abatement Trades: Submit copy of the asbestos abatement employee training program, and current certificates which verify that each employee has successfully completed an Asbestos Awareness Course meeting the requirements of 8 CCR 1529 and 8 CCR 5208.

6. Respirators: Submit a written standard operating procedure governing selection, fit-testing, and use of respirators in accordance with Title 8, Section 5144 and Section 1529. Also submit manufacturer's certification that the respirators to be used in this project comply with these regulatory requirements.

7. Medical Examination: Submit proof that personnel who will be entering contaminated areas have had medical examinations, and furnish the results of said exam to the Owner and signed by the medical examiner. Comply with Title 8, Section 3204 for access to employee exposure and medical records, and make such records available to the Owner upon request.

a. Before exposure to airborne asbestos, provide each employee with a comprehensive medical exam meeting the requirements of 8 CCR 1529 and 8 CCR 5144.

b. Submit an employee roster to the Owner for each Work Shift.

8. Transportation of Friable and Non-Friable Asbestos Containing Materials: Submit proof that the Contractor or subcontractor is a registered hazardous waste transporter with the State of California and Department of Toxic Substances Control.

9. Waste Sites: Submit for approval the name, class, address, EPA I.D. number and telephone number of hazardous and non-hazardous waste site(s) to be utilized for disposal.
10. Waste Profiles: Submit all waste profiles.

11. Copies of all transport manifests, trip tickets and disposal receipts for all waste materials removed from the work area within 48 hours of the transport, to the Owner or Owner's Representative.

B. Notifications, Communications and Postings: Subcontractor shall notify the Owner at the same time each notification is issued; properly identify each notification for the Owner.

1. Submit copies of notifications to all appropriate government agencies, including the following:
   a. Division of Occupational Safety and Health - Occupational Carcinogen Control Unit: Notification shall be in accordance with Section 341.9 of Title 8 of the California Code of Regulations.
   b. BAAQMD
   c. Copies of government agency correspondence shall be included in the submittals.
   d. Secure approval of local police and fire departments having jurisdiction of the proposed security and safety plans for the work prior to submittal to the Owner. Contact both departments for the requirements of the approval process.

2. Safety Compliance: In addition to detailed requirements of this Specification, comply with laws, ordinances, rules, and regulations of federal, state, regional, and local authorities regarding handling, storing, transporting, and disposing of asbestos waste materials. Comply with applicable requirements of the current issue of 29 CFR 1910.1001, and 40 CFR 61, Subparts A & M, 40 CFR 61.152, and Title 8, Section 1529. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting Work. Where requirements of this Specification and reference documents vary, the most stringent requirement shall apply.

3. The Contractor shall have at least one copy each of 29 CFR 1910, Subpart I, 29 CFR.1910.1001; 40 CFR Part 61, Subparts A & M; and Title 8, Section 1529, at his office and also at the job site.

4. Before the commencement of any Work at the site, post bilingual EPA and CAL/OSHA danger signs in and around the Work Area to comply with EPA and OSHA regulations.

C. Field Air Sampling: Personnel monitoring and other monitoring which is required by law or considered necessary by the Contractor for Worker protection shall be the responsibility of the Contractor and performed by the Contractor's Air Sampling Professional. The Contractor shall disclose any interest they may have in the firm or laboratory performing the Field Air Sampling or analysis.

D. Certifications:

1. Equipment Certification: Submit manufacturer's certification that vacuums, differential pressure equipment filters, and other local exhaust ventilation equipment conform to ANSI Z9.2-2006.

2. Rental Equipment: When rental equipment is to be used in removal areas or to transport waste materials, a copy of the written notification provided to the rental company informing them of the nature of use of the rented equipment shall be submitted to the Owner's Construction Supervisor and signed by the rental company.

3. Land Disposal Restrictions: Submit a copy of the completed Notice and Certification with each Hazardous Waste Manifest for wastes intended for land disposal pursuant to Title 22, Section 67740, to
the Owner’s Construction Supervisor and signed by the generator.

4. For HEPA-filtration systems and vacuums submit the results of on-site DOP or Portacount testing of required efficiency.
   a. Testing must include not only testing at the inlet, but also around the exterior housing of the filtration system including the control panel, wheels and exterior seams, rivets, and bolts.
   b. HEPA-filtration systems which pass testing at the filter, but fail testing of the housing may only be utilized within the work area as Air Filtration Equipment.

1.07 EMERGENCY PLANNING

A. Emergency planning and procedures shall be developed by Contractor prior to abatement initiation.

B. Emergency procedures shall be in written form and prominently posted. Contractor shall ensure that all persons entering the work area read these procedures and understand the Project site layout, location of emergency exits and emergency procedures.

C. Emergency planning shall include considerations of fire, explosion, electrical hazards, slips, trips and falls, confined spaces, earthquakes and heat related injury. Written procedures shall be developed and employee training in procedures shall be provided by Contractor.

D. Employees shall be trained in evacuation procedures in the event of work place emergencies.

   1. For non-life threatening situations, employees injured or otherwise incapacitated shall decontaminate following normal procedures with assistance from fellow workers, if necessary, before exiting the work place to obtain proper medical treatment.

   2. For life threatening injury or illness, worker decontamination shall take least priority. After measures to stabilize the injured worker, remove him from the work place and secure proper medical treatment.

      a. Telephone numbers of all emergency response personnel shall be prominently posted in the clean and equipment rooms.

1.08 FIRE PROTECTION

A. All plastic, spray-on strippable coatings, and structural materials used in the asbestos abatement process shall be UL-approved and certified as fire retardant or noncombustible.

B. Wood shall be pressure impregnable and certified as fire retardant.

C. Safety Data Sheets (SDS) for fire retardant materials shall be made available upon request.

D. All combustible rubbish and debris, including properly bagged asbestos shall be properly disposed of at the end of each working day.

E. A minimum of one (1) 4A/60BC dry-chemical extinguisher shall be maintained at each of the following locations:

   1. At each corner of the work area. Where no clear corners exist, four (4) extinguishers shall be placed around the exterior wall of the work area so that they are approximately 25 percent of the total distance apart.

      a. Exception: Where total contained work area is less than 1,000 square feet, two (2) 4A/60BC
extinguishers shall be provided. All extinguishers shall be clearly identified with red tape.

2. Contractor shall ensure that on site personnel are aware of the location and proper use of all extinguishers and other fire/life safety equipment.

F. All existing fire detection, alarm systems, connections and standpipes shall remain in place, active and unobstructed. Any alteration must be approved by Owner.

PART 2 – PRODUCTS

2.01 GENERAL
A. Submit manufacturer’s product data, including Safety Data Sheets (SDS) for all the items listed under Part 2 – Products.

2.02 PROTECTIVE COVERING (PLASTIC)
A. Fire retardant polyethylene sheets 6 mil and 4 mil in sizes to minimize frequency of joints, approved and listed by the State Fire Marshal per appropriate sections of the California Health and Safety Code.

2.03 TAPE, ADHESIVE, SEALANTS
A. Duct tape 2 inches or wider, or equal, capable of sealing joints of adjacent sheets of plastic sheets and for attachment of plastic sheet to finished or unfinished surfaces of dissimilar materials and capable of adhering under both dry and wet conditions.
B. Spray adhesive for sealing polyethylene to polyethylene shall contain no methylene chloride compounds.

2.04 PROTECTIVE PACKAGING
A. Appropriately labeled 6 mil (or double 3 mil) sealable polyethylene bags as a minimum.
B. Bilingual labels (English and Spanish) on containment glove bags, waste packages, contaminated material packages and other containers shall be in accordance with EPA or OSHA standards.

2.05 WARNING LABELS AND SIGNS
A. As required by Title 8, Section 1529, Title 8, Section 5194 and BAAQMD.

2.06 REMOVAL AND ENCAPSULATION
A. Surfactant (wetting agent) shall be a 50/50 mixture of polyoxyethylene ether and polyoxyethylene ester, or equivalent, mixed in proportion of 1 fluid once to 5 gallons.
B. Encapsulating agent shall not be flammable and should not be solvent-based or utilize a vehicle (the liquid in which the solid parts of the encapsulant are suspended) consisting of hydrocarbon.
C. Mastic removal solvents shall NOT be, or create, a RCRA waste, and shall be of the low odor variety.

2.07 PERSONAL PROTECTIVE EQUIPMENT
A. Personal Protective Equipment shall comply with the requirements of Title 8, 1529.
B. Work clothes shall consist of fire retardant, disposable, full-body coveralls, head covers, foot wear, and gloves, in accordance with Title 8, Section 1529, and ASTM standards. Sleeves at wrists and cuffs at ankles shall be secure.

C. Eye protection and hard hats shall be available as required by applicable safety regulations and shall conform to ANSI Z87.1-2003 and Z89.1-1986.

D. Provide authorized visitors with suitable protective clothing, headgear, eye protection, and footwear whenever they are required to enter Work Area.

2.08 RESPIRATORS

A. Provide all workers, foremen, superintendents, authorized visitors, and inspectors personally issued and marked respiratory equipment jointly approved by NIOSH/MSHA. When respirators are employed, provide sufficient filters for replacement as recommended by manufacturers or this specification. Selection of respirators shall be made according to the guidance of Title 8, Section 1529, Title 8, Section 5144; and Table I of this section.

B. The minimum respiratory protection required for this project is as follows (See also Table I of this section):

1. Use either full face or half face negative pressured air purifying respirators for the following tasks:
   a. Pre-construction sealing of openings and penetrations to the work areas with plastic sheeting,
   b. Decontamination of tools and other removable items,
   c. Loading asbestos-containing drums on truck for transportation and unloading bags at approved landfill,
   d. During final wipe down of workspace; and
   e. Owner or their environmental consultant will consider alternate respiratory protection systems proposed by the Contractor. The Contractor must provide documentation that asbestos levels during previous, comparable jobs were within the protection factors of the respirators to be used as outlined in Table I. The use of the following type of respirators is contingent upon approval by Owner and their environmental consultant.
## TABLE I

<table>
<thead>
<tr>
<th>Maximum Airborne Fiber Concentration Outside Respirator*</th>
<th>Protection Factor</th>
<th>Minimum Acceptable Respirator**</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1 fiber/cc</td>
<td>10</td>
<td>Half-mask air-purifying respirator, other than a disposable respirator, equipped with high efficiency filters</td>
</tr>
<tr>
<td>0.5 fibers/cc</td>
<td>50</td>
<td>Full face piece air-purifying respirator equipped with high efficiency filters or Type “C” supplied air respirators, full face piece, demand mode</td>
</tr>
<tr>
<td>10.0 fibers/cc</td>
<td>1,000</td>
<td>Full face piece powered air-purifying respirator equipped with high efficiency filters or Type “C” supplied air respirators, full face piece, pressure demand mode.</td>
</tr>
<tr>
<td>Over 10.0 fibers/cc</td>
<td>10,000</td>
<td>Self-contained breathing apparatus (SCBA), full face piece, pressure demand mode</td>
</tr>
</tbody>
</table>

Disposable single use respirators are not to be worn for protection against asbestos.

*Must demonstrate that the fiber levels will not exceed 0.01 f/cc inside the respirator using the respirator protection factor formula.

**Greater respiratory protection is always acceptable regardless of asbestos concentrations.

2. Use high efficiency powered air-purifying respirators (PAPR) for the following provided maximum airborne fiber concentration outside the respirator is at or below 1.0 fibers/cc:

   a. All Class 1 work.

3. Alternate respiratory protection systems proposed by the Contractor will be considered by the Owner’s Environmental Consultant. Documentation must be provided by the Contractor that asbestos levels during previous, comparable jobs within the prior 12 months were within the protection factors of the respirators to be used as outlined in Table I. The use of the alternate respiratory protection systems is contingent upon approval by the Owner’s Environmental Consultant.

4. Provide workers with approved, permanent, personally-issued and marked respirators with replaceable filters. Provide sufficient quantity of filters approved by NIOSH for use in asbestos environments so that workers can change filters as required by manufacturer during the workday. Filters shall not be used any longer than one workday. New, unused, and factory sealed, respirator filters shall be stored at the job site in the Clean Room and shall be totally protected from exposure to asbestos prior to their use.

2.09 VENTILATION EQUIPMENT

A. Provide differential pressure equipment. This equipment shall have intact and properly installed HEPA filtration systems in compliance with ANSI Z9.2-2006, local exhaust ventilation. No air movement system or air filtering equipment shall discharge unfiltered air outside the Work Area. A minimum of negative 0.02 column inches of water pressure differential, relative to the outside pressure, shall be maintained inside the work area, during abatement, as evidenced by manometric measurements. Replace HEPA and preliminary filters when filters become clogged with particulate matter. Ventilation of the Work Area is to move contaminated air away from the breathing zone of employees and toward a filtration or collection device equipped with a HEPA filter. Provide enough air filtration devices within the Work Area to maintain fiber levels within the protection factors of workers’ respirators and to provide at least 4 air changes per hour.
PART 3 – EXECUTION

3.01 PROJECT PROCEDURES:

A. Abatement Procedure Plans: Submit a detailed site specific plan of the work procedures for abatement and painting of asbestos-containing materials. Include, at a minimum, the following:

1. Methods of removal and phasing of abatement.
2. Schedule of abatement.
3. Procedures for protecting workers, visitors, and employees and protection of spaces outside Work Area from contamination.
4. Plans for decontamination facilities.
5. Personnel monitoring procedures in accordance with Title 8, Section 1529.
6. Warning Sign locations as per Title 8, Section 1529.

B. Emergency Precautions and Procedures

1. Establish emergency and fire exits from the Work Area.
2. The Contractor shall be prepared to administer first aid to injured personnel after decontamination. Seriously injured personnel shall be treated immediately or evacuated without delay for decontamination. When an injury occurs, the Contractor shall stop Work and implement fiber reduction techniques (e.g., water spraying) until the injured person has been removed from the Work Area.

C. Worker Protection Procedures (Bilingual: English and Spanish) – To Be Posted in Clean Room.

1. Each Worker and authorized visitor shall, upon entering the job site: Remove street clothes in the Clean-Change Room and put on a respirator and clean protective clothing before entering the Equipment Room or the Work Area.
2. Workers shall, each time they leave the Work Area: Remove gross contamination from clothing before leaving the Work Area; proceed to the Equipment Room and remove clothing except respirators; still wearing the respirator, proceed to the showers; clean the outside of the respirator with soap and water; remove the respirator; thoroughly wash themselves.
3. Contaminated work footwear shall be stored in the Equipment Room when not in use in the Work Area. Upon completion of asbestos abatement, dispose of footwear as contaminated waste or double bag and transport to next regulated work area.
4. Workers shall not eat, drink, smoke, or chew gum or tobacco while in the Work Area.
5. Workers and Authorized visitors with beards shall not enter the Work Area unless equipped with respirators approved for use with beards.

3.02 PREPARATION

A. Work Areas (General):
1. Contractor shall shut down, lock out, and tag-out electric power to all Work Areas.
2. Contractor shall provide temporary power and lighting sources, insure safe installation of temporary power sources and equipment by compliance with all applicable electrical code requirements and Cal/OSHA requirements for temporary electrical systems. Protect each circuit with a Ground Fault Circuit Interrupter (GFCI) of proper size located in the temporary panel.

3. Shut down and isolate heating, cooling, ventilation air systems to prevent contamination and fiber dispersal to other areas of the structure. During the Work, vents within the Work Area shall be sealed with tape and plastic sheeting and/or as shown on plans.

4. Do not begin Work until area is free of loose equipment.

5. Pre-clean fixed objects within the proposed Work Areas, using HEPA filtered vacuum equipment and/or wet cleaning methods as appropriate, and enclose with protective barriers of plywood covered with minimum 4 mil plastic sheeting sealed with tape.

6. Seal off openings, including but not limited to corridors, doorways, ducts, grills, diffusers, and any other penetrations of the Work Areas, with plastic sheeting sealed with tape. Doorways and corridors which will not be used for passage during work must be sealed with barriers.

7. Install sufficient quantity of pressure differential systems consisting of HEPA-Equipped, DOP tested machines.

8. Install and maintain a manometer equipped with a strip chart recorder and zero calibrate. A minimum of negative 0.02 column inches of water pressure differential, relative to the outside pressure, shall be maintained inside the work area, during abatement.

9. Install asbestos barrier tape within twenty feet of perimeter of building or designated work area.

10. Install Decontamination Enclosure System with the proper number of chambers and decontamination equipment or equivalent prefabricated portable decontamination units as approved.

11. Install view ports which allow outside observation of all stripping and removal of ACM.

12. Maintain emergency and fire exits from Work Areas.

B. Asbestos abatement work shall not commence until:

1. Arrangements have been made for disposal of waste at an acceptable site.

2. Arrangements have been made for containing and disposal of waste water resulting from wet stripping.

3. Work areas and parts of the building required to remain in use are effectively segregated.

4. Applicable notices posted and permits obtained.

5. Differential pressure systems and calibrated manometer are installed and operating.

6. Tools, equipment, and waste bins are on hand.

7. Arrangements have been made for building security.

8. The contractor's work plan has been reviewed and approved by the Owner or Owner's Environmental Consultant.
C. Decontamination Enclosure System (General):
   1. Construct Decontamination Enclosure System with suitable framing. Walls and floor of Decontamination Enclosure System shall be lined with a minimum of 2 layers of 6 mil polyethylene sheeting sealed with duct tape.
   2. Access between contaminated and uncontaminated rooms or areas shall be through a curtained airlock.

D. Maintenance of Enclosure Systems:
   1. Ensure that barriers and plastic linings are effectively sealed and taped. Repair damaged barriers and remedy defects immediately upon discovery.
   2. Visually inspect enclosures at the beginning of each work period.

3.03 ASBESTOS REMOVAL (GROSS REMOVAL TECHNIQUE)

A. Spray asbestos material with amended water, using spray equipment capable of providing a "mist" application to reduce the release of fibers. Saturate material sufficiently to wet it to substrate without causing excess dripping or de-lamination of the material. Spray asbestos material repeatedly during work process to maintain wet condition and to minimize asbestos fiber dispersion.

B. Remove saturated asbestos material in small sections. As it is removed, pack material in sealed, properly labeled plastic bags of 6 mil minimum thickness and place in labeled containers for transport. Material shall not be allowed to dry out prior to insertion into container.

C. The Contractor shall carry out all asbestos removal activities in a manner that will minimize pulverizing, breaking or creation of dust. Generally, manual removal methods will be preferred, although larger systems, such as power washers, are acceptable, as long as they are equipped with proper HEPA-filtration equipment and do not create an undue hazard.

D. Seal and secure filled containers. Place labels on bags and containers in accordance with Title 8, Section 1529, Title 8, Section 5194 and BAAQMD. Disposal procedure and clean up shall be in accordance with Title 8, Section 1529. Store filled secured containers in an approved container area.

E. After completion of stripping work, surfaces from which asbestos has been removed shall be wire brushed and/or wet sponged or cleaned by an equivalent method to remove all visible material and residue. During this work the surfaces being cleaned shall be kept wet.

F. Vacuum cleaners equipped with HEPA filters shall be used collect all debris and dust containing asbestos.

G. On the perimeter beams and around stairwells and other core walls to remain remove fireproofing to the extent necessary to facilitate construction of an enclosure system and re-fireproofing. Removal adjacent to these areas shall be done manually to ensure that areas removed can be re-fireproofed and so that water/blast media does not penetrate the building envelope.

H. Notify the Owner and the Owner's Observation Service in writing 24 hours in advance that the Work Area is ready for visual inspection review. During visual inspection the Owner's Observation Service shall verify that all surfaces in the Work Area are free from all visible material and residue. Otherwise, repeat wire brushing and/or wet sponging and cleaning as above until the Work Area is in compliance.

I. After written notification to proceed from the Owner's Observation Service that the Work Area passed visual inspection, encapsulate all surfaces within the work area.
J. After encapsulation notify the Owner and the Owner's Observation Service in writing that the Work Area is ready for air clearance sampling. A minimum of 12 hours is needed between encapsulation and air clearance sampling to allow for adequate drying. If air sampling fails air clearance criteria, repeat cleaning and/or application of encapsulant until the work area is in compliance.

3.04 ASBESTOS REMOVAL – ROOFING MATERIALS

A. Roofing Material shall be removed in an intact state to the extent feasible. Wet methods shall be used to remove roofing materials that are not intact, or that will be rendered not intact during removal, unless such methods are not feasible or will create safety hazards.

B. Cutting machines shall be continuously misted during use, unless a competent person determines that misting substantially decreases worker safety. When removing built-up roofs with asbestos-containing roofing felts and aggregate surface using a power roof cutter, all dust resulting from the cutting operation shall be collected by a HEPA dust collector, or shall be HEPA vacuumed by vacuuming along the cut line. When removing built-up roofs with asbestos-containing roofing felts and a smooth surface using a power roof cutter, the dust resulting from the cutting operation shall be collected by a HEPA dust collector, or shall be HEPA vacuumed by vacuuming along the cut line, or by gently sweeping and then carefully and completely wiping up the still-wet dust and de-bris left along the cut line.

C. Seal filled containers. Place labels on containers in accordance with Title 8, Section 1529, Title 8, Section 5194 and SMAQMD Rule 902, Asbestos.

D. Asbestos-containing materials that have been removed from a roof shall not be dropped or thrown to the ground. Unless the material is carried or passed to the ground by hand, it shall be lowered to the ground via covered, dust-tight chute, crane or hoist. Any ACM that is not intact shall be lowered to the ground as soon as practicable, but in any event no later than the end of the work shift. While the material remains on the roof it shall be kept wet, placed in an impermeable waste bag, or wrapped in plastic sheeting. Upon being lowered to the ground, unwrapped material shall be transferred to a closed receptacle in such a manner so as to preclude the dispersion of dust.

E. Notify the Owner and the Owner's Observation Service in writing 24 hours in advance that the Work Area is ready for visual inspection review. During the visual inspection the Owner's Environmental Consultant shall verify that all surfaces in the work area are free from all visible material and three dimension residue. Otherwise cleaning shall be repeated until the Work Area is in compliance.

3.05 DISPOSAL

A. Waste Transportation: Submit the method of transport of hazardous and non-hazardous waste including name, address, EPA I.D. number (If applicable) and telephone number of transporter.

B. Waste Sites: Submit for approval the name, class, address, EPA I.D. number and telephone number of hazardous and non-hazardous waste site(s) to be utilized for disposal.

C. Waste Profiles: Abatement contractor is responsible for profiling all waste streams at the start of the project. Waste streams shall be segregated for required disposal testing. Contractor is responsible to test said materials in accordance with all Federal, State and local laws. Contractor must separate non-hazardous waste from hazardous waste. Contractor is to test all wastewater prior to release into the sanitary sewer drain in accordance with local and State water standards.

D. Waste Manifests: Submit for approval at the pre-construction meeting a filled out hazardous and/or non-hazardous waste manifest form(s). Obtain necessary information for this purpose from the Owner. Give a copy of the Waste Manifest and the weight ticket from the landfill to the Owner's Environmental Consultant for each required shipment.
E. Notify the Owner and the Owner's Observation Service in writing 48 hours in advance of the time when contaminated materials are to be removed from the site.

F. The Contractor shall be responsible for safe handling and transportation of hazardous waste generated by this Contract to the designated Waste Site.

G. The Contractor shall hold the Owner and Owner's Environmental Service harmless for claims, damages, losses, and expenses against them, including attorney's fees arising out of or resulting from asbestos spills on the site or spills en-route to the disposal site.

3.06 AIR MONITORING

A. Area Air Monitoring:

1. Throughout the abatement process area air monitoring may be performed by the Owner's Environmental Consultant to ensure Work is done in conformance with fiber concentration limits of this section.

2. If area air monitoring results analyzed by Phase Contrast Microscopy, NIOSH 7400 Methodology, outside the Work Area are in excess of 0.01 fibers per cubic centimeters (f/cc) of air, the Contractor shall make changes in work procedures to assure compliance with these minimum standards.

B. Personnel Air Monitoring:

1. The Contractor shall submit written reports to the Owner's Environmental Consultant of the Contractor's personnel air monitoring within twenty-four hours of the end of the previous day's shift. Personnel air monitoring shall not exceed the levels recommended for the type of respiratory protection in use.

C. Air Clearance Sampling:

1. Air clearance release criteria is when all samples collected in each work area are equal to or below 0.01 fibers per cubic centimeters (f/cc) of air analyzed by Phase Contrast Microscopy, NIOSH 7400 Methodology. The owner will be responsible for one set of clearances inside each work area with a 24 hour turnaround time. If the first set of air clearances fails to meet release criteria, the Contractor shall re-clean the work area(s) and additional air clearance sampling will be performed. The Contractor will be responsible for all costs incurred for the cleaning of the contamination, Owners Environmental Consultant's time to observe re-cleaning and perform sampling, and analytical costs for additional sampling at a less than 12 hour turnaround time.

3.07 DAMAGE

A. Damage to finishes and other items as a result of work under this section shall be repaired or replaced, painted, or cleaned to match existing adjacent surfaces to satisfaction of the Owner and as specified elsewhere.

3.08 CLEAN UP

A. Maintain a clean project site during and upon completion of Work of this Section. Cleaning shall be in accordance with the General Requirements and Conditions.

END OF SECTION
PART 1 – GENERAL

1.01 RELATED DOCUMENTS
A. Hazardous materials reports, drawings, and general provisions of the Contract, including Division 0, 1, and other related Specification Sections, Drawings, addenda and clarifications, apply to this Section.

1.02 SCOPE OF WORK
A. The work includes all demolition, removal, storage, transportation, waste characterization and disposal of all toxic metal containing or contaminated building materials, articles, and items as specified, shown or reasonably implied in the contract documents, or discovered during work activities.

B. For a listing of toxic metals identified at the Project Site refer to Vista Environmental Consulting's report titled “Pre-Renovation Hazardous Materials Survey Report, AC Transit Division 3 – Bus Maintenance Facility, 2016 MacDonald Avenue, Richmond, California” dated February 13, 2015.

C. The contractor is to review all contract documents and reports, and field verify quantities and locations of toxic metals related work. Any discrepancies between the contractual bid set documentation and site visits must be submitted in writing to the Owner or Owner’s representative, prior to bidding.

D. The contractor shall make sure that Toxic Metals does not contaminate areas outside the regulated work areas. These areas include, but are not limited to, the interior of the buildings or the environment outside the buildings. If such contamination occurs, the contractor shall incur all costs associated with the decontamination of the areas. These costs include, but are not limited to, the Owner’s Environmental Consultant fees and analytical fees deemed necessary by the Owner.

E. The Work includes, but is not limited to, the demolition, removal, cleaning, and disposal of the following lead containing/contaminated materials:
   1. Lead Based Paint ($≥5,000$ parts per million (ppm) or $≥1.0$ mg/cm² lead).
   2. Lead-Containing Paint.
   4. Chromium and Mercury Containing Paint.
   5. Lead-Contaminated Dust ($≥40$ µg/ft² for interior floor surfaces, $≥250$ µg/ft² for interior horizontal surfaces; or $≥400$ µg/ft² for exterior floor and exterior horizontal surfaces).
   6. Materials that can be cleaned of all residue and will be disposed of as general construction debris.
   7. All materials used for work area preparation.
   8. All discarded personnel protective equipment.
   9. Other materials discovered during selective demolition and new work activities.

F. If demolition activities include the application of heat, all surfaces covered with lead or other toxic preservatives,
including coatings which generate toxic substances upon heating, shall be stripped for a distance of at least twelve inches in all directions from the area of heat application prior to heat application.

G. All removal, manual demolition, and clean-up of lead-based paint, lead-contaminated dust, and chromium and mercury containing paint shall be performed by a state-licensed contractor, using CDPH-certified workers with at least one CDPH-certified Supervisor. The abatement Contractor and Workers shall also meet the certification and training requirements of Federal EPA Renovation, Repair and Painting Rule 40 CFR 745.80.

H. All removal and disturbance of lead-containing materials (not meeting the definition of “lead-based”) as defined in 8 CCR 1532.1, may be performed by a state-licensed contractor, using lead-trained workers with certification of training meeting the requirements of 8 CCR 1532.1. Abatement contractor's workforce shall be supervised by experienced persons trained, knowledgeable and qualified in the techniques of lead abatement, handling and disposal of lead-containing and/or lead-contaminated materials, and the subsequent cleaning of contaminated areas. For this work the contractor and on-site supervisor shall meet the certification and training requirements of the Federal EPA Renovation, Repair and Painting Rule 40 CFR 745.80.

I. It is not the responsibility of the Owner's Environmental Consultant to supervise the Contractor; nor to direct the Contractor's work effort; nor to assume the management of, or responsibility for, the Contractor's health and/or safety practices, nor its waste management, nor its regulatory compliance. At all times, the Contractor shall be solely responsible for the quality and execution of all phases and aspects of the work.

1.03 REFERENCES

A. The following references are not an exhaustive list of all applicable federal, state, and local regulations, standards, laws, ordinances, and codes applicable to lead related construction work. The contractor shall perform all lead related work in accordance with the most recent edition of all applicable federal, state, and local regulations, standards, laws, ordinances, and codes and, where conflicts occur, the most stringent requirements shall be adhered to.

1. Code of Federal Regulations (CFR);
   e. 29 CFR 1910.1020 - Access to Employee Exposure and Medical Records.
   g. 29 CFR 1926.55 - Gases, Vapors, Fumes, Dusts and Mists
   h. 29 CFR 1926.62 - Lead – Construction Industry
   j. 40 CFR 745.80 - Federal EPA Renovation, Repair and Painting Rule
2. California Code of Regulations (CCR):
   a. Title 8, Section 1532.1 - Lead in the Construction Industry
   b. Title 8, Section 1537 - Welding, Cutting, and Heating of Coated Metals
   c. Title 8, Section 5216 - General Industry Safety Orders, Lead Regulations.
   d. Title 8, Section 5144 - Respiratory Protection
   e. Title 8, Section 5194 - Hazard Communication
   f. Title 8, Section 3204 - Access to Employee Exposure and Medical Records
   g. Title 8, Section 1500 - 1938 – Construction Safety Orders
   h. Title 8, Section 3200 - 6184 – General Industry Safety Orders
   i. Title 17 Sections 35001 - 36100 - Accreditation, Certification and Work Practices for Lead-Based Paint and Lead Hazards
   j. Title 22, Division 4.5, Environmental Health Standards for the Management of Hazardous Waste

3. California Health & Safety Code:
   a. 17920.10 – Lead Hazards

B. Local Regulations

1.04 NOTIFICATIONS

A. Contractor shall make all required written notifications to regulatory agencies including the following (If Applicable):
   1. California Division of Occupational Safety and Health
   2. California Department of Public Health

1.05 PROCEDURES

A. Contractor shall perform all Work in compliance with the most recent edition of all applicable federal, state, and local regulations, standards and codes governing lead abatement.
   1. Requirements include obtaining permits, licenses, inspections, releases and similar documentation, as well as payments, statements and similar requirements associated with codes, regulations, and standards.

B. Regulations, Standards, and Codes (General):
   1. General applicability of federal, state, and local regulations, standards and codes governing lead abatement, except to the extent that more explicit or more stringent requirements are written directly into the contract documents, all applicable regulations, standards, and codes have the same force and effect and are made a part of the contract documents as if copied directly into the contract documents, or as if published copies are bound herewith.
C. Contractor Responsibility: The Contractor shall assume full responsibility and liability for compliance with all applicable federal, state, and local regulations pertaining to work practices and protection of workers, visitors to the site, and persons occupying areas adjacent to the site. The contractor is responsible for providing training, medical examinations and maintaining training/medical records of personnel as required by the applicable federal, state, and local regulations. The Contractor shall hold the Owner and the Environmental Consultant harmless for failure to comply with any applicable lead abatement, safety, health or other regulation on the part of himself, his employees, or his subcontractors.

1.06 SUBMITTALS

A. Requirements are as set forth in Division 1 Specification Section for items required to be submitted under this section.

B. Prior to commencement of work, the Contractor shall submit copies to the Owner or Owner's Environmental Consultant, documentation for approval that includes, without limitation, the following:

1. Copies of licenses and registrations required including subcontractors licenses.

2. The Contractor shall specify in writing which contractors will be performing work that impacts painted and coated surfaces. This list shall match the name of the contractor with the work task they will be performing that impacts painted and coated surfaces.

3. Transportation: Submit proof that the Contractor or subcontractor is a registered hazardous waste transporter with the State of California and Department of Toxic Substances.

4. Waste Sites: Submit for approval the name, class, address, EPA I.D. number and telephone number of waste site(s) to be utilized for disposal.

5. Copies of written notification to the following regulatory agencies:
   a. California Division of Occupational Safety and Health
   b. California Department of Public Health

6. Proof of legal right to use patented equipment or processes.

7. Manufacturer’s certification that HEPA vacuums, differential pressure air filtration devices and other local exhaust ventilation equipment conform to ANSI Z9.2-2006.

8. Full manufacturer’s product data and material safety data sheets for all chemical products to be used on site and maintain current information on site at all times

9. A construction schedule indicating milestones and dates of completion for each phase of the Work. Submit the schedule to Owner or their representative for review prior to the Pre-Construction Meeting.

10. Documentation that Contractor's employees performing removal, disposal, and air sampling operations have received training in accordance with Title 8, Section1532.1, Federal EPA Renovation, Repair and Painting Rule 40 CFR 745.80, and Title 17, Sections 35001-36100.

11. Documentation, from a Physician, that all Contractor's employees or agents who may be exposed to airborne lead in excess of background levels have received medical surveillance in accordance with Title 8, Section 1532.1 to determine whether they are physically capable of working while wearing the respirator required without suffering adverse health effects. The Contractor must be aware of and provide
information to the examining physician about unusual conditions in the workplace environment (e.g. high temperatures, humidity, chemical contaminants) that may impact on the employee's ability to perform work activities.

12. Documentation, from a Physician, that all Contractor's employees or agents who may be exposed to lead contaminated dust have received a comprehensive medical examination as required by Title 8, Section 1532.1. In addition, the Contractor is to provide Blood Lead Tests on each employee within a two-week period prior to the commencement of said work and within a two-week period of the completion of this project.

13. Documentation of respirator fit testing for all Contractor employees and agents who must enter the work area. This fit testing shall be in accordance with qualitative or quantitative procedures as required by Title 8, Sections 1532.1 & 5144 regulations and conducted at least annually.

14. An emergency preparedness plan as required by Article 1.09 - EMERGENCY PLANNING.

15. A site specific work plan based on scope of work, detailing removal methods to be utilized and measures to prevent the release of lead containing/contaminated materials to soil, water, air, and other environmental media. Include a diagram showing containment set-up, decontamination unit(s), location of negative air machine and exhaust placement.

16. Master schedule, showing phasing, number of shifts, time for air clearances, tear down and manpower loading to be utilized for the duration of the project.

17. Copies of all transport manifests, trip tickets and disposal receipts for all waste materials removed from the work area within 48 hours of the transport, to the Owner or Owner’s Representative.

C. During abatement activities, Contractor shall submit to Owner or Owner’s Environmental Consultant documentation that includes, without limitation, the following:

1. Copies of the work area entry/exit log book daily. Log book must record name, affiliation, time in, and time out for each entry into the work area.

2. Post on site (within 48 hours) results of all required OSHA air monitoring.

3. Copies of all accident/incident reports where injury or damage has occurred on or to the Owner's property within 2 hours.

1.07 NOTICES

A. Post in the clean room area of the worker decontamination enclosure a list containing the names, and telephone numbers of Owner or Owner’s Environmental Consultant.

B. Post in the clean room area of the worker decontamination enclosure, or other approved prominent location, a list of all persons authorized to enter the work area.

C. Additional postings shall include:

1. Visitor Entry and Exit Log.

2. Employee Daily Sign in Log.

3. Entry and Exit Procedures.
5. As required by the Department of Labor.
6. As required by the Federal EPA Renovation, Repair and Painting Rule.

1.08 SITE USE AND SECURITY

A. Confine operations at the site to the areas permitted under the Contract. Portions of the site beyond which areas on which work is indicated are not to be disturbed.

B. The work area shall be restricted only to authorized, trained and protected personnel, including Contractor, Contractor’s employees, Owner’s employees, Owner’s Environmental Consultant, Federal, State, and Local inspectors.

C. Entry into the work area by unauthorized individuals shall be reported immediately to the Owner’s Environmental Consultant.

D. Contractor shall be responsible for project area security during abatement operations in order to protect work efforts and equipment. Contractor shall remove wastes and clean areas prior to leaving the area each day. Contractor is responsible for any containment or equipment left beyond the scheduled shift.

1.09 EMERGENCY PLANNING

A. Emergency planning and procedures shall be developed by Contractor prior to abatement initiation.

B. Emergency procedures shall be in written form and prominently posted. Contractor shall ensure that all persons entering the work area read these procedures and understand the Project site layout, location of emergency exits and emergency procedures.

C. Emergency planning shall include considerations of fire, explosion, electrical hazards, slips, trips and falls, confined spaces, earthquakes and heat related injury. Written procedures shall be developed and employee training in procedures shall be provided by Contractor.

D. Employees shall be trained in evacuation procedures in the event of work place emergencies.

1. For non-life threatening situations, employees injured or otherwise incapacitated shall decontaminate following normal procedures with assistance from fellow workers, if necessary, before exiting the work place to obtain proper medical treatment.

2. For life threatening injury or illness, worker decontamination shall take least priority. After measures to stabilize the injured worker, remove him from the work place and secure proper medical treatment.

a. Telephone numbers of all emergency response personnel shall be prominently posted in the clean and equipment rooms.

1.10 FIRE PROTECTION

A. All plastic, spray-on strippable coatings, and structural materials used in the removal and disposal of material containing lead process shall be UL approved and certified as fire retardant or noncombustible.

B. Wood shall be pressure treated and certified as fire retardant.

C. Safety Data Sheets (SDS) for fire retardant materials shall be made available upon request.
D. All combustible rubbish and debris, including properly bagged lead associated waste shall be properly disposed of at the end of each working day.

E. A minimum of one (1) 4A/60BC dry-chemical extinguisher shall be maintained at each of the following locations:

1. At each corner of the work area. Where no clear corners exist, four (4) extinguishers shall be placed around the exterior wall of the work area so that they are approximately 25 percent of the total distance apart.
   a. Exception: Where total contained work area is less than 1,000 square feet, two (2) 4A/60BC extinguishers shall be provided. All extinguishers shall be clearly identified with red tape.

2. Contractor shall ensure that on site personnel are aware of the location and proper use of all extinguishers and other fire/life safety equipment.

PART 2 – PRODUCTS

2.01 MATERIALS

A. General: Contractor shall carefully adhere to the following:

1. All plastic, spray-on strippable coatings and structural materials used shall be UL certified as fire retardant or non-combustible.

2. Deliver all materials in the original packages, containers, or bundles bearing the name of the manufacturer and brand name (where applicable).

3. Polyethylene sheeting utilized for worker decontamination enclosures and barriers shall be black or opaque in color and shall be a minimum of 6 mil. thick.

4. Disposal bags shall be minimum 6 mil polyethylene, as required by Title 8, Section 1532.1 and Title 22 Sections 66262.31 and 66262.32.

5. Stick on labels as per EPA, DTSC, DOT and/or CAL/OSHA requirements for disposal drums.

6. Warning signs as required by CAL/OSHA shall be utilized at each regulated work area.

7. Postings at all entrances to the structure(s) undergoing disturbance of lead-based or lead containing paint as per Title 8, Section 1532.1, Title 17, Sections 35000-36100 and 40 CFR 745.80.

B. Lead Removal:

1. Furnish all SDS sheets for applicable materials. Non-phosphate based cleaning agents, such as “Lead Dissolve” or equivalent, shall be used for clean-up applications.

2.02 EQUIPMENT

A. General:

1. Respirators shall be furnished to the abatement workers by Contractor. The respirators shall have been tested and approved by National Institute of Occupational Safety and Health (NIOSH) for use in lead-contaminated atmospheres.
2. Contractor shall provide full body disposable protective clothing, including head, body, and foot coverings to all workers and visitors working in and/or inspecting the work area where exposure to lead dust may exist, in sizes adequate to accommodate movement without tearing.

3. Additional safety equipment (e.g. hard hats, eye, safety, and disposable gloves), as necessary, shall be furnished to all workers and authorized visitors and shall comply with Title 8, Sections 1500-1938 and 3200-6184.

4. Nonskid footwear shall be worn by all abatement workers. Disposable clothing shall be adequately sealed to the footwear to prevent body contamination.

5. Furnish a sufficient supply of disposable mops, rags, and sponges for work area decontamination.

B. Removal:

1. A sufficient supply of scaffolds, ladders, lifts and hand tools (e.g., scrapers, wire cutters, brushes, utility knives, wire saws, etc.) shall be furnished as needed.

2. Rubber dustpans and rubber squeegees shall be furnished for cleanup.

3. Brushes utilized for removing loose lead containing material shall have nylon or fiber bristles, not metal.

4. A sufficient supply of HEPA filtered vacuum systems shall be furnished during cleanup.

C. Enclosure:

1. Powered tools equipped with HEPA filtered local exhaust ventilation shall be utilized during the installation of enclosures and supports if there is any need to disturb lead-containing materials during this process. As an alternative, lead material may be partially removed following controlled removal procedures approved by the Owner or their representative.

PART 3 – EXECUTION

3.01 LBP/LBM/LCSC REMOVAL PREPARATION:

A. All work must be performed using “Lead-Safe Work Practices” per Title 17 Sections 35000-36100 and 40 CFR 745.80.

B. All lead abatement workers shall be provided, at a minimum, with the following:

1. A clean changing area.

2. Wash basins equipped with soap, clean water and towels.

3. Proper respiratory protection.

4. Training on proper techniques in decontamination and personal hygiene requirements.

5. Training on the health hazards of lead exposure including ingestion of lead-contaminated food.

C. Removal Preparation:

1. Set up a lead control area by cordonning abatement area off with warning tape bearing bold, 2 inch lettering stating the following: "WARNING LEAD WORK AREA POISON NO SMOKING OR EATING"
or as required by local ordinances.

2. Install remote worker decontamination unit described below or as agreed upon with the Owner or the
Owner’s Environmental Consultant.

3. Workers shall don personnel protective equipment as required.

4. Pre-clean all vertical and horizontal surfaces within the work area using a HEPA-filtered vacuum and/or
wet cleaning (with non-phosphate detergents) as appropriate. Contractor shall not use any methods that
would raise dust such as dry sweeping or otherwise disturb toxic metals during the pre-cleaning phase.

5. HEPA vacuum all surfaces below for a distance of three feet in all directions from the intended building
component on which removal is to be conducted, removing all pre-existing paint debris.

6. Place 6-mil polyethylene sheeting on the floors and all openings into the work area. Openings include,
but are not limited to, doors, windows, and HVAC supply/return grills.

7. Perform removal activities in accordance with this specification.

3.02 LBP/LBM/LCSC REMOVAL PROCEDURES

A. Prior to the start of work the Contractor shall submit to the Owner or the Owner’s Environmental Consultant, for
approval, a site specific work plan detailing removal methods to be utilized and measures to prevent the release of
lead contaminated materials to soil, water, air, and other environmental media.

B. Lead glazed ceramic tiles shall be removed substantially intact using methods that reduce the amount of airborne
lead particulates generated and the amount of waste for disposal.

C. For health and safety reasons the following removal methods shall not be used:

1. Chemical removal methods that produce liquid waste that is regulated under present United States
Environmental Protection Agency, RCRA, state and local hazardous waste regulations, unless approved
by the Owner.

2. Burning of lead based paint with a heat guns operating at temperatures greater than 1,100o F, an open
flame torch, or equivalent method that will generate airborne lead fumes/particles.

3. Dry sanding lead based paint with an abrasive electric or air-powered sander without a HEPA exhaust
tool or HEPA vacuum filtration equipment.

4. Uncontained water blasting.

3.03 WASTE HANDLING PROCEDURES

A. Maintain surfaces within the control area free of accumulations of paint chips and dust. Restrict the spread of dust
and debris; keep waste from being distributed over the work area. Do not dry sweep or use compressed air to clean
up the area. At the end of each work shift and when the removal operation has been completed, clean the area of
visible contamination by vacuuming with a HEPA filtered vacuum cleaner and/or wet mopping the area.

B. All disposable personal protective equipment, respirator cartridges, and HEPA vacuum filters shall be disposed of
upon completion of the work shift and when the removal operation has been completed.

C. All removed materials, contaminated clothing and equipment, and contaminated dust/debris shall be placed into a
55-gallon drum that meets the requirements of 49 CFR 178, Title 22, Sections 66263.10 - 66263.58 and any other
applicable state regulations.

1. Waste streams shall be segregated for required disposal testing. Contractor is responsible to test said materials in accordance with all Federal, State and local laws. Contractor must separate non-hazardous waste from hazardous waste. Contractor is to test all wastewater prior to release into the sanitary sewer drain in accordance with local and State water standards. The Owner’s Environmental Consultant must be notified in writing at least 48 hours in advance of testing, so testing can be verified. A copy of the test results and waste profiles shall be sent to the Owner and Owner’s Environmental Consultant prior to waste removal.

2. Properly label each drum to identify the type of waste per 49 CFR 172, Title 22, Sections 66263.10 - 66263.58 and any other applicable state regulations, and the date contaminated wastes were first put into the drum.

D. The Contractor shall make provisions for the safe storage of waste on site while waste characterization is being performed and until transport off site for disposal. All wastes must be transported for disposal within 90 days of the generation. For health and safety reasons, waste storage areas must be treated as lead control areas with restricted access.

E. All waste shall be characterized by performing TTLC, STLC and/or TCLP tests prior to disposal. Waste characterization and disposal shall be the responsibility of the Contractor and shall be performed while the Owner’s Environmental Consultant is present.

3.04 TRANSPORTATION OF LEAD WASTE

A. The transporter of the hazardous waste shall comply with requirements of Title 22, Sections 66263.10 - 66263.58 and with applicable provisions of hazardous materials regulations adopted by the Department of California Highway Patrol, Title 13, Division 2, Chapter 6, Article 3, commencing with section 1160, pursuant to Vehicle Code Sections 27903, 34500, 34501, and 31309, governing containers, packing, labels, marking, vehicle placards, shipping papers, loading, shipping certificates and incident reporting.

3.05 WORK AREA CLEAN UP PROCEDURE

A. After all removal activities have been completed from the specified building components, the Contractor shall clean all identified surfaces and remove any "settled" dust/debris. The following procedures shall be used:

1. HEPA vacuum all surfaces in the work area including woodwork, walls, windows, window wells, and floors.

2. Wash all surfaces in the work area with a solution containing non-phosphate detergents. Prepare solution using hot water. Workers shall use towels, sponges, and mops to clean all surfaces including all areas that had been covered with polyethylene sheeting. Cleaning shall start at the ceiling and work down to the floors. Mix up a new cleaning solution frequently so it remains relatively clean.

3. Discard all items used for cleaning (towels, sponges, rags, mop heads, etc.) in a plastic bag for later disposal into steel drums.

4. After the surfaces have dried, HEPA vacuum all surfaces a second time until no dust or residue can be seen.

3.06 FINAL INSPECTION

A. The following two inspections shall be performed by the Owner or their Environmental Consultant with the
assistance of the General Contractor:

1. A visual inspection after all removal work is completed. This inspection will determine that all required surfaces have been properly stabilized. The inspection will occur at a minimum of 24 hours after all wet methods have been used to assure that de-lamination caused by the water has not occurred. The General Contractor shall sign off in writing that the paint has been sufficiently stabilized and the remaining paints and coatings are ready for repainting.

2. After the final cleanup of the work areas a visual inspection will be conducted to ensure that all settled dust and contaminated debris has been removed.

3.07 LEAD WORKER DECONTAMINATION SYSTEMS

A. Worker decontamination enclosure systems shall be provided for all locations where workers will enter or exit the work area. As a minimum, one system at a single location is required.

B. Worker decontamination enclosure systems constructed at the Project site shall utilize 6 mil black or opaque polyethylene sheeting, or other approved materials for privacy.

C. Alternate methods of providing Decontamination facilities may be submitted to the Owner or their representative for approval. Do not proceed with any such method(s) without the written authorization.

1. Prior to the receipt of negative exposure assessments as required in Title 8, Section 1532.1, the worker decontamination enclosure system shall consist of at least a clean room, wash room, and an equipment room, each separated from the other and from the work area by airlocks.

2. Clean rooms shall be sized to adequately accommodate the work crew. Space for storing respirators shall be provided in this area. Clean work clothes, clean disposable clothing, replacement filters for respirators, towels and other necessary items shall be provided in adequate supply at the clean room. A location for posting notices shall also be provided in this area.

3. Wash room shall contain one or more washbasins as necessary to adequately accommodate workers. An adequate supply of soap, shampoo and towels shall be supplied by Contractor and available at all times.

4. The equipment room shall be used for storage of equipment and tools at the end of a shift after they have been decontaminated using a HEPA filtered vacuum and/or wet cleaning techniques as appropriate. Replacement filters (in sealed containers until used) for filtration equipment, extra tools, containers or surfactant and other materials and equipment that may be required during the abatement may also be stored here as needed. A walk off pan (a small children's swimming pool or equivalent filled with water shall be located in the room for workers to clean off foot coverings after leaving the work area and prevent excessive contamination of the worker decontamination enclosure system. A drum lined with a 6 mil polyethylene bag for collection of disposable clothing shall be located in this room. Contaminated footwear shall be stored in this area for reuse the following workday.

3.08 ALTERNATE PROCEDURES

A. If specified procedures cannot be utilized, a request shall be made in writing to the Owner or Owner’s Environmental Consultant providing details of the problem encountered and recommended alternatives.

B. Alternative procedures shall provide equivalent or greater protection than procedures that are replaced.

C. Any alternative procedure must be approved in writing by the Owner or the Owner’s Environmental Consultant prior to the implementation of the procedure and must have no additional cost impacts.
3.09 OWNER PERFORMED SAMPLING AND TESTING

A. The Owner may, at its discretion, perform environmental air, soil, and/or wipe sampling for lead or other toxic metals. Contractor shall control lead and other toxic metals levels following the completion of related work in the work boundary or control area and at all times outside the work boundary or control area so that the airborne levels, soil levels, and ground surface levels do not exceed established background or regulatory levels.

B. Wipe and Soil clearance sampling may be performed within the controlled work areas following completion of all lead-related impact and decontamination efforts.

1. Release Criteria: Decontamination of the work site is complete when each of at least two samples per work area are analyzed and reveal lead concentrations below those set forth by CDPH in 17 CCR 35001, et. seq.

2. If these conditions are not met then the decontamination is incomplete and the cleaning procedures shall be repeated. The area shall be re-tested by the Owner’s Environmental Consultant at the contractor’s expense at no additional cost to Owner until satisfactory levels are obtained.

3.10 OSHA PERSONNEL AIR MONITORING

A. The contractor is responsible for providing daily OSHA compliance monitoring as required by Title 8, Section 1532.1.

1. At minimum, Contractor shall conduct breathing zone personal air monitoring of each and every different job category/task (i.e. preparation, wet scraping, feathering, priming, clean-up, etc.). Breathing zone shall be considered an area within a hemisphere, forward of the shoulders, with a radius of 6 to 9 inches from the center at the nose or mouth of an employee.

2. Monitoring shall be conducted by a qualified professional experienced and knowledgeable about the methods of air monitoring and in accordance with Title 8, Section 1532.1.

3. Monitoring shall be performed daily until an NEA has been established for each and every different job category/task.

4. Monitoring results and appropriate laboratory analysis reports shall be submitted to Owner or Owner’s Environmental Consultant within forty-eight (48) hours of the monitoring work.

END OF SECTION
HAZARDOUS MATERIALS REMOVAL AND DISPOSAL

PART 1  GENERAL

1.01  RELATED DOCUMENTS

A.  Hazardous materials reports, drawings, and general provisions of the Contract, including Division 0, 1, and other related Specification Sections, addenda and clarifications, apply to this Section.

1.02  SCOPE OF WORK

A.  All work shall be supervised by experienced certified persons trained, knowledgeable and qualified in the techniques of hazardous materials abatement, and handling of hazardous waste, hazardous containing and contaminated materials and the subsequent cleaning of hazardous material contaminated areas.

B.  For a listing of hazardous materials identified at the Project Site refer to Vista Environmental Consulting’s report titled “Pre-Renovation Hazardous Materials Survey Report, AC Transit Division 3 – Bus Maintenance Facility, 2016 MacDonald Avenue, Richmond, California” dated February 13, 2015.

C.  Handling and management of hazardous waste shall be performed by personnel trained to the requirements of 29 CFR 1910. 120(p)(8) & (q); 22 CCR 66265.16 and 66273.36. The Contractor shall provide documentation that such training has been provided to its employees pursuant to 29 CFR 1910.120(p)(8) & (q).

D.  Contractor shall furnish all labor, materials, services, insurance (specifically covering the handling of hazardous waste), disposal and/or recycling of said waste, waste characterization of all potentially hazardous materials and equipment which is specified, shown or reasonably implied in project documents or discovered during renovation/demolition activities.

E.  The contractor is to review all contract documents and reports and field verify quantities and location of hazardous materials related work. This work includes, but is not limited to, all selective demolition and new work that impacts hazardous materials.

F.  The contractor shall make sure that hazardous materials do not contaminate areas outside the regulated work areas. These areas include, but are not limited to, the interior of the buildings or the environment outside the buildings. If such contamination occurs, the contractor shall incur all costs associated with the decontamination of the areas. These costs include, but are not limited to, the Owner’s Environmental Consultant fees and analytical fees deemed necessary by the Owner.

G.  The work, in general, includes, but is not limited to, the following:

1.  The removal, handling, transportation, and recycling or disposal of all materials that meet the definition of hazardous or extremely hazardous waste, as defined in Title 22, Division 4.5 et seq. of the California Code of Regulations (CCR) or is otherwise regulated by local, state or federal law and is not covered by related sections. This includes, but is not limited to:
   a.  Hydraulic lifts and hydraulic elevator equipment and associated piping. All remaining product shall be extracted from the system, waste characterized and disposed of. The system shall be triple rinsed prior to demolition and the liquid collected and properly waste characterized and disposed of.
   b.  Oil collector and waste oil equipment and associated piping. All remaining product shall be extracted from the system, waste characterized and disposed of. The system shall be triple rinsed prior to demolition and the liquid collected and properly waste characterized
and disposed of.

c. Ballasts from light fixtures. All light fixtures are to be visually inspected, prior to removal or retrofitting, to determine if they contain PCB’s or are classified as electronic waste.

1) Ballasts that are unmarked or not labeled as electronic ballasts should be considered PCB-containing and properly handled.

2) Ballasts marked No PCB’s or PCB Free should be considered as such.

3) Ballasts marked or labeled as electronic ballasts shall be considered electronic waste and handled as such.

d. Oil-based transformers. All oil-based transformers are assumed to contain PCB’s.

e. Fluorescent light tubes and other non-incandescent lamps (e.g. Metal Halide, Mercury Vapor, High Pressure Sodium, Halogen and Compact Fluorescent) from light fixtures.

f. Mercury containing switching devices found in thermometers, thermostats and other equipment controls.

g. Batteries contained in equipment or building systems such as emergency lighting, fire alarm systems, hard wired exit signs, or free-standing.

h. Electronic waste, such as computer systems, communications equipment, electronic light ballasts, fire life and safety systems, televisions, and other electronic devices. This includes any device with a “printed” circuit board.

i. Other materials classified as Universal Wastes per Title 22 CCR Sections 66273.1-66273.90.

j. Ozone depleting chemicals found in Heating, Ventilation, and Air Conditioning (HVAC) systems, water fountains/coolers, and fire suppression systems.

k. Radiation containing devices such as smoke detectors and non-hard wired fire exit signs.

2. Placement of all contaminated items generated as a result of work activities and clean up in approved storage containers;

3. Marking and labeling of all hazardous Articles and Items for storage and disposal purposes;

4. Transportation of all hazardous waste, items and containers to disposal facility or, to an approved and permitted off-site processing site for recycling;

5. Labeling and record keeping in accordance with all applicable laws and regulations;

6. Prepare manifests and all other required documentation for transportation, processing and disposal of hazardous waste for signature by the Owner’s Representative.

O. Contractor is responsible for profiling all waste streams. Results must be submitted to the Environmental Consultant for verification of proper disposal.

P. It is not the responsibility of the Owner’s Environmental Consultant to supervise the Contractor; nor to direct the Contractor’s work effort; nor to assume the management of, or responsibility for, the Contractor’s health and/or safety practices, nor its waste management, nor its regulatory compliance. At all times, the Contractor shall be
1.03 QUALITY ASSURANCE

A. Work under this Contract is unique, in that it includes the handling and transportation of highly toxic substances and materials requiring special expertise. Therefore, the Contractor or his Agent must meet specific qualifications.

1. Single Party Responsibility: The firm performing the work of this contract shall be responsible for, and accomplish, all hazardous materials related activities as noted in the contract documents and included herein.

2. License Requirements: Any Contractor or his Agent performing work on this contract must be currently licensed by the State of California, for the transporting, handling and hauling of hazardous and extremely hazardous wastes as required for the work to be performed.

3. Qualifications Statement: Provide a Statement of Qualifications to the Owner or Owner’s Environmental Consultant for review and acceptance. The statement shall provide sufficient data and information to prove to the satisfaction of the Owner's Authorized Representative that the firm performing the work of this contract is fully experienced in the handling, transportation and storage of hazardous waste and contaminated articles and items.

   a. The statement shall, at a minimum, provide the following information and data regarding work experience with hazardous waste:

      1) Show, that as a major activity of work, the firm proposing to perform work of this contract has been engaged in hazardous waste related activities, including the removal, spill clean-up, transportation and disposal of high and low concentration toxic fluids and solids.

      2) Provide data proving experience on a minimum of three prior projects involving the type of activities as noted in this specification section during the last two years.

      3) Provide proof of current licensing for the transportation and hauling of extremely hazardous wastes as required in this specification section.

4. If the Contractor or his Agent does not meet the pre-qualification specified herein, a qualified alternative should be provided at no additional cost to the client.

1.04 GENERAL REQUIREMENTS

A. Insurance: Refer to General and Supplementary Conditions for insurance requirements.

B. Regulations: All work shall comply with the United States Environmental Protection Agency (EPA) rules and regulations governing hazardous waste: Title 40 CFR, 239 - 282, as well as the United States Department of Transportation Hazmat Safety Regulations Title 49, CFR, Parts 100-185 as published in the most recently published edition of the Federal Register. Additionally, all work and work related practices should comply with applicable federal, state and local rules and regulations including, but not limited to, Title 40, CFR Part 761—Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution In Commerce, And Use Prohibitions; the California Department of Industrial Relations, Title 8 CCR, Division 1, Chapter 4; California Department of Public Health, Title 22 CCR, Division 4.5; and the California Health and Safety Code. Where conflicts occur, compliance will be based upon the most stringent for the location and activity being conducted.

C. Coordination with Electrical Trades: All hazardous waste related work activities to be accomplished under this contract shall be closely coordinated with the electrical work to minimize potential toxic exposure as well as...
minimize service interruptions.

D. Scheduling of Work: Prior to commencing any work, thoroughly inspect the work area and prepare a schedule which lists anticipated time frames and sequence of operations for the various work activities. The schedule shall include activities such as, removal of equipment, spill clean-up, removal of all hazardous waste containing or contaminated articles, items and containers from the work to on-site long-term storage facilities or off-site disposal facility. The schedule shall also include intended routing for all hazardous waste items to be removed from the work area and transported to on-site long-term storage facilities or off-site disposal facility. Work activities, sequence of work, required service interruptions and routing scheme should be coordinated with the Owner or Owner’s Environmental Consultant. Schedules of disconnections, hazardous waste related activities, and re-energization shall be presented to the Owner or Owner’s Environmental Consultant for approval at least two weeks in advance of commencing any work. All other electrical work shall be accomplished before starting removal stages of hazardous waste work. Schedule shall be tightly held to and coordinated with the Owner or Owner’s Environmental Consultant.

E. Work Plan: Prior to the start of work the Contractor performing the work of this Contract shall develop, together with applicable subcontractors, a site specific work plan and submit to the Owner’s Environmental Consultant for approval. This work plan shall, at a minimum, specify procedures, products and materials for containment of the regulated work area, removal of hazardous waste containing/contaminated liquids and solids, decontamination and disposal of the equipment which contained the hazardous wastes, waste storage containers, spill clean-up, personnel decontamination, emergencies, first aid and temporary on-site waste storage. This work plan shall also include the names and day time phone numbers of all key personnel, the location of all required on-site documentation and emergency/first aid equipment and delineation of the regulated work area. A generalized, “boilerplate” type of plan will not be acceptable.

1.05 SUBMITTALS

A. Requirements are as set forth in Division 1 Specification Sections for items required to be submitted under this section.

B. Complete lists of all materials and equipment proposed for use in the work. List shall include such items as protective clothing, respiratory protection, absorbents, solvents, waste storage containers, Article and Item containers, and all appurtenances. A current material safety data sheet (MSDS) shall be submitted for each item for which a MSDS is available. For items for which no MSDS is available, the name of manufacturer, brand name and catalog number of each item where applicable shall be submitted.

C. The Work Plan, Hazardous Waste Permits (where applicable), Qualifications Statement, Hazardous Waste Haulers License Number, EPA Identification Number, Certification of Disposal (where applicable), Accidental Spill Contingency Plans and routing of equipment to be removed.

D. A contingency plan covering accidental hazardous waste spills and worker exposure to hazardous waste.

E. Copies of all transport manifests, trip tickets and disposal receipts for all asbestos waste materials removed from the work area within 48 hours of the transport, to the Environmental Consultant.

1.06 SAFETY PROCEDURES AND WORKER PROTECTION

A. Take all precautions and measures required to protect employees, inspection personnel, Owner's on site personnel and the general public from exposure to hazardous waste solids, liquids and vapors.

1. All personnel authorized for entry into work areas shall be instructed in the proper procedures for working with or around electrical hazards energized equipment and hazardous waste containing/contaminated materials.
2. All electrical equipment upon which hazardous waste related activities are to be performed shall be de-energized, locked out/tagged out and permanently disconnected from any power source prior to the commencement of the work.

3. Consumption of food or tobacco products shall not be permitted in any of the project work areas where hazardous wastes, volatile solvents and/or other hazardous materials are present. Additionally, no open flames will be permitted in these same areas. Signage to this effect shall be provided for each work area.

4. The Contractor performing the work of this Contract shall develop, together with applicable subcontractors, a contingency plan covering accidental hazardous waste spills and worker exposure to hazardous waste. Separate sections of the plan shall address unique conditions and emergency resources at the facility under the Contract. A generalized, "boilerplate" type of plan will not be acceptable. The submittal shall also include a separate section to describe the hauler's spill contingency plan and avoidance procedures.

B. Work Area Protection and Marking: Prior to commencing any hazardous waste related work activities provide barricades and warning signs or warning tape to clearly identify and effectively guard against unauthorized entry into work area.

1. Place barricades or otherwise demarcate to maintain a minimum of 25-feet from all perimeters of the work being conducted to the barricades, where feasible.

   a. Warning tape: Waming tape bearing bold, 2 inch lettering stating the following: "DANGER - KEEP OUT - TOXIC CHEMICAL WORK AREA' or as required by local ordinances.

   b. Signs: Warning signs shall be suspended from rope and placed at intervals of approximately 10 feet. Warning signs for work area shall be approximately 18 inches square with yellow background and 1 inch black letters. Signs shall read: "DANGER - KEEP OUT - TOXIC CHEMICAL WORK AREA".

2. All equipment such as tools, containers, etc., shall be confined to the work area until work is complete, containers are sealed and equipment properly decontaminated and safely stored for transport.

C. Protective Clothing and Equipment: All workers will follow applicable Federal and State regulations regarding the work activities, including but not limited to OSHA regulations, fall protection standards, respiratory protection, ladder/scaffolding safety, training requirements, personal air monitoring, and personal protective equipment (PPE). At all times when hazardous waste fluids or mixtures in any volume are not sealed in drums, containers or electrical equipment, workers shall wear:

1. Gloves impermeable to both hazardous waste and the clean-up agent in use.

2. Disposable, full body suit, impermeable to both hazardous waste and the clean-up agent in use.

3. Appropriate eye protection to insure that eyes are protected from liquid splatter or exposure to concentrated vapors or fumes.

4. Respiratory protection appropriate for the concentration of the hazardous material(s) and atmosphere present. Supplied air must meet requirements for Grade D air, at a minimum.

   a. The Contractor shall provide protective clothing, eye protection, and breathing apparatus as required for authorized inspection personnel upon request.

D. Personnel Protection and Procedures: The hazardous waste work area shall at no time be left unattended from the commencement of remediation work and until all hazardous waste and incidentals have been sealed in approved
1. During work procedures and at all times when hazardous waste containing/contaminated fluids in any volume are not sealed in drums, containers or electrical equipment, all personnel entering the regulated work area must don protective clothing and equipment. Upon exiting the work area, all disposable protective clothing shall be placed in appropriate waste storage drums and sealed, for subsequent transportation to the on-site storage facility or disposal facility.

2. Workers with cuts or scratches shall seal these wounds sufficiently to prevent accidental contact of the hazardous materials within the regulated work area prior to entering the regulated work area. Similarly, workers who accidentally incur minor cuts or scratches in the course of work activities shall immediately leave the work area, follow appropriate medical decontamination for known hazards and/or seek medical attention, before returning to the work area.

3. The contractor shall develop and submit to the Owner's Environmental Health and Safety Department for approval a Health & Safety Plan (HASP) specific to the work activities.

4. All Safety Data Sheets (SDS) for materials used on this project shall be submitted to the Owner's Environmental Health and Safety Department for approval.

5. The Contractor shall perform exposure monitoring in accordance with the appropriate NIOSH testing method for all solvents used, to ensure compliance with the airborne contaminant PELs established in Title 29 CFR 1910.1000 and Title 8 CCR 5155. For example, if Contractor were to utilize Hexane as a cleaning solvent, NIOSH Method 1500, or an equivalent method, shall be utilized to ensure that worker exposure to Hexane is 50 ppm or below, for n-Hexane, and 500 ppm or below, for other isomers of Hexane.

6. The first day’s samples for all personal air monitoring shall be submitted to the laboratory on a rush basis to ensure rapid reporting of the initial exposure level and to adjust PPE, appropriately.
procedures shall be provided by Contractor.

D. Employees shall be trained in evacuation procedures in the event of workplace emergencies.

1. For non-life-threatening situations, employees injured or otherwise incapacitated shall decontaminate following normal procedures with assistance from fellow workers, if necessary, before exiting the workplace to obtain proper medical treatment.

2. For life-threatening injury or illness, worker decontamination shall take least priority. After measures to stabilize the injured worker, remove him from the workplace and secure proper medical treatment.

   a. Telephone numbers of all emergency response personnel shall be prominently posted in the clean and equipment rooms.

E. Employees shall be trained in the location and proper use of all extinguishers and other fire/life safety equipment.

PART 2 – PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Storage Containers:

1. All hazardous waste fluids, hazardous waste-contaminated fluids, including flush and cleaning solvents and mixtures, shall be stored in sealed DOT approved closed top drums or other waste container approved for storage of these materials.

2. All hazardous waste solid wastes and items including disposable items used in the course of the work such as rags, absorbents, protective clothing, etc., shall be stored in sealed DOT approved closed top type drums or other waste container approved for storage of these materials.

3. Any hazardous waste article container, other than approved DOT drums, intended for storage, shall be submitted to the Owner or Owner’s Environmental Consultant for approval.

B. Solvents, Cleaning Agents and Absorbents:

1. Solvents: An appropriate solvent in which hazardous wastes are shown to be soluble in. Care should be taken to limit the complexity of the waste stream. In all cases where solvents are used in the course of work, proper ventilation shall be provided by the Contractor to insure that resulting fumes/vapors are not dispersed to occupied building areas either as a result of natural convection or via air intakes for building ventilation systems. The manufacturer’s recommendations for application and requirements of Cal/OSHA shall be strictly observed.

2. Cleaning Agent: An appropriate cleaning agent in which hazardous wastes are shown to be soluble in. Care should be taken to limit the complexity of the waste stream. Numerous, non-toxic, cleaning agents shown to meet or exceed the solubility requirement above are commercially available. In all cases where cleaners are used in the course of work, proper ventilation shall be provided by the Contractor to insure that resulting fumes/vapors are not dispersed to occupied building areas either as a result of natural convection or via air intakes for building ventilation systems. The manufacturer’s recommendations for application and requirements of Cal/OSHA shall be strictly observed.

3. Absorbents: An appropriate absorbent for the hazardous waste being collected/contained. Care should be taken to limit the complexity of the waste stream. Numerous, non-toxic, absorbents shown to meet or exceed the solubility requirement above are commercially available. The manufacturer’s recommendations for use or application and requirements of Cal/OSHA shall be strictly observed.
PART 3 – EXECUTION

3.01 SPILL CLEAN-UP, CONTAINERIZATION AND MARKING

A. Clean-Up of Work Area, Hazardous Waste Articles and Spills:

1. Equipment and Tools: After the last hazardous waste has been removed and all fluids and solids cleaned from remaining fixtures and surfaces, all tools and equipment used in the work shall be decontaminated and properly stored for reuse.
   a. All non-permeable tools that may have come in contact with hazardous waste at any concentration shall be thoroughly double washed/rinsed with an appropriate cleaning agent, wiped clean and properly stored.

2. Hazardous Waste Contaminated Articles: All exterior surfaces of equipment that may have come in contact with hazardous waste or contaminated solids or fluids either during the course of work activities or due to past leaks shall be double washed/rinsed, at a minimum, with an appropriate cleaning agent and wiped clean.

3. Solid Impenetrable Surfaces: All metal surfaces and surfaces with impervious liners which have come in contact with hazardous waste or hazardous waste mixtures in the course of the work or as a result of past leaks shall be thoroughly cleaned using a combination of absorbents and solvents or cleaning agents. Minimum cleaning requirements for these surfaces include removal of bulk material and two rinses with the cleaning agent of the surface or surfaces, which come in contact with hazardous waste or hazardous waste mixtures in the course of the work or as a result of past leaks.
   a. The work area shall be effectively ventilated during operations such that vapors used in decontamination and cleaning are not vented to occupied building areas. Upon completion of hazardous waste-related activities, if fumes or vapors are still present in levels, which could impede breathing or be considered toxic under state and/or NIOSH standards, the Contractor shall provide additional ventilation to accelerate drying.
   b. Auxiliary breathing apparatus may only be used by personnel trained in the use of this equipment, medically cleared to wear this equipment and experienced in conducting the required work activities while wearing equipment, which could impede safe work practices.

4. Soils and Porous Materials: The U.S. EPA, Region IX, regards soil, asphalt, wood, cement and unsealed concrete as porous materials that absorb hazardous waste. Where practicable, these materials must be removed when they are within the spill or contamination boundary.

5. Decontamination Verification: Completion of decontamination activities will be verified by the Owner's Authorized Representative collecting an appropriate number and type of samples for specific hazardous waste and surfaces. Contractor is responsible for all costs associated with spill clean-up oversight and sampling.

B. Containerization and Marking:

1. All liquids generated as a result of work activities and clean-up operations shall be placed in appropriate waste containers and the containers sealed.

2. All solids such as absorbents, rags, disposable protective clothing, soils, and other incidentals shall be placed in appropriate waste containers and the containers sealed.
3. All drums (and Article containers where used) shall be permanently marked as to specific contents and the first date of accumulation. In addition, each drum (and container) shall be marked with the appropriate labels as per 40 CFR Part 273, 49 CFR Part 178, 40 CFR Part 262 and Title 22 CCR Section 66262.34.

3.02 HANDLING AND TRANSPORTATION TO STORAGE Facilities

A. Handling:

1. Drums: All closed and open top drums must be permanently sealed and marked prior to loading on transport vehicle. Filled drums shall be loaded on the transport vehicle by any of the following methods:
   a. By a hoist or lift truck utilizing a two-point drum lifter.
   b. By a hoist or lift truck provided with a band-around type drum lifter, or;
   c. By a lift truck lifting the drums from underneath by a pallet attached to the drum by a banding arrangement.

2. Drums shall not be lifted by:
   a. Any rope, chain or cloth slings tied about the drum.
   b. Placement of drums on bare lift truck forks.
   c. Forcing drums between forks of a lift truck, or;
   d. Any commercial drum lifters exerting force on the sides of a drum.

3. All drums or article containers shall be secured to the transport vehicle to prevent movement in transit.

3.03 TRANSPORTATION TO DISPOSAL FACILITY

A. General: All Hazardous Waste Articles removed and all drums containing liquids, solids and incidentals shall be transported to the off-site hazardous waste approved and permitted recycling/disposal facility.

1. The firm performing the work of this Section shall be licensed for the transportation and hauling of hazardous or extremely hazardous wastes as appropriate. The firm shall provide a route plan, which clearly identifies the routes he proposes to follow while transporting hazardous waste items from the various work sites (points of generation) to the off-site facilities.

2. A minimum of two operators shall be in attendance at all times when hazardous waste items are being transported, loaded and unloaded.

B. Application of the Rules in This Part - General Provisions:

1. The rules in this section apply to each motor carrier engaged in the transportation of hazardous materials by a motor vehicle which must be marked or placarded in accordance with 49 CFR Parts 171 and 177 and:
   a. Each officer or employee of the carrier who performs supervisory duties related to the transportation of hazardous wastes and hazardous materials.
   b. Each person who operates or who is in charge of motor vehicle(s) transporting hazardous materials.
materials.

C. Compliance with Federal Motor Carrier Safety Regulations:

1. A motor carrier driver or other person must comply with the rules when he/she is transporting hazardous materials by a motor vehicle, which must be marked or placarded in accordance with 49 CFR Parts 171 and 177.

D. State and Local Laws, Ordinances and Regulations:

1. Every motor vehicle transporting or storing Articles and Items containing hazardous materials must be operated and parked in compliance with the laws, ordinances and regulations of the state jurisdiction of which it is being operated in, unless they are at variance with specific regulations of the Department of Transportation which are applicable to the operation of that vehicle which impose a more stringent obligation or restraint.

E. Attendance and Surveillance of Motor Vehicles:

1. A motor vehicle, which contains hazardous material, which is located on a public street or highway or the shoulder of a public highway, must be attended by its driver. However, the vehicle need not be attended while its driver is performing duties, which are necessary to his duties as the operator of the vehicle. For purpose of this section:

   a. A motor vehicle is attended when the person in charge of the vehicle is on the vehicle, awake, or is within one hundred feet of the vehicle and has it within his unobstructed field of view.

   b. A qualified representative of a motor carrier is a person who:

      1) Has been designated by the carrier to attend the vehicle;

      2) Is aware of the nature of the hazardous materials contained in the vehicle he attends to;

      3) Has been instructed in the procedures he must follow in emergencies and;

      4) Is authorized to move the vehicle and has the means and ability to do so.

F. Parking:

1. A motor vehicle, which contains or hazardous materials, must not be parked on or within five feet of the traveled portion of public street or highway except for brief periods when the necessities of operation require the vehicle to be parked and make it impractical to stop the vehicle in any other place.

G. Routes:

1. Unless there is no practicable alternative, a motor vehicle which contains hazardous materials must be operated over routes which do not go through or near heavily populated areas, places where crowds are assembled, tunnels, narrow streets, or alleys. Operating convenience is not a basis for determining whether it is practicable to operate a motor vehicle in accordance with this paragraph.

H. Fires/Open Flames:

1. A motor vehicle containing hazardous materials must not be operated near an open fire unless its driver has first taken precautions to ascertain that the vehicle can safely pass the fire without stopping.
a. A motor vehicle containing hazardous materials must not be parked within three hundred feet of an open fire.

I. Smoking:

1. No person may smoke or carry a lighted cigarette, cigar, or pipe, on or within twenty-five (25) feet of any contractor's vehicle, which contains flammable materials (flushing solvents), or an empty tank motor vehicle, which has been used to transport flammable materials.

J. Fueling:

1. When a motor vehicle, which contains hazardous materials, is being fueled:
   a. Its engine must not be operating and;
   b. A person must be in control of the fueling process at the point where the fuel tank is filled.

K. Tires:

1. If a motor vehicle which contains hazardous materials is equipped with dual tires on any axle, its driver must stop the vehicle in a safe location at least once during each two hours or one hundred miles of travel, whichever is less, and must examine the tires. The driver must also examine the vehicle tires at the beginning of each trip and each time the vehicle is parked.

   2. If, as the result of an examination pursuant to the preceding paragraph of this section, or otherwise, a tire is found to be flat, leaking or improperly inflated the driver must cause the tire to be repaired, replaced, or properly inflated before the vehicle is driven. However, the vehicle may be driven to the nearest safe place to perform the required repair, replacement, or inflation. If, as the result of an examination a tire is found to be overheated the tire will be removed and placed at a safe distance from the vehicle. The driver shall not operate the vehicle until the cause of the overheating is corrected.

L. Binding and Tie-Down:

1. If a motor vehicle transports hazardous materials all containers must be properly secured in place to insure that no equipment items or containers can be loose or unsafely placed into the transport vehicle. This may include chaining, roping or strapping and winching. The driver of the vehicle must stop the vehicle in a safe location at least once during each two hours or one hundred miles of travel whichever is less and inspect the contents of the shipment. At the time of inspection if any form of binding is found to be loose the driver shall immediately take action to remedy the situation for safe transportation.

   2. Any equipment, drums, or other Articles carried in an open, flatbed or stake type truck shall be covered with a tarp to protect it from the elements.

M. Hazardous Waste Instruction and Documents:

1. A motor carrier that transports "Hazardous Waste" must furnish the driver of each motor vehicle in which the waste is transported the following documents:
   a. A copy of these rules.
   b. A document containing instructions on procedures to be followed in the event of accident or delay. The documents must include the names and telephone numbers of persons to be contacted, and the substance of the hazardous wastes being transported, and the precautions
to be taken in emergencies such as fires, accident or leakages.

c. Manifest and permit documents described in these specifications and required for waste transport.

N. Marking of Vehicles:

1. A motor vehicle being operated must be marked if that vehicle is:
   a. Transporting hazardous materials of a kind that require the vehicle to be marked or placarded in accordance with 49 CFR Parts 171 and 177 and;
   b. Commercial vehicles must display the name or trade name of the carrier operating the vehicle. These vehicles must display markings, which designate the carrier as being a commercial vehicle "for hire".

3.04 HAZARDOUS WASTE DISPOSAL AND RECYCLING

A. The Contractor shall recycle or treat and dispose of all collected hazardous wastes collected and generated during the execution of this Contract including those Articles, fluids, etc. set forth in PART 1 GENERAL of these specifications.

B. Except as may be otherwise specifically directed by the Owner or Owner's Environmental Consultant, the Contractor shall recycle or treat and dispose of the waste materials as governed by Title 40 CFR, 239 - 282, Title 22 CCR Division 4.5, and other federal, state, local regulations and subsequent amendments:

1. By disposal, incineration or recycling at a facility approved for such use by the U.S. Environmental Protection Agency, and all other controlling regulatory agencies and bodies of the state, county and municipality of that facility's location all hazardous waste fluids, flushing fluids, and other hazardous waste contaminants. Waste contaminated solids are also to be incinerated as suitable and allowed for this type of disposal.

C. All hazardous wastes generated as part of these operations will be likewise disposed of by the Contractor in a legal manner and said disposal is included in the Contractor's total work item fee.

D. The Contractor shall not sell, transfer, or recover any material from the wastes received from the Owner without their prior written consent.

3.05 MANIFEST AND RECORDS

A. The Contractor shall provide the Owner or Owner's Environmental Consultant with a compliance certificate verifying that all waste received by it has been properly recycled or treated and disposed.

B. The Contractor shall provide the Owner or Owner's Environmental Consultant copies of all manifests, permits, weight tickets or other documents currently in effect relating to the specific hazardous wastes to be transported, recycled or treated and disposed hereunder except as otherwise stated in this Section. The Contractor shall also promptly furnish to the Owner or Owner's Environmental Consultant copies of all new or renewal permits or other documents applicable to this agreement as soon as the Contractor receives same.

C. The Contractor shall furnish completed U.S. EPA approved Uniform Hazardous Waste Manifest for all Hazardous Waste Articles to be collected from the facility at which the removal and decontamination occurred. These manifests shall accompany the waste loads to disposal and be properly completed by the hauler and disposal agent as required by federal and state hazardous waste management law. The final manifest and weight ticket shall then be returned by registered mail to the Owner or Owner's Environmental Consultant within the designated
time period specified by federal law.

D. It shall be the responsibility of the Owner to finalize their hazardous waste records regarding the removal and final disposition of hazardous waste articles.

E. The contract work will not be considered complete nor will the Owner make final payment until the Owner or Owner’s Environmental Consultant receives certifications of proper disposal, incineration and/or recycling.

3.06 PLACEMENT IN STORAGE AND RECORDS

A. Unloading and Placement in Storage:

1. Transport vehicles shall be unloaded utilizing the same equipment and methods as for loading.

2. Drums and articles shall be placed in the storage facility in locations as directed by the Owner or Owner’s Environmental Consultant.
   a. Articles shall be placed such that ample clearance is provided around equipment to facilitate future inspection.
   b. Drums shall be placed on pallets of sufficient strength to withstand double stacking. Drums shall not be stacked at time of storage unless space is limited as determined by the Owner or Owner’s Environmental Consultant. Where stacking of drums is necessary, pallets shall be placed between the drum layers.

3. Immediately following unloading of the hazardous waste transport vehicle, the cargo area shall be inspected to check for any fluid leaks. If any fluids are found, the source of the leaking drum or items shall be identified and sealed.
   a. The contaminated cargo area shall be thoroughly double washed/rinsed clean with absorbents, solvents and liquid cleaner. Cleaning agents, solvents and solids shall be placed in proper drums for disposal.

B. Records: Upon completion of all hazardous waste work related activities the Contractor shall provide a complete record of such activities and storage data to the Safety Officer or other administrator responsible for hazardous wastes at the site. In addition, two copies of the record shall be transmitted to the Owner or Owner’s Environmental Consultant. The record shall include the following data:

1. Name of the firm performing the work of this Section and technician in charge.

2. Drums (and Article Containers where applicable):
   a. Drum size (30 or 55 gallon).
   b. Identification of contents, i.e., for liquids, flush solvents, cleaning solvents for solids, rags, absorbents, soil, etc.
   c. Weight in pounds and gallons of contents of each drum (or container).
   d. Date placed in storage.

3.07 ALTERNATE PROCEDURES

A. If specified procedures cannot be utilized, a request shall be made in writing to the Owner or Owner’s
Environmental Consultant providing details of the problem encountered and recommended alternatives.

B. Alternative procedures shall provide equivalent or greater protection than procedures that are replaced.

C. Any alternative procedure must be approved in writing by the Owner or the Owner’s Environmental Consultant prior to the implementation of the procedure and must have no additional cost impacts.

3.08 OWNER PERFORMED SAMPLING AND TESTING

A. The Owner may, at its discretion, perform environmental air, soil, and/or wipe sampling as appropriate or required for the hazardous materials work performed. Contractor shall control hazardous materials following the completion of related work in the work boundary or control area and at all times outside the work boundary or control area so that the airborne levels, soil levels, and ground surface levels do not exceed established background or regulatory levels for the hazardous material for which work is performed.

3.09 OSHA PERSONNEL AIR MONITORING

A. The contractor is responsible for providing daily OSHA compliance monitoring as required by CCR Title 8 and 29 CFR, for the hazardous materials work being performed.

   1. At minimum, Contractor shall conduct breathing zone personal air monitoring of each and every different job category/task (i.e. preparation, wet scraping, feathering, priming, clean-up, etc.). Breathing zone shall be considered an area within a hemisphere, forward of the shoulders, with a radius of 6 to 9 inches from the center at the nose or mouth of an employee.

   2. Monitoring shall be conducted by a qualified professional experienced and knowledgeable about the methods of air monitoring and in accordance with Title 8 and 29 CFR.

   3. Monitoring results and appropriate laboratory analysis reports shall be submitted to Owner or Owner’s Environmental Consultant within twenty four (24) hours of the receipt of the analytical results.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION
   A. This Section includes a clear concrete floor sealer where scheduled.

1.02 SYSTEM PERFORMANCE REQUIREMENTS
   A. Concrete floor sealer shall react with concrete surfaces to produce a dense, hydrophobic, insoluble, moisture barrier to seal out contaminants, while hardening and densifying concrete surface.

1.03 SUBMITTALS
   A. General: Comply with Division 01.
   B. Product Data: Manufacturer's product data and application and installation instructions.
   C. Warranty.

1.04 JOB CONDITIONS
   A. Ensure concrete has been cured a minimum of 3-days, is free of curing compounds and other sealers, and is free of laitance, grease, oil, and contaminants.
   B. Protect adjacent surfaces/areas from damage due to overspray.

1.05 WARRANTY
   A. Warranty sealed concrete floors to be free of dusting from abrasion for a period of 10-years from Substantial Completion. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS
   A. L&M Construction Chemicals, Inc. “PermaGuard SPS”, Euclid, Sonneborn or approved equal.

2.02 MATERIALS
   A. Sealer: Low odor, VOC-compliant topical sealer consisting of low molecular emulsified cross-linking, coupling polymers that protect concrete from staining, defacing, and deterioration, complying with the following physical properties:
      1. Total Solids: 24-percent.
      2. pH: 8.5.
      4. VOC: <50 g/L.

PART 3 - EXECUTION

3.01 PREPARATION
   A. Ensure surfaces are clean and free of all contaminants and any film forming compounds or sealers.
   B. Ensure concrete has been cured a minimum of 3-days.
C. Test concrete surface for Ph levels and verify that Ph levels are acceptable to sealer manufacturer.

3.02 APPLICATION

A. Apply concrete floor sealer to interior concrete floors where scheduled, in accordance with manufacturer's instructions.

B. Apply directly from container onto prepared surfaces, undiluted.

C. Pre-moisten micro-fiber pad with sealer. Working from joint to joint, apply evenly and thinly with the pad. Do not puddle.

D. Burnish after final coat has dried a minimum of 4-hours, using a high-speed, 2,000 RPM burnisher with soft white pad or soft natural hogs hair.

E. If multiple coats are required, allow previous coat to dry a minimum of 30-minutes at 70-deg. F.
SECTION 03 10 00
CONCRETE FORMWORK AND ACCESSORIES

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

A. Requirements of Division 1 apply to all work of this section.

1.02 SCOPE

A. Design, furnish and install forms for concrete as indicated on drawings and specified here. Remove forms and shores at specified time. Clean up.

1.03 RELATED WORK (See also Table of Contents)

A. Reinforcing Steel: Section 03 21 00.
B. Cast-In-Place Concrete: Section 03 30 00.
C. Structural Steel: Section 05 12 00.
D. Metal Fabrications: Section 05 50 00.
E. Rough Carpentry: Section 06 10 00.
F. Items relating solely to mechanical or electrical work are included under those Divisions, except as specifically indicated otherwise on Drawings.

1.04 QUALITY ASSURANCE

A. General:
   1. Conform to all requirements of ACI 347 and ACI 318 Section 6.1 and 6.2.
   2. Concrete formwork shall be designed and constructed to safely support fluid concrete and superimposed construction loads without excessive deflection or concrete leakage. Provide bracing to maintain accurate alignment and to resist all anticipated lateral loads. Forms shall conform with drawings as to shape, line, and dimension. Design, engineering and construction of forms shall be Contractor's responsibility. Formwork for exposed concrete shall be constructed to tolerances indicated in ACI 303R.
   3. Cooperate and coordinate with other trades who furnish and/or install piping, conduit, reglets, anchors, inserts, sleeves, hangers, etc., as their work requires; including provisions for recesses and chases.

B. Submittals: (Submit under provisions of Section 01 33 00)
   1. Product Data. Provide manufacturers data and installation instructions for the following:
      a. Tie rods and spreaders.
      b. Formwork for exposed concrete.
      c. Form coatings and release agents.

C. Standards and References: (Latest Edition unless otherwise noted)
   2. American Concrete Institute (ACI).
      a. ACI 303R - “Guide to Cast-In-Place Architectural Concrete Practice”
      b. ACI 318 – “Building Code Requirements for Structural Concrete”
      c. ACI 347 - “Recommended Practice for Concrete Formwork”
   3. Standard Grading and Dressing Rules #17, West Coast Lumber Inspection Bureau (For Douglas Fir Form Lumber).
PART 2 - PRODUCTS

2.01 MATERIALS

A. Form Material:
   1. Smooth Concrete exposed to view: 5/8 inch minimum APA Plyform or steel.
   2. Concrete concealed from view: 5/8 inch minimum APA Plyform, steel or clean and sound 1 x 8 Standard Grade Douglas Fir.

B. Fiber Forms: Tubular column forms spirally constructed of laminated plies of fiber. Plies shall be laminated using a non-water sensitive adhesive and surface wax impregnated for moisture protection. Forms shall give a smooth and seamless appearance to the cast concrete. Provide reveals, as shown on the drawings, as supplied by the form manufacturer. Forms shall be as manufactured by Sonoco Products, plastic lined; Burke Smoothtube by Burke Co.; or approved equal.

C. Form Clamps: Assembly to have cone washers, (1 inch break back) 3/8” inch center rod.

D. Form Ties:
   1. Concrete exposed to view: Snap ties allowing full 1 inch break back.
   2. Concrete concealed from view: Snap ties or wire.
   3. Verify special spacing requirements with architectural drawings at exposed concrete.

E. Spreaders: Metal (no wood).

F. Form Coating: Non-grain 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.
   1. Form coating containing mineral oils or other non-drying materials will not be permitted for any concrete work.

G. Joint Tape: No. 471 plastic film tape 3 inches wide, as manufactured by the Industrial Tape Division of 3M Company.


I. Extruded Polystyrene Foam: ASTM C578 type IV. Dow Chemical Corp. "Styrofoam", UC Industries "Foamular", or approved equal.

PART 3 - EXECUTION

3.01 FORM CONSTRUCTION

A. Construct substantial forms to the shapes, lines, grades and elevations shown, sufficiently tight to prevent leakage of mortar, and tied, clamped and braced to prevent spreading, shifting or settling. Plywood joints shall be square and tight; plywood shall be arranged in such manner as to minimize number of joints and to provide a smooth, attractive finished concrete surface.

B. Apply form coating to forms before reinforcing steel is in place.

C. Sleeves, anchors and bolts, including those for angle frames, supports, ties and other materials in connection with concrete construction, shall be secured in position before the concrete is placed.

D. Proper provisions shall be made for openings, blockouts, sleeves, offsets, sinkages, recesses and depressions required by other trades and suppliers prior to placing concrete.
   1. The Contractor shall also see that sleeves have been installed and other provisions have been made for the installation of mechanical, electrical and other equipment.
   2. Coordinate with all trades to insure proper placement of all items in forms and to provide proper blockouts wherever required.
E. Concrete work out of alignment, level or plumb will be cause for rejection of the whole work affected and, if so rejected, such work shall be removed and replaced, as directed by Architect, with no additional cost to the Owner.

F. Form Not Required: Concrete footings may be poured directly against cut earth where feasible and when the Architect’s approval has been obtained.
1. See structural drawings for requirements for placing concrete footings directly against earth without forms.

G. Use ¾ inch minimum wood chamfer strips typical at all exposed corners unless noted otherwise on drawings.

3.02 CLEANING OF FORMS

A. All dirt, chips, sawdust, rubbish, water, etc. shall be completely removed from form by water hosing and air pressure before any concrete is deposited therein. No wooden ties or blocking shall be left in concrete except where indicated for attachment of other work.

B. Thoroughly clean and patch all holes in formwork and re-coat as required before reusing. Forms not suited to obtain concrete surfaces and tolerances in conformity with Contract requirements will be rejected by Architect.
1. Reuse of forming materials shall be limited only as required to produce the finishes as specified, free from blemishes and other defects unless covered by other building materials in which case blemish free concrete is not required.

3.03 INSPECTION OF FORMS

A. Notify the Architect at least 48 hours in advance of the beginning of pouring operations and at the completion of formwork and location of all construction joints. An inspection of forms and joints will be made for approval of finished work and general layout only. The foregoing inspection shall in no way relieve the Contractor of responsibility of design and safety or formwork, bulkheads and shorings.

3.04 REMOVAL OF FORMS AND SHORING

A. Do not remove forms until concrete has attained sufficient strength to support its weight and any construction loading. Concrete must be allowed to cure long enough to avoid damage during form removal. Contractor or his representative in charge of concrete construction shall be present during removal of forms and shores, and shall be personally responsible for safety of this operation at all times and under all conditions.

B. As a minimum, formwork and shoring shall remain in place for the following periods:
1. Concrete on grade: 24 hours
2. Walls and Columns: 3 days
3. Formwork may be removed and shores installed before the times indicated above, provided the concrete has cured sufficiently to avoid damage when formwork is removed. Shores must be immediately replaced with shores in a sequence designed to avoid inducing stress in the concrete member.

3.05 ADJUSTING AND CLEANING

A. Upon completion of this Work, clean up and remove from Site all equipment and debris resulting from this work.

B. Surfaces to be painted shall be smooth and free of substances such as dirt, wax, excessive latex, grease or materials that would prevent proper bonding of finishes.
1. Removal of foregoing contaminants, and complete removal of parting and curing compounds affecting proper paint bond, shall be responsibility of this Section of Work. Sandblast cleaning shall not be employed without specific approval of Structural Engineer.

END OF SECTION 03 10 00
PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Requirements of Division 1 apply to all work of this Section.

1.02 SCOPE

A. Unless noted otherwise, furnish and install reinforcing for all concrete, including dowels, chairs, spacers, bolsters, etc., necessary for supporting and fastening reinforcement in place as shown on the Drawings and specified herein.

1.03 RELATED WORK (See also Table of Contents)

A. Concrete Formwork: Section 03 10 00.
B. Cast-In-Place Concrete: Section 03 30 00.
C. Clay Unit Masonry: Section 04 21 00.
D. Concrete Unit Masonry: Section 04 22 00.

1.04 QUALITY ASSURANCE

A. General:
   2. Installer Qualifications: Installation shall be done only by an installation firm normally engaged in this business. All work shall be performed by qualified mechanics working under an experienced supervisor.
   3. Welding Qualifications: Welding procedures, welding operators and welders shall be qualified in accordance with AWS D1.4 - "Structural Welding Code Reinforcing Steel".
      a. Welders whose work fails to pass inspection shall be re-qualified before performing further welding.
   4. Reinforcement Work shall conform to ACI 301 and ACI 318 Chapter 7, as minimum standards.
   5. Allowable Tolerances:
      a. Fabrication:
         1) Sheared length: 1 inch.
         2) Depth of truss bars: Plus or minus ½-inch.
         3) Ties: Plus or minus ½-inch.
         4) All other bends: Plus or minus 1 inch.
      b. Placement:
         1) Concrete cover to form surfaces: Plus or minus ¼-inch.
         2) Minimum spacing between bars: Plus or minus ¼-inch.
         3) Crosswise of members: Spaced evenly within 2 inches of stated separation.
         4) Lengthwise of members: Plus or minus 2 inches.
      c. Maximum bar movement to avoid interference with other reinforcing steel, conduits, or embedded items: 2 bar diameters.

B. Standards and References: (Latest Edition unless otherwise noted):
   2. American Concrete Institute (ACI).
      a. ACI 301 - "Specifications for Structural Concrete for Buildings".
      b. ACI 315 - "Details and Detailing of Concrete Reinforcing".
      c. ACI 318 – “Building Code Requirements for Structural Concrete”
      a. ASTM A82 - "Cold Drawn Wire for Concrete Reinforcement".
b. ASTM A185 - "Welded Steel Wire Fabric for Concrete Reinforcement".
c. ASTM A615 - "Deformed and Plain Billet-Steel Bars for Concrete Reinforcement".
d. ASTM A706 – "Low Alloy Steel Deformed Bars for Concrete Reinforcement".

4. Concrete Reinforcing Steel Institute (CRSI) - "Manual of Standard Practice".
a. AWS D1.4 - "Structural Welding Code – Reinforcing Steel".

C. Submittals: (Submit under provisions of Section 01 33 00)
1. Shop Drawings: Prepare in accordance ACI 315. Indicate bending diagrams, assembly diagrams, splicing and laps of bars and shapes, dimensions and details of bar reinforcing and assemblies. Correctness of all reinforcing requirements and work is the responsibility of Contractor. Identify such shop drawings with reference thereon to sheet and detail numbers from Contract Drawings.
   a. Do not use scaled dimensions from Contract Drawings in determining the lengths of reinforcing bars.
   b. No reinforcing steel shall be fabricated without approved shop drawings.
   c. Any deviations from the contract documents must be clearly indicated as a deviation on the shop drawings.
   d. Areas of high congestion, including member joints and embed locations shall be fully detailed to verify clearances and assembly parameters and coordination with other trades.

2. Certified mill test reports of supplied reinforcing indicating chemical and physical analysis. Tensile and bend tests shall be performed by the mill in accordance with ASTM A615.

3. Product Data:
   a. Manufacturer's specifications and installation instructions for splice devices.
   b. Bar Supports.

4. Certificates of Compliance with specified standards:
   a. Reinforcing bars.
   c. Welding electrodes.

5. Samples: Only as requested by Architect.

D. 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 reinforcing steel whose properties are not identifiable by mill test reports shall be tested in accordance with ASTM A615. One Series of tests for each missing report to be borne by the Contractor.

3. When inspections are indicated for reinforcement placement on the Structural drawings, a special inspector shall be employed to inspect reinforcing placement per CBC Section 1704.

4. When tests are indicated for reinforcing steel on the structural drawings, the reinforcing steel used shall be tested in accordance with ASTM A615. One tensile and one bend test for each 2-1/2 tons of steel or fraction thereof, shall be made.

5. Inspect shop and field welding in accordance with AWS D1.4, including checking materials, equipment, procedure and welder qualification as well as the welds. Inspector will use non-destructive testing or any other aid to visual inspection that he deems necessary to assure himself of the adequacy of the weld.

6. Tests and inspection shall be performed by Owners testing agency except when needed to justify rejected work, in which case the cost of retests and reinspection shall be borne by the Contractor.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver reinforcement to project site in bundles marked with metal tags indicating bar size and length.

B. Handle and store materials to prevent contamination.
   1. Store reinforcement in a manner that will prevent excessive rusting or coating with grease, oil, dirt, and other objectionable materials. Storage shall be in separate piles or racks so as to avoid confusion or loss of identification after bundles are broken.

C. Deliver and store welding electrodes in accordance with AWS D1.4.
2.01 MATERIALS

A. Reinforcement Bars: ASTM A615, Grade 60 for all bars.
   1. Bar reinforcement to be welded shall meet chemical requirements of ASTM A706.
   2. Longitudinal reinforcement in column and beams of special moment-resisting frames shall meet the chemical requirements of ASTM A706.

B. Stirrups and Ties: ASTM A615, Grade 60 for all bars.

C. Steel Dowels: Same grade as bars to which dowels are connected.

D. Welded wire Fabric: ASTM A185.

E. Tie Wires: FS-QQ-W-461, annealed steel, black, 16 gauge minimum.


G. Bar Supports:
   1. Typical, unless noted otherwise; CRSI Class 2 wire supports.
      a. Do not use wood, brick or other objectionable materials.
      b. Do not use galvanized supports.
   2. Supports placed against ground: Pre-cast concrete blocks not less than 4 inches square with embedded wire.


PART 3 - EXECUTION

3.01 FABRICATION

A. Shop fabricate reinforcement to meet requirements of Drawings.

B. Fabricate reinforcement in accordance with the requirements of ACI 315 where specific details are not shown or where Drawings and Specifications are not more demanding.

C. 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 bars for bending will not be permitted.

D. Reinforcing shall not be field bent or straightened without structural engineer’s review.

E. Provide offsets in rebar (1:6 maximum) where required to maintain clearances.

3.02 CONDITION OF SURFACES

A. Examine surfaces and conditions receiving or affecting the work. Do not proceed until unsuitable conditions have been corrected.

3.03 GENERAL

A. Concrete shown without reinforcing shall be reinforced as similar parts shown with reinforcing except where concrete is specifically noted to be unreinforced.

3.04 PLACEMENT

A. All reinforcement shall be accurately set in place, lapped, spliced, spaced rigidly and securely held in place and tied with specified wire at all splices and crossing points. All wire tie ends shall point away from the form. Carefully locate all dowel steel to align with wall and column steel.
1. Bars shall be in long lengths with laps and splices as shown. Offset laps in adjacent bars. Place steel with clearances and cover as shown. Bar laps shall be as indicated on the Drawings. Tie all laps and intersections with the specified wire.

2. Maintain clear space between parallel bars not less than 1-1/2 times nominal diameter, but in no case shall clear space be less than 1-1/2 times maximum size concrete aggregate.

3. Reinforcing dowels for slabs shall be placed as detailed. Sleeves may be used if reviewed by the Structural Engineer before installation. Install dowel through all construction and expansion joints for all slabs on grade.

B. Bar Supports: Support and securely fasten bars with chairs, spacers and ties to prevent displacement by construction loads or placement of concrete beyond the tolerances specified. Conform to CRSI as a minimum standard.

C. Steel Adjustment:
   1. Move within allowable tolerances to avoid interference with other reinforcing steel, conduits, or embedded items.
   2. Do not move bars beyond allowable without concurrence of Structural Engineer.
   3. Do not heat, bend, or cut bars without concurrence of Structural Engineer.
   4. Reinforcement shall not be bent after being embedded in hardened concrete.

D. Splices:
   1. Splice reinforcing as shown.
   2. Lap Splices: Tie securely with wire to prevent displacement of splices during placement of concrete.
   4. Do not splice bars except at locations shown without concurrence of Structural Engineer.
      a. Where splices in addition to those indicated are required, indicate location on shop drawings clearly and highlight "for Engineer's approval".

E. Welding:
   1. Welding is not permitted unless specifically detailed on Drawings or approved by Engineer.
   2. Employ shielding metal-arc method and meet requirements of AWS D1.4.
   3. Welding is not permitted on bars where the carbon equivalent is unknown or is determined to exceed 0.55.
   4. Welding shall not be done within two bar diameters of any bent portion of a bar which has been bent cold.
   5. Welding of crossing bars is not permitted.

F. Welded Wire Fabric: Install in long lengths, lapping 24 inches at end splices and one mesh at side splices. Offset laps in adjacent widths. Place fabric in approximately the middle of the slab thickness unless shown otherwise on the Drawings by dimension. Wire tie lap joints at 12-inch centers. Use concrete blocks to support mesh in proper position.

G. Reinforcement shall be free of mud, oil or other materials that may reduce bond at the time concrete is placed. Reinforcement with tightly adhered rust or mill scale will be accepted without cleaning provided that rusting has not reduced dimensions and weights below applicable standards. Remove loose rust.

H. Protection against rust:
   1. Where there is danger of rust staining adjacent surfaces, wrap reinforcement with impervious tape or otherwise prevent rust staining.
   2. Remove protective materials and clean reinforcement as required before proceeding with concrete placement.

I. Drawing Notes: Refer to notes on Drawings for additional reinforcement requirements.

J. Mechanical and Electrical Drawings: Refer to Mechanical and Electrical Drawings for formed concrete requiring reinforcing steel. All such steel shall be included under the work of this Section.

END OF SECTION 03 21 00
SECTION 03 25 30
FIBER REINFORCED POLYMER COATINGS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Requirements of Division 1 apply to all work of this Section.

1.02 SCOPE

A. This specification is intended to define the minimum requirements of structural strengthening using externally bonded fiber reinforced polymer (FRP) composite systems.

B. The work includes the furnishing of all materials, labor, equipment and services for the supply, installation and finish of all structural strengthening using externally bonded FRP composite system.

C. The general contractor or subcontractor shall furnish all materials, tools, equipment, transportation, necessary storage, access, labor and supervision required for the proper installation of the externally bonded FRP composite system.

1.03 RELATED WORK (See also Table of Contents)

A. Concrete Formwork: Section 03 10 00.
B. Cast-In-Place Concrete: Section 03 30 00.
C. Concrete Unit Masonry: Section 04 22 00.
D. Clay Unit Masonry: Section 04 21 00.

1.04 REFERENCE STANDARDS

A. 2013 California Building Code (CBC)
B. International Code Council (ICC)
C. American Standard for Testing and Materials (ASTM)
D. American Concrete Institute (ACI)
   a. ACI 440.2R-08, Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures.

1.05 MATERIAL QUALIFICATIONS

A. Specifications for the FRP system have been developed using products supplied by Fyfe Co. LLC. Alternate FRP systems must be equivalent and must provide all items listed in Section 1.6 of this specification.

1.06 SUBMITTALS

A. Quality Control and Quality Assurance:
   a. Submit product data indicating product standards, physical and chemical characteristics, technical
specifications, limitations, installation instructions, maintenance instructions and general recommendations regarding each individual material. Only epoxy resins will be accepted for construction of FRP systems referenced in this specification. Other resins, such as polyesters/vinyl esters, are not allowed as substitutes. The manufacturer shall clearly define the epoxy resin working time. Any batch that exceeds the batch life shall not be used.
b. Submit FRP system durability and structural testing information provided by FRP composite system manufacturer to demonstrate system properties of material to be used. Systems shall provide equivalent environmental durability testing to that defined in ICC AC125 or provide an approved ICC Evaluation Service Report for the proposed FRP system(s). Systems without the required environmental durability testing will not be allowed.
c. Submit a list of completed surface bonded FRP composite strengthening projects completed with the manufacturer's FRP composite system in the past 3 years. The list should include at a minimum 25 projects with proposed FRP system, the dates of work, type, description and amount of work performed.
d. Surface bonded FRP composite system shall be installed by certified applicator with written consent from manufacturer that the contractor has been trained. Certified applicator shall have a minimum of 3 years experience in performing FRP composite retrofits.
e. The Engineer may suspend the work if the Contractor substitutes an unapproved fiber reinforced composite system or unapproved personnel during construction.

B. Design and working drawings:
   a. Working drawings shall detail the type, locations, dimensions, numbers of layers, and orientation of all FRP materials and coatings to be installed.
   b. A list of two different qualified testing laboratories that can perform the required ASTM D3039 tests as per Section 3.3 of this specification.

C. Product Information:
   a. Provide an ICC Evaluation Report, compliant with the 2013 CBC, for the proposed products.
   b. Provide approved UL assembly data for any required fire-resistant finishes (e.g. 2-hour beam-slab assembly).
   c. Properties of the composite materials as determined by independent laboratory testing in accordance with ASTM D 3039 (tensile modulus, stress and strain).
   d. Installation procedures, maintenance instructions, and general recommendations regarding each material to be used.
   e. Manufacturer’s Material Safety Data Sheets (MSDS) for all materials to be used.
   f. Manufacturer’s product data sheet indicating physical, mechanical and chemical characteristics of all materials used in the FRP system.
   g. Written verification from the manufacturer that their applicator has received the required certifications and training.
   h. Certification by the manufacturer that supplied products comply with local regulations controlling use of volatile organic compounds (VOC's).

1.07 PERFORMANCE

A. Design the composite system to achieve the structural performance shown on the structural drawings and the following data. Design calculations for the composite system shall be submitted for approval by the engineer of record, and shall be stamped by a registered Civil or Structural Engineer.

B. Calculations shall conform to requirements set forth in the bid documents and be based on the design modulus and associated area of the composite to be installed. FRP design values must be lower than the calculated mean determined from the test results received from the ASTM D3039 field test specimens (See Section 3.3 of this specification).

1.08 PRODUCT DELIVERY, HANDLING AND STORAGE

A. Deliver epoxy materials in factory-sealed containers with the manufacturer’s labels intact and legible with verification of date of manufacture and shelf life.

B. Store materials in a protected area at a temperature between 40°F (4°C) and 100°F (38°C).

C. Products shall be stored according to the manufacturer’s requirements and shall avoid contact with soil and
AC Transit  FIBER REINFORCED POLYMER COATINGS
D3 Richmond Yard Reactivation P2095  03 25 30 - 3

moisture. Products shall be stored to avoid UV exposure.

1.09 COORDINATE WITH OTHER TRADES
A. Prior to construction, the trades shall be briefed on any new or unusual construction procedures to ensure that they are aware of special conditions (e.g. new penetrations).

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS & COMPOSITE STRENGTHENING SYSTEM
A. Project Standard: Tyfo® Fibrwrap® System as supplied by Fyfe Company LLC, 8380 Miralani Drive, Suite A, San Diego, CA 92126. Tel: 858-642-0694. Systems other than the pre-qualified standard above can be evaluated. Alternate systems and materials meeting the requirements below will be allowed by written addendum.
B. Products:
b. Epoxy saturant/primer: Tyfo® S epoxy is used as a primer and is also combined with the fiber to form the Tyfo® Fibrwrap® System.
c. Primer/Filler: Thickened Tyfo® S, WS, WP or TC thickened epoxy for protective seal coat, filling voids and primer where needed.
d. Finishes: Tyfo® RR, for any applicable fire resistant finish. Alternate finishes must be approved by the Architect.
C. Field thickened epoxy matrix, which is compatible with composite system’s resin matrix, may be used to patch “bugholes” up to 1.5” (40mm) in depth and to fill voids.
D. The manufacturer shall provide specific information on physical, mechanical and chemical properties of fiber, epoxy resin and FRP composite. FRP systems shall be equated based on the relative stiffness in terms of the product of the tested tensile modulus and the associated gross laminate area (E x A). Net fiber values shall not be used for design or testing requirements.

2.02 CERTIFIED APPLICATORS
A. Installation of the FRP system shall be performed by manufacturer certified applicators only. Certified applicators shall have the minimum experience and consent as recommended by the manufacturer

2.03 OTHER MATERIALS
A. Contractor to provide compatible primer, filler and other materials recommended by the manufacturer as needed for the proper installation of the complete surface bonded FRP composite system.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION
A. Surfaces shall be prepared for bonding by means of abrasive blasting or grinding to remove existing laitance and expose aggregate [Concrete Surface Profile 2 (CSP-2)]. All contact surfaces shall then be cleaned by hand or compressed air. One prime coat of the manufacturer’s epoxy shall be applied and allowed to cure for a minimum of one hour. Prior to the application of the saturated composite fabric, fill any uneven surfaces with the manufacturers thickened epoxy. Provide anchorage as detailed on construction drawings, if required.
B. Round off sharp and chamfered corners (to be wrapped around) to a minimum radius of 0.5” (20mm) by means of grinding or forming with the system’s thickened epoxy. Variations in the radius along the edge shall not exceed 0.5” (12mm) for each 12” (300mm) of length.
3.02 INSTALLATION

A. Preparation work for project: Visit site to ensure that all patch work is complete and cured. Review project specifications in detail.

B. Verify ambient and concrete temperatures. No work shall proceed if the temperature of the concrete surface is less than 40°F (4°C) or greater than 100°F (38°C) or as specified on the epoxy component labels. The ambient temperature and temperature of the components shall be between 40°F (4°C) and 100°F (38°C), unless provisions have been made to ensure components’ temperature is maintained within this range or the range specified by the manufacturer.

C. Prepare the epoxy matrix by combining components at a weight (or volume) ratio specified by the manufacturer. The components of epoxy resin shall be mixed with a mechanical mixer until uniformly mixed, typically 5 minutes at 400-600 rpm.

D. Components that have exceeded their shelf life shall not be used.

E. Saturation of the fabric shall be performed and monitored according to the manufacturer’s specified fiber-epoxy resin ratio. Fabric shall be completely saturated prior to application to contact surface in order to ensure complete impregnation. Saturation shall be supervised and checked by the certified installer. Both the epoxy resin and fabric shall be measured accurately, combined, and applied uniformly at the rates shown on the approved working drawings and per manufacturer’s recommendations.

F. All cutting of fabrics, mixing of epoxy and combination thereof shall take place in a protected area away from critical structure functions and any electrical equipment.

G. Prepare surfaces as required, including corner preparation.

H. Remove dust and debris by hand or with compressed air as per specification.

I. Clean up and protect area adjacent to element where FRP composite is being applied.

J. Using a roller or trowel, apply one prime coat of epoxy resin to the substrate (2 mil min.). Allow primer to become tacky to the touch.

K. Fill any uneven surfaces or recesses with thickened epoxy.

L. Apply saturated fabric to substrate surface by hand lay-up, using methods that produce a uniform, constant tensile force that is distributed across the entire width of the fabric, and ensure proper orientation of the fabric. Under certain application conditions, the system may be placed entirely by hand methods assuring a uniform, even final appearance. Gaps between composite bands may not exceed 0.5" (12mm) width in the fabric’s transverse joint unless otherwise noted on project drawings. A lap length of at least 6" (150mm) is required at all necessary overlaps in the primary fiber direction of the fabric.

M. Apply subsequent layers, continuously or spliced, until designed number of layers is achieved, per project drawings.

N. Using a roller or hand pressure, release or roll out entrapped air, and ensure that each individual layer is firmly embedded and adhered to the preceding layer or substrate.

O. Detail all fabric edges, including termination points and edges, with thickened epoxy.

P. Finish: All edges and seams must be feathered. Use system as directed by the manufacturer. Finish as specified between 24 and 72 hours after final application of epoxy. If after 72 hours the epoxy is cured; the surface must be roughened by hand sanding or brush blasting, prior to finishing.

Q. System may incorporate structural fasteners but limitations and detailing must be verified with composite system manufacturer.

3.03 INSPECTION AND TESTING
A. Field inspection

B. The contractor shall monitor the mixing of all epoxy components for proper ratio and adherence to manufacturer’s recommendations. Record batch numbers for fabric and epoxy used each day, and note locations of installation. Measure square footage of fabric and volume of epoxy used each day. Complete report and submit to the Owner, engineer-of-record and FRP composite system manufacturer.

C. A Certified Special Inspector shall periodically observe all aspects of preparation, mixing, and application. All FRP composite applied areas shall be inspected, in accordance with the manufacturer’s specifications for voids, bubbles, and delaminations. All defective areas shall be repaired as specified in Section 3.4 “Remedial Works”.

D. The contractor shall provide a report signed by a registered professional engineer certifying that the installation is acceptable, complete with the testing reports and photographs.

E. In-situ Testing

   a. Pull-off Tests:

      i. Direct tension adhesion testing of cored samples shall be conducted using the method described by ASTM D4541. A minimum of three tests shall be performed for each day of production or for each 500 ft² (45m²) of FRP application, whichever is less. Pull-off tests shall be performed on a representative adjacent area to the area being strengthened whenever possible. Tests shall be performed on each type of substrate or for each surface preparation technique used.

      ii. The prepared surface of the bonded FRP system shall be allowed to cure a minimum of 72 hours before execution of the direct tension pull-off test. The locations of the pull-off tests shall be representative and on flat surfaces. If no adjacent areas exist, the tests shall be conducted on areas of the FRP system subjected to relatively low stress during service. The minimum acceptable value for any single tension test is 175 psi (1.2MPa). The average of the tests at each location shall not be less than 200 psi (1.4MPa). Additional tests may be performed to qualify the work.

      iii. Test locations shall be filled with thickened epoxy after the values have been recorded and verified by the special instructor and the test dollies have been removed.

F. Laboratory Testing

   a. Sampling:

      i. Record lot number of fabric and epoxy resin used, and location of installation. Measure square footage of fabric and volume of epoxy used each day. Label each sample from each day’s production.

      ii. A “sample batch” shall consist of two 12” by 12” (300mm by 300mm) samples of cured composite, A minimum of two “sample batches” shall be made daily. The two “sample batches” will be taken at appropriate times during the day as to ensure the maximum material deviance in the components of the FRP composite.

   b. Preparation of Samples:

      i. Prepare sample on a smooth, flat, level surface covered with polyethylene sheeting, or 16 mil plastic Elm, prime with epoxy resin. Then place one layer of saturated fabric and apply additional topping of epoxy. Cover with plastic film and squeegee out all bubbles.

      ii. Samples shall be stored in a sample box and not moved for a minimum 48 hours after casting. The prepared, identified samples shall be given to a pre-approved and experienced testing laboratory. The laboratory shall then precondition samples for 48 hours at 140°F (60 °C) before testing.

   c. Testing:
i. Testing specimens shall be cut from samples and tested for ultimate tensile strength, tensile modulus and percentage elongation as per ASTM D3039 in the longitudinal fiber direction.

ii. Test a minimum of 15% of all samples as per ICC AC178. If one coupon fails, specimens from the same 12” x 12” (300mm x 300mm) sample will be tested. If these specimens also fail, the other 12” x 12” (300mm x 300mm) sample from the same “sample batch” will be tested. In the extreme case that this sample also fails, the remaining “sample batch” for that day will be tested and appropriate remedial measures shall be taken to ensure integrity of the system at locations from the failed “sample batch”. In addition, 25% of the remaining samples shall be tested by the same criteria as per ICC AC178.

iii. Testing results shall be made available within 3 weeks of sample submission.

d. Acceptance Criteria:

i. FRP design values must be lower than the calculated mean determined from the test results received from the ASTM D3039 field test specimens.

ii. Acceptable minimum values for ultimate tensile strength, tensile modulus, and elongation shall not be below the submitted design values.

iii. Any values below the submitted design values are considered a failure and require remedial works.

3.04 REMEDIAL WORKS

A. Small voids and bubbles [on the order of 3” (75mm) diameter] shall be injected or back filled with epoxy.

B. Voids and delaminations on the order of 6” (150 mm) in diameter or an area of 5” x 5” (135mm x 135mm) shall be reported to the engineer of record and remedial measures shall be submitted by the contractor for approval.

C. In the event that laboratory testing determines a “sample batch” to possess insufficient material properties, remedial measures shall be taken. Any member where the installed FRP composite system has material properties determined to be below the minimum specified values, additional layers shall be installed until the composite thickness is increased by the same percentage as the deficiency of the materials tensile modulus. Or any other remedial measures directed by the engineer.

3.05 MAKE GOOD

A. Make good at no cost to the Owner, any damage to the new or existing structures, property or services caused by the installation and testing of the FRP composite.

3.06 CLEAN UP

A. Remove all surplus material, equipment and debris from the site on completion of the work. Leave the site clean.

END OF SECTION
SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS
   A. Requirements of Division 1 apply to all Work of this Section.

1.02 SCOPE
   A. Furnish, place and finish cast in place concrete and related work as indicated on the Drawings and specified here.
      1. Install miscellaneous metal and other items furnished by other trades to be installed in concrete work.
      2. Provide facilities for job curing of test cylinders and transporting to Testing Laboratory.
   B. Provide grouting of steel base plates as indicated on the Drawings and specified here.

1.03 RELATED WORK (See also Table of Contents)
   A. Concrete Formwork: Section 03 10 00.
   B. Reinforcing Steel: Section 03 21 00.
   C. Mortar and Grout: 04 05 00.
   D. Structural Steel: Section 05 12 00.
   E. Metal Decking: Section 05 30 00.
   F. Metal Fabrications: Section 05 50 00.

1.04 QUALITY ASSURANCE
   A. Standards and References: (Latest Edition unless otherwise noted)
      2. American Concrete Institute (ACI)
         a. ACI 117 – “Standard Tolerances for Concrete Construction and Materials”
         b. ACI 211.1 – “Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete”
         c. ACI 211.2 – “Standard Practice for Selecting Proportions for Structural Lightweight Concrete”
         d. ACI 301 – “Structural Concrete for Buildings”
         e. ACI 302 – “Guide for Concrete Floor and Slab Construction”
         f. ACI 305R – “Hot Weather Concreting”
         g. ACI 306R – “Cold Weather Concreting”
         h. ACI 318 – “Building Code Requirements for Structural Concrete”
         i. ACI 360 – “Design of Slabs-On-Ground”
      3. American Society for Testing and Materials (ASTM)
         a. ASTM C31 – “Making and Curing Concrete Test Specimens in the Field”
         b. ASTM C33 – “Concrete Aggregates”
         c. ASTM C39 – “Compressive Strength of Cylindrical Concrete Specimens”
         d. ASTM C42 – “Obtaining and Testing Drilled Cores and Sawed Beams of Concrete”
         e. ASTM C94 – “Ready-Mixed Concrete”
         f. ASTM C109 – “Test of Hydraulic Cement Concrete”
         g. ASTM C143 – “Slump of Hydraulic Cement Concrete”
         h. ASTM C150 – “Portland Cement”
         i. ASTM C172 – “Sampling Freshly Mixed Concrete by the Volumetric Method”
         j. ASTM C192 – “Making and Curing Concrete Test Specimens in the Laboratory”
         k. ASTM C260 – “Air-Entraining Admixtures for Concrete”
l. ASTM C330 – “Lightweight Aggregates for Structural Concrete”
m. ASTM C494 – “Chemical Admixtures for Concrete”
n. ASTM C618 – “Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete”
o. ASTM C685 – “Volumetric Batching and Continuous Mixing”
p. ASTM C1157 – “Hydraulic-Cement”

B. Submittals: (Submit under provisions of Section 01 33 00)
1. Concrete mix designs. See “Mix Design” below. Include results of test data used to establish proportions.
2. Certificates of Compliance from Manufacturer
   a. Cement certificates
   b. Aggregates
   c. Admixtures.
3. Data regarding hardeners and sealers.
4. Grout samples for sacked surface textures and colors upon Architects request only.
5. Layout drawings for construction, control and expansion joints.
6. Transit-mix delivery slips:
   a. Keep record at the job site showing time and place of each pour of concrete, together with transit-mix delivery slips certifying contents of the pour.
   b. Make the record available to the Architect for his inspection upon request.
   c. Upon completion of this portion of the work, deliver the record and the delivery slips to the Architect.
7. See Section 03 21 00 for reinforcing steel submittals.

C. 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. The following tests shall be made by a recognized testing laboratory selected by the Owner and approved by the governing agency. All tests shall be in accordance with the previously mentioned standards and ACI 318 Section 5.6. A complete record of all tests and inspections shall be kept per CBC Section 1903.1.
   a. Compressive Strength: Make and cure in accordance with ASTM C-31. Test in accordance with ASTM C-39 and ACI 318 Section 5.6.
      1) A record shall be made of time and of locations of concrete from which samples were taken.
      2) Four identical cylinders shall be taken from each pour of 150 cubic yards or 5000 square feet or part thereof, being placed each day per ACI 318 Section 5.6.2. One cylinder shall be tested at age 7 days, and two at age 28 days unless otherwise specified. Preserve remaining cylinder for future use.
   b. Drying Shrinkage: (applies to lightweight concrete only unless noted otherwise)
      1) A record shall be made of time cylinders and of locations of concrete from which samples were taken.
      2) Three identical 4” x 4” x 11” specimens shall be made from same concrete as used in structure. Percent of shrinkage shall be reported at 21 days after 7 day moist curing period. Average results of 3 specimens shall be used as the accepted value. The value for laboratory cast specimens shall not exceed .075%. If field test specimens are used in lieu of laboratory specimens, a tolerance of +33% may be used.
      3) Test specimens in accordance with ASTM C157.
   c. Concrete consistency (slump) shall be tested in accordance with ASTM C143.
3. Provide full time inspection per CBC Section 1704.3 during the taking of test specimens and during the placing of all concrete and embedded steel.
4. See Section 03 21 00 for reinforcing steel tests and inspections.
5. Provide concrete batch plant inspections per ASTM C685.

PART 2 - PRODUCTS

2.01 MATERIAL

A. Portland Cement: ASTM C 150, Type II or Type V. One brand of cement shall be used throughout to maintain uniform color for all exposed concrete.
B. Concrete Aggregate: Fine and coarse aggregates shall be regarded as separate ingredients. Each size of coarse aggregate, as well as combination of sizes when two or more are used, shall conform to grading requirements of appropriate ASTM Standards and ACI 318.
   1. Concrete Aggregates for Standard Weight Concrete: ASTM C 33. Aggregate shall be crushed granite or Perkins type.
   2. Concrete Aggregates for Lightweight Concrete: ASTM C330 to produce concrete weighing no more than 115 pcf at 28 days. Aggregate shall be vacuum saturated expanded shale as produced through the rotary kiln method.

C. Water: Clean and free from injurious amounts of oil, acids, alkali, organic matter and other deleterious substances; suitable for domestic consumption.

D. Admixtures shall be subject to prior approval by the Architect, in accordance with ACI 318 Section 3.6. Calcium Chloride is not permitted.
   1. Water Reducing
      a. ASTM C494 Type A - for use in cool weather.
      b. ASTM C494 Type D - for use in hot weather.
   2. Air Entraining
      a. Conform to ASTM C 260
   3. Fly Ash
      a. Conform to ASTM C 618
   4. Mid-Range Water-Reducers
      a. Master Builders "Polyheed" or approved equal.
   5. Fly Ash Pozzolan
      a. Conforming to ASTM A-618 Class F

E. Slab on Grade Vapor Retarder
   1. Vapor Retarder must have the following qualities:
      a. 15 mil thickness minimum
      b. WVTR less than 0.008 as tested by ASTM E 96
      c. ASTM E 1745 Class A (Plastics)
   2. Vapor Retarder Products
      a. Stego Wrap Vapor Retarder by STEGO Industries LLC.
      b. W.R. Meadows Premoulded Membrane with Plasmatic Core.
      c. Zero-Perm by Alumiseal.
   3. Vapor Retarder Tape
      a. Water Vapor Transmission Rate: ASTM E 96, 0.3 perms or lower
      b. Minimum 8-mils thick
      c. Minimum 3 3/4 inches wide
      d. Manufactured from High Density Polyethylene
      e. Pressure Sensitive Adhesive

F. Sand: Clean, dry, well graded.

G. Abrasive aggregate for non-slip finish: Fused aluminum oxide grits, graded 12/30. Use factory-graded rustproof and non-glazing material that is unaffected by freezing, moisture and cleaning materials.
   1. Products offered by manufacturers to comply with the above requirements include: A-H Alox; Anti-Hydro Waterproofing Co., Toxgrip; Toch Div. - Carboline, or approved equal.

H. Expansion Joint Filler:
   1. Joint fill shall be a preformed non-extruded resilient filler, saturated with bituminous materials and conforming to ASTM D 1751. Products shall be equivalent to Burke "Fiber Expansion Joint", W.R. Meadows "Fibrated Expansion Joint Filler", or approved equal.

I. Bonding Agent: Sonneborn "Sonobond"; the Euclid Chemical Company "Euco-Weld"; Larsen Products Corp., "Weld-Crete" or approved equivalent.
J. Concrete Sealer: Cure and Seal, as manufactured by the Euclid Chemical Company "Aqua-Cure VOX", Sonneborn "Kure-N-Seal WB", Burke "Spartan-Cote", W.R. Meadows "Intex" or approved equal conforming to ASTM C-309, Type I, Class B requirements, and conforming to State of California Air Resources Board VOC Regulations.


L. Concrete Cure: Water based curing compound conforming to ASTM C-309, Type 1, Class A and B, and AASHTO Specification M-148; Type 1, Class A and B requirements, and State of California Air Resources Board VOC Regulations. Product shall be equivalent to Euclid Chemical Company "Kurez VOX", Burke "No. 1127" or "Aqua-Resin Cure", W.R. Meadows "1100 Clear", or approved equal.

M. Non-Shrink Grout: See Section 2.2.A.6.

2.02 CONCRETE

A. Concrete Mixes:

1. Type A Concrete:
   - Strength: 3000 lbs. per square inch at 28 days.
   - Maximum Aggregate Size: 1-1/2 inch.
   - Cement Content: As required by mix design (ACI 318 Section 5.3).
   - 5.0 sacks per yard minimum.
   - Maximum Water to Cement Ratio: 0.58
   - Weight: 145 lbs. per cubic foot
   - Use for unexposed foundation concrete except as otherwise specified. At Contractor's option, Type B concrete may be substituted for this.

2. Type B Concrete:
   - Strength: 3500 lbs. per square inch at 28 days.
   - Maximum Aggregate Size: 1 inch.
   - Minimum Cement Content: As required by mix design. (ACI 318 Section 5.3).
   - 5.5 sacks per yard minimum.
   - Maximum Water to Cement Ratio: 0.45
   - Admixture: Water reducing.
   - Weight: 145 lbs. per cubic foot
   - Use for building slab on grade
   - Maximum Fly Ash content as a percentage of total cementitious material: 15%

3. Type C Concrete:
   - Strength: 4000 lbs. per square inch at 28 days.
   - Maximum Aggregate Size: 1 inch.
   - Minimum Cement Content: As required by mix design (ACI 318 Section 5.3).
   - 6.5 sacks per yard minimum.
   - Maximum Water to Cement Ratio: 0.50
   - Admixture: Water reducing.
   - Weight: 145 lbs. per cubic foot
   - Use for columns, beams, walls and overhead structural slabs except as otherwise specified

4. Type D Concrete:
   - Strength: 3500 lbs. per square inch at 28 days.
   - Maximum Aggregate Size: 3/4 inch.
   - Minimum Cement Content: As required by mix design (ACI 318 Section 5.3).
   - 6.0 sack per cubic yard minimum.
   - Maximum Water to Cement Ratio: 0.52
   - Admixture: Water reducing.
Weight: 145 lbs. per cubic foot
Use for normal weight concrete over metal deck

5. Type E Concrete:
   Strength: 3,000 lbs. per square inch at 28 days.
   Maximum Aggregate Size: 3/4 inch.
   Minimum Cement Content: As required by mix design (ACI 318 Section 5.3).
   6.0 sacks per yard minimum.
   Maximum Water to Cement Ratio: 0.52
   Admixture: Water reducing.
   Weight: 115 ± 3 lbs. per cubic foot.
   Use for lightweight concrete over metal deck.

6. Grout shall be non-shrink, non-metallic, flowable Type "713" or "928" by Master Builders.
   a. Metallic grout equivalent to Master Builders "Embeco" may be used only where covered by earth, concrete, or masonry.
   b. Acceptance by Architect required before using.

B. Consistency of Concrete: Concrete slump, measured in accordance with ASTM C 143, shall fall within following limits.
   1. For General concrete placement: 3 inch plus or minus 1 inch.
   2. Mixes employing the specified mid-range water reducer shall provide a measured slump not to exceed 7 inch ±1 inch after dosing, 2 inch ±1 inch before dosing.
   3. Concrete slump shall be taken at point of placement. Use water reducing admixtures as required to provide a workable consistency for pump mixers. Water shall not be added at the jobsite without written review by the structural engineer.

C. Mix Design:
   1. Initial mix design shall be prepared for all concrete in accordance with ACI 318 Section 5.3. Mix proportions shall be determined in accordance with ACI 318 Section 5.3 or Section 5.4. In the event that additional mix designs are required due to depletion of aggregate sources, aggregate not conforming to Specifications or at request of Contractor, these mixes shall be prepared as above.
   2. Contractor shall notify the Testing Laboratory and Architect of intent to use concrete pumps to place concrete so that mix designs can be modified accordingly.
   3. Fly ash shall not exceed fifteen percent of the total cementitious material.
   4. Provide 6% air entrainment typical for exterior concrete exposed to freeze-thaw cycles.
   5. Owner's testing laboratory shall review all mix design before submittal.

D. Mixing:
   1. Equipment: All concrete shall be machine mixed. Provide adequate equipment and facilities for accurate measurement and control of materials.
   2. Method of Mixing:
      a. Transit Mixing: Comply with ASTM C 94. Ready mixed concrete shall be used throughout, except as specified below.
      b. On-Site Mixing: Use only if method of storing material, mixing of material and type of mixing equipment is approved by Architect. Approval of site mixing does not relieve Contractor of any other requirements of Specifications.
      c. Mixing shall be in accordance with ACI 318 Section 5.8.
   3. Mixing Time: After mix water has been added, concrete shall be mixed not less than 1-1/2 minutes nor more than 1-1/2 hours. Concrete shall be rejected if not deposited within the time specified.
   4. Admixtures:
      a. Air entraining and chemical admixtures shall be charged into mixer as a solution and shall be dispensed by an automatic dispenser or similar metering device. Powdered admixtures shall be weighed or measured by volume as recommended by manufacturer. Accuracy of measurement of any admixture shall be within plus or minus 3%.
      b. Two or more admixtures may be used in same concrete, provided such admixtures are added separately during batching sequence, and provided further that admixtures used in that combination retain full efficiency and have no deleterious effect on concrete or on properties of each other.
      c. All admixtures are to be approved by Structural Engineer prior to commencing this work.
5. Retempering:
   a. Concrete shall be mixed only in quantities for immediate use. Concrete which has set shall be discarded, not retempered.
   b. Indiscriminate addition of water to increase slump is prohibited.
   c. When concrete arrives at project with slump below that suitable for placing, water may be added only if neither maximum permissible water-cement ratio nor maximum slump is exceeded. Water shall be incorporated by additional mixing equal to at least half of total mixing time required. Any addition of water above that permitted by limitation of water-cement ratio shall be accompanied by a quantity of cement sufficient to maintain proper water-cement ratio. Such additions shall only be used if approved by Architect. In any event, with or without addition of cement, not more than 2 gallons of water per cubic yard of concrete, over that specified in design mix, shall be added.

6. Cold Weather Batching: When average of the highest and lowest air temperature falls below 40 degrees F for more than three consecutive days, provide adequate equipment for heating concrete materials. No frozen materials or materials containing ice shall be used. When placed in forms, concrete placed in these temperatures shall have a minimum temperature based on dimensions of concrete sections placed per ACI 301.

7. Hot Weather Batching: Concrete deposited in hot weather shall have a placing temperature below 90 degrees F per ACI 301. If necessary, ingredients shall be cooled to accomplish this.

2.03 FLOOR LEVELING AND FILL MATERIALS

A. Epoxy Concrete Mortar: Floor leveling, non-shrink trowel applied epoxy concrete mortar; TPM 115 General Polymers Corp., A-H Emery Epoxy Topping #170 Anti-Hydro Corp., or approved equal, where areas to fill are less than 1/4 inch thick.

B. Concrete Mortar: Floor leveling, patching and repair, non-shrink trowel applied concrete mortar; Master Builders EMBECO 411-A, Euclid EUCO, or approved equal, where areas of fill are greater than 1/4 inch thick.

C. Cementitious Floor Leveling Material: Shall be self-leveling or trowelable with a minimum 28 day compressive strength of 3000 psi in accordance with ASTM C-109. Material shall be equal to Quickrete No. 1249, Ardex V-600/K-55, Mapei "Ultra/Flex" or approved equal.

PART 3 - EXECUTION

3.01 PLACEMENT

A. 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, adequately braced, cleaned, sealed, lubricated if required, and bulkheaded where placing is to stop.
   2. 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.
   3. Reinforcing steel shall have been placed, tied and supported.
   4. Embedded work of all trades shall be in place in the forms and adequately tied and braced.
   5. The entire place of deposit shall have been cleaned of wood chips, sawdust, dirt, debris, hardened concrete and other foreign matter. No wooden ties or blocking shall be left in the concrete except where indicated for attachment of other work.
   6. Reinforcing steel, at the time the concrete is placed around it, shall be cleaned of scale, mill scale or other contaminants that will destroy or reduce bond.
   7. Concrete surfaces to which fresh concrete is to be bonded 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.
   8. Prior to placing concrete for any slabs on grade, the moisture content of the subgrade below the slabs shall be adjusted to at least optimum moisture.
   9. No concrete shall be placed until formwork and reinforcement has been approved by Architect. Clean forms of all debris and remove standing water. Thoroughly clean reinforcement and all handling equipment for mixing and transporting concrete. Concrete shall not be placed against reinforcing steel that is hot to the touch. Notify Structural Engineer 48 hours in advance of concrete pour.

B. Conveying: Handle concrete from mixer to place of final deposit by methods which will prevent separation or loss of ingredients. Deposit concrete in forms as nearly as practicable at its final position in a manner which will insure that
required quality is obtained. Chutes shall slope not less than 4 inches and not more than 6 inches per foot of horizontal run.

C. Depositing: Deposit concrete into forms in horizontal layers not exceeding 24 inches in thickness around building, proceeding along forms at a uniform rate and consolidating into previous pour. In no case shall concrete be poured into an accumulation of water ahead of pour, nor shall concrete be flowed along forms to its final place of deposit. Fresh concrete shall not be permitted to fall from a height greater than 6 feet without use of adjustable length pipes or, in narrow walls, of adjustable flexible hose sleeves. Concrete shall be scheduled so that placing is a continuous operation for the completion of each section between predetermined construction joints. If any concreting operation, once planned, cannot be carried on in a continuous operation, concreting shall stop at temporary bulkheads, located where resulting construction joints will least impair the strength of the structure. Location of construction joints shall be as shown on the drawings or as approved by Structural Engineer. The rate of rise in walls shall not be less than 2 feet per hour.

1. Consolidation: Concrete shall be thoroughly compacted and worked to all points with solid continuous contact to forms and reinforcement to eliminate air pockets and honeycombing. Power vibrators of approved type shall be used immediately following pour. Spading by hand, hammering of forms or other combination of methods will be allowed only where permitted by Structural Engineer. In no case shall vibrators be placed against reinforcing steel or used for extensive shifting of deposited fresh concrete. Provide and maintain standby vibrators, ready for immediate use.

2. Hot Weather Concreting: Unless otherwise directed by the Architect, perform all work in accordance with ACI 305 when air temperature rises above 75 degrees F and the following:
   a. Mixing Water: Keep water temperature as low as necessary to provide for the required concrete temperature at time of placing. Ice may be required to provide for the design temperature.
   Aggregate: Keep aggregate piles continuously moist by sprinkling with water.
   Temperature of Concrete: The temperature of the concrete mix at the time it is being placed in the forms shall not exceed 90 degrees F per ACI 301. The method employed to provide this temperature shall in no way alter or endanger the design mix or the design strength required.
   Dampen subgrade and formwork before placing concrete. Remove all excess water before placing concrete.
   Keep concrete continuously wet when air temperature exceeds 85 degrees F for a minimum of 48 hours after placing concrete. For slab on grade construction, see Section 3.1.E.
   Protection: Minimize evaporation from concrete in place by providing shade and windbreaks. Maintain such protection in place for 14 days minimum.

3. Cold Weather Concreting: Follow recommended ACI 306 procedures when average of the highest and lowest air temperature falls below 40 degrees F for more than three consecutive days, as approved by Architect. Concrete placed in these temperatures shall have a minimum temperature based on dimensions of concrete sections placed as shown in ACI 301. No chemicals or salts shall be used to prevent freezing and no accelerating agents shall be used without prior approval from Architect.

D. Construction Joints: Install only as indicated and noted on Drawings. Joints not indicated on Drawings shall be so located, when approved, as to least impair strength of structure, and shall conform to typical details. Construction joints shall have level tops, vertical sides. Horizontal construction joints shall be thoroughly cleaned and roughened by removing entire surface film and exposing clean aggregate solidly embedded in mortar matrix. Joints between concrete and masonry shall be considered construction joints. Vertical construction joints need not be roughened. See Drawings for doweling and required keys.

1. Roughen construction joints by any of following methods:
   a. By sandblasting joint.
   b. By thoroughly washing joint, using a high pressure hose, after concrete has taken initial set. Washing shall be done not less than 2 hours nor more than 4 hours after concrete has been poured, depending upon setting time.
   c. By chipping and wire brushing.

2. All decisions pertaining to adequacy of construction joint surfaces and to compliance with requirements pertaining to construction joints shall be reviewed with the Structural Engineer.

3. Just before starting new pour, horizontal and vertical joint surfaces shall be dampened (but not saturated).

4. Before placing regular concrete mix, horizontal construction joint surfaces shall be covered with a layer of mortar composed of cement and fine aggregate of same proportions as that used in prescribed mix, but omitting coarse aggregate.

5. For slabs, construction joints shall be in locations shown on plan. If not shown, locate at intervals not exceeding 150 feet in each direction. Refer to drawings for proper details for reinforcing at construction joints.
E. Concrete Slabs on Grade:
1. Exterior and interior concrete slabs on grade shall be poured as required under this Section. Base shall be accurately leveled and compacted prior to placing of concrete.
2. Typically, interior slabs on grade shall be poured over a minimum of four (4 inch) inches of compacted crushed rock, unless otherwise indicated, over a vapor retarder.
3. Protect slab on grade subbase from moisture prior to placing concrete. Avoid wetting rock layer to allow adequate concrete curing and avoid future vapor transmission. If the subbase has been wet excessively, verify that water has been eliminated prior to placement of concrete.
4. Vapor Retarder installation shall be in accordance with manufacturer’s instructions and ASTM E 1643-98.
   a. Unroll Vapor Retarder with the longest dimension parallel with the direction of the pour.
   b. Lap Vapor Retarder over footings and seal to foundation walls.
   c. Overlap joints 6 inches and seal with specified tape.
   d. Seal all penetrations (including pipes) per manufacturer’s instructions.
   e. No penetration of the Vapor Retarder is allowed except for reinforcing steel and permanent utilities.
   f. Repair damaged areas by cutting patches of Vapor Retarder, overlapping damaged area 6 inches and taping all four sides with tape.

F. Control Jointing - Slabs on Grade:
1. Joints shall be in locations indicated on Drawings, or as directed by Architect.
2. Joints in interior slabs shall be made by one of following methods:
   a. By use of construction joints laid out in checkerboard pattern; pour and allow alternate slabs to set; fill out balance of checkerboard pattern with second pour.
   b. By use of dummy groove joints at least 1/4 depth of slab, and at least 1/8 inch wide. These joints may be sawcut as soon as wet concrete can support the weight of the equipment and operator. Delaying sawcutting past this point will make jointing ineffective.
3. Control jointing in exterior paving slabs shall be laid out in a checkerboard pattern; pour as described above, but with joint edges tooled to provide a uniform joint at least 3/8 inch in depth.
4. Slab reinforcing need not be terminated at control joints.
5. Construction and expansion joints shall be counted as control joints.

G. Expansion Joints:
1. Unless otherwise indicated, use 3/8 inch thick expansion joint filler. See Section 2.1 H
2. Joints in interior slabs on grade shall be only in locations indicated.
3. Joints in exterior slabs on grade shall be installed at each side of structures, at curb transitions opposite apron joints, at ends of curb returns, at back of curb when adjacent to sidewalk, and at uniformly spaced intervals not exceeding 20 feet.
4. Edges of concrete at joints shall be edger finished to approximately 3/8 inch radius.
5. Interrupt reinforcing at all expansion joints.

H. Score markings on exterior slabs on grade shall be located as indicated. Where not indicated, mark slabs into rectangles of not less than 12 square feet nor more than 20 square feet using a scoring tool which will leave edges of score markings rounded.

3.02 CURING AND PROTECTION

A. Curing: Exposed surfaces of all concrete used in structure shall be maintained in a moist condition for at least 7 days after placing. The following final curing processes shall normally be considered to accomplish this. Concrete shall be maintained at not less than 50 degrees F nor more than 100 degrees F for a period of 72 hours after being deposited.
1. Flatwork to be exposed, stained, or painted shall have curing process submitted and approved by the architect prior to construction.
2. Initial Curing Process - Flat Work:
   a. Mist Spraying: As soon as troweling of concrete surfaces is completed, exposed concrete shall be sprayed continuously with a special atomizer spray nozzle, capable of producing a fine mist. Spraying shall be done without any dripping of water from nozzle. Amount of spraying shall be such as to maintain surface of concrete moist without any water accumulating on surface. Maintain spraying for a minimum of 12 hours, or until such time as hereinafter described curing process is applied. Mist spraying will not normally be required when the ambient air temperature is below 90 degrees F.
3. Final Curing Process - Flatwork: Except as noted, use any of the following:
   a. Water Curing: Concrete shall be kept wet by mechanical sprinklers or by any other approved method which will keep surfaces continuously wet.
   b. Saturated Burlap Curing: Finished surfaces shall be covered with a minimum of two layers of heavy burlap which shall be kept saturated during the curing period.
   c. Curing Compounds: Membrane curing compounds of chlorinated rubber or resin type conforming to ASTM C309 may be used only if specifically approved by Architect. Use of membrane curing compound will not be permitted on surfaces to be painted, or to receive ceramic tile, membrane water-proofing or hardeners and sealers. Membrane curing compound may be used in areas to receive resilient floor tile, provided it is wax-free, compatible with adhesive used and approved by adhesive manufacturer. Agitate curing compounds thoroughly by mechanical means continuously during use and spray or brush uniformly in accordance with manufacturer's recommendations. Apply immediately following final finishing operation. All curing compounds shall conform to State of California Air Resources Board VOC Regulations.
   d. Waterproof paper conforming to ASTM C171, or opaque polyethylene film, may be used. Concrete shall be covered immediately following final finishing operation. Anchor paper or film securely and seal all edges in such a manner as to prevent moisture escaping from concrete.

4. Curing Process - Formed Surfaces: Forms heated by sun shall be kept moist during curing period. If forms are to be removed during curing period, curing as described for flatwork shall be commenced immediately.

B. Refer to Drawings for areas of concrete slab not to receive curing compounds or hardening compounds. Where concrete floors are to receive heavy duty coatings, waterproof coatings and the like, verify with coating installer the type of finish required for specified coating.

C. Protection: Contractor shall be responsible for protection of finished concrete against injury by rain, cold, vibration, animal tracks, marking by visitors, vandalism, etc.

D. Provide additional curing agents or compounds, not necessarily listed herein, but as recommended and required for use with shake type hardeners or other special coatings and coverings by their manufacturers for a complete and proper installation.

3.03 FINISHES

A. Formed Surfaces:
   1. Rough Form Finish: Surfaces shall be reasonably true to line and plane with no specified requirements for selected facing materials. Tie holes and defects shall be patched and fins exceeding 1/4 inch in height shall be rubbed down with wooden blocks. Fins and other rough spots at surfaces to receive membrane waterproofing shall be completely removed and the surfaces rubbed smooth. Otherwise, surfaces shall be left with the texture imparted by forms.
      a. Rough finish shall be used for the following areas:
         1) Below grade and unexposed surfaces.
   2. Smooth Plywood Form Finish: Finish shall be true to line and plane. Tie holes and defects shall have been patched and ground with surface fins removed. Arrangement of plywood sheets shall be orderly, symmetrical, as large as practical and free of torn grain or worn edges. Surface concrete shall be treated with 1 part muriatic acid, in three parts water solution, followed immediately by a thorough rinsing with clear water. Surfaces which are glazed, have efflorescence, or traces of form oil, curing compounds or parting compounds shall be cleaned or treated to match other formed surfaces, except as otherwise indicated or specified.
      a. Smooth Plywood Form Finish shall be used for the following areas:
         1) All surfaces above grade unless otherwise specified.
         2) At Contractor's option, may also be used in lieu of rough form finish.
   3. Smooth Plastic Liner Finish: Surface shall be smooth, concrete free of honeycombing, air pockets larger than 1/8 inch in diameter, and fins.
      a. This finish shall be used only where indicated on the Drawings.

B. Flatwork:
   1. Unless otherwise indicated or specified, flatwork shall have an integral monolithic finish.
   2. Integral Monolithic Finish: Apply as soon as freshly poured concrete slabs will bear weight of workers. Pour slabs full thickness to finish floor elevations indicated. At proper time, tamp surface repeatedly with a wire mesh or grid tamper in a manner to force aggregate down below surface and to bring sufficient mortar to surface to provide for...
a smooth coating of cement mortar over entire surface. Allow surface mortar to partially set, then float with wooden floats and finish with one of following, as required.

a. Broom Finish: Steel trowel surface to a smooth dense surface free of lines, tool marks, cat faces and other imperfections. After troweling, and before final set, give surface a broom finish, brushing in direction noted on Drawings, or as directed. Broom finish shall be used typically on exterior flatwork except as otherwise indicated or specified and shall be "medium" texture as approved by Architect.

b. Smooth Steel Trowel Finish: Apply 2 steel trowelings to obtain hard, smooth surface. All lips, irregularities, uneven levels, etc. shall be worked out before last troweling. All interior flatwork shall have a smooth steel trowel finish unless specified otherwise.

3. Tolerances:
   a. For tolerances not indicated, refer to ACI 117.
   b. Slabs on grade – Comply with Fr & Fl as specified by Architect, or at a minimum shall be sufficiently even to contact a 10' long straightedge with a tolerance of 1/8 inch.
   c. Concrete over metal deck – Refer to Section 05 30 00 for minimum requirements.
   d. Elevated slabs – Comply with Architectural requirements.
   e. Finished surfaces of exterior integral finished flatwork shall not vary more than 1/4 inch from a 10' long straightedge, except at grade changes.

C. Sacked Surfaces: Exposed surfaces that are unacceptable in appearance to the Architect shall be sacked.
   1. Prepare concrete surfaces in accordance with the referenced standards. Remove any form release materials by stoning by hand, power grinding or other method approved by the Architect.
   2. Prepare concrete surfaces to receive sack finishing with a light sand blasting.
   3. For best results, grout application and rubbing should be performed when areas to be treated are shaded and during cool, damp weather. When work is to be performed in hot and dry weather, a fog spray should be available for continuous use.
   4. Prepare grout samples for matching of concrete surfaces for approval by the Architect. These shall be made in the following proportions of gray cement to white cement to sand: 1:1:2, 1:2:3, and 2:1:3, etc. until the correct matching color is obtained on the test areas. Sand should be fine enough to pass the Number 30 sieve. Mixes should be made to a good workable consistency in a clean container and the mix with the best color chosen, or modified if needed.
   5. Provide sufficient qualities of sand and cement from the same source for the complete work at the job site.
   6. Mixing and Application:
      a. Mixing of grout on the job should be timed for it to be used up within 1 to 1-1/2 hours.
      b. Let the grout stand 20 to 30 minutes after mixing, and then remixed before applying.
      c. Soak the concrete surface thoroughly with water at least 15 minutes before applying grout and again just before application so that the surface is adequately wet during the operation.
      d. Apply grout with plasterer's trowel or sponge rubber float in sweeping strokes from the bottom up. Brush or spray gun applications may be used when approved by the Architect.
      e. Work in freshly applied grout vigorously with a sponge rubber float, then let sit until some of its plasticity is gone but not until it loses its damp appearance. At this point it shall be rubbed with clean, dry burlap to remove the excess grout, leaving no visible film on the surface but filling all air holes.
      f. Keep the surface wet for a day after grouting and sack rubbing are completed.
   7. Alternate methods of application and materials shall be subject to the approval of the Architect.

3.04 PATCHING

A. Formed Surfaces:
   1. Promptly upon removal of contact forms and after concrete surfaces have been inspected, form ties shall be removed and all necessary patching and pointing shall be expertly done.
   2. Honeycombed areas shall be removed down to sound concrete, coated with a bonding grout or approved compound and patched using a low shrinkage high bond mortar. Patched areas shall be cured by being kept damp for at least 5 days.
   3. Tie holes shall be cleaned, dampened and filled solid with patching mortar or cement plugs of an approved variety.

B. Slabs on Grade: After entire slab is finished, shrinkage cracks that may appear shall be patched as follows:
   1. Where slab is not exposed or where appearance is not important, cracks larger than 1/32 inch wide shall be filled with cement grout and struck off level with surface.
2. Where slab is exposed and appearance is important, unsightly cracks shall be repaired in a manner satisfactory in appearance to Architect. If this cannot be accomplished, concrete shall be considered defective.

3.05 DEFECTIVE CONCRETE

A. Defective concrete shall mean any of the following:
   1. Concrete not meeting 100 percent of the specified 28 day compressive strength.
   2. Concrete exhibiting rock pockets, voids, spalls, streaks, cracks, exposed reinforcing to extent that strength, durability, or appearance is adversely affected.
   3. Concrete significantly out of place, line, or level.
   4. Concrete not containing the required embedded items.

B. Upon determination that concrete strength is defective:
   1. Should cylinder tests fall below minimum strength specified, concrete mix for remainder of work shall be adjusted to produce required strength. Core samples shall be taken and tested from cast-in-place concrete where cylinders and samples indicate inferior concrete with less than minimum specified strength.
      a. Cores of hardened concrete shall be taken and tested in accordance with ASTM C 42 and C 39. Number and location of such cores shall be subject to the approval of Architect.
      b. Cost of core sampling and testing will be paid for by the Contractor.
      c. “85 percent” reduction in ACI 318 Section 5.6.5.4 will not justify low cylinder tests.

C. Upon determining that concrete surface is defective, Contractor may restore concrete to acceptable condition by cutting, chipping, pointing, patching, grinding, if this can be done without significantly altering strength of structure. Permission to patch defective areas will not be considered a waiver of the right to require removal if patching does not, in the opinion of the Architect, satisfactorily restore quality and appearance.

D. If core tests indicate that concrete is below the strength specified, or if patching does not restore concrete to specified quality and appearance, the concrete shall be deemed defective, and shall be removed and replaced without additional cost to the Owner.

E. No repair work shall begin until procedure has been reviewed by the Architect and Structural Engineer.

3.06 SURFACE HARDENER AND SEALER

A. Seal all interior exposed flatwork with clear sealer, except surfaces receiving ceramic tile, quarry tile, poured flooring or other special finishes specified, or as scheduled on the Drawings.
   1. Apply sealer in 2 or 3 coats, in accordance with manufacturer's directions, using the maximum quantity recommended.
      a. Concrete floors must be thoroughly cured for a minimum of 30 days and completely dry before treatment.
      b. Surfaces to be treated must be clean, free of membrane curing compounds, dust, oil, grease and other foreign matter.
      c. Upon completion, concrete surfaces shall be clean and without discoloration or traces of excess hardener left on the surface.

B. Apply sprayable hardener/sealer at locations as scheduled or as indicated on the Drawings. Apply in accordance with the manufacturer's favorably reviewed application instructions and recommendations.

3.07 GROUTING

A. Prepare and place grout materials at locations as indicated on the Drawings in accordance with the manufacturer's recommendations and installation instructions.

B. Pack grout materials solidly between bearing surfaces and bases or plates as indicated and to ensure no voids.

3.08 ADJUSTING AND CLEANING

A. Remove all debris, excess materials, tools and equipment resulting from or used in this operation at completion of this work.
PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Requirements of Division 1 shall apply to all Work of this Section.

1.02 SCOPE

A. Furnish all labor, materials, equipment, facilities, and transportation necessary to complete all pneumatically placed concrete work indicated and/or specified, including, but not limited to:
   1. Furnishing, mixing, depositing, and curing of pneumatically placed concrete. (Wet-mix or Dry-mix methods)
   2. Pneumatically placed concrete finishing.
   3. Install cast-in-place miscellaneous steel, fittings, anchors, and other items furnished by other trades to be installed in pneumatically placed concrete work.

1.03 RELATED WORK (See also Table of Contents)

A. Concrete Formwork: Section 03 10 00.
B. Reinforcing Steel: Section 03 21 00.
C. Cast-in-Place Concrete: Section 03 30 00.

1.04 QUALITY ASSURANCE

A. General:
   1. Contractor, to be eligible, shall have had at least 3 years of experience in pneumatically placed concrete construction and must list at least 5 structural projects that he has constructed.
   2. Only experienced foremen and workmen shall be employed and satisfactory evidence of such experience shall be furnished upon demand.
   3. Very close tolerances will be strictly enforced on all phases of this work. Variance of more than 1/4" from specified thickness will be considered defective.
   4. Provide at least one person to be present at all times during execution of the work of this Section and who shall be thoroughly familiar with the manufacturer's recommended methods of installation as well as the requirements of this work, and who shall direct all installation performed under this Section.

B. Standards and References: (Latest Edition unless otherwise noted)
   2. American Concrete Institute (ACI).
      a. ACI 301 - "Structural Concrete for Buildings".
      b. ACI 306.1 - "Cold Weather Concreting".
      c. ACI 506 - "Specification for Materials, Proportioning and Application of Shotcrete".
      a. ASTM C42 – "Obtaining and Testing Drilled Cores and Sawed Beams of Concrete."

C. 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. The following tests shall be made by a recognized Testing and Inspection Agency engaged by the Owner.
      a. Test cement in accordance with ASTM C150. One sample shall be taken and tested for each 10 tons of cement. Analysis and test reports by supplier certifying that cement conforms to Specifications is acceptable in lieu of tests.
b. Review and check proposed mix proportions by the testing laboratory.

c. Test preconstruction test specimens in accordance with ASTM C42.

d. Review certificates and production samples of materials prepared by Contractor during construction and review for compliance with Specifications.

e. Test strength of the concrete as work progresses in accordance with ASTM C42.

f. Provide special inspection of materials, equipment, reinforcing placement, all shotcrete placing and the taking of test specimens per CBC Section 1705.3.

3. Preconstruction Testing: The Contractor shall at his expense prepare test panels for examination and testing prior to construction.

a. Produce one test panel for each mix design, each anticipated shooting direction, and each ACI certified nozzleman. All test panels and cores should be clearly marked with the date of shooting, name of nozzleman, and mix design number.

b. Test panel shall be large enough to contain the same reinforcement as the most congested portion of the structure in at least half of the panel (to verify proper encasement of reinforcement) and provide enough space to obtain the non-reinforced cores. Test panel shall not be less than 30 inches by 30 inches and the same thickness as the structure, but not less than 6 inches. Contractor shall obtain six test specimens from each test panel, three without reinforcing and 3 with reinforcing. All cut or broken surfaces shall be dense and free from laminations and sand pockets.

c. Shotcrete cores shall be graded according to ACI 506.2. A minimum average grade of 2.5 or less is required for proper acceptance.

4. Construction Testing:

a. At his expense, Contractor shall make, store and cure 1 test panel with minimum dimensions of 18 inches x 18 inches minimum with thickness to match construction, gunned in same position as work represented, for every 50 cubic yards of concrete placed, but at least 1 panel per shift. Panels shall be gunned during the course of the work by Contractor's regular nozzleman. Field cure panels in the same manner as the work, except that the test specimens shall be soaked in water for a minimum of 24 hours prior to testing. Test panels shall contain reinforcing similar to actual conditions.

b. Contractor shall deliver test panels to testing laboratory where the testing agency will obtain test specimens per ASTM C1140. Provide minimum of one reinforce core for grading purposes and four non-reinforced cores for verification of strength, one at 7-days and three at 28-days. See CBC Section 1910.10 for further requirements.

c. When the length of the core is less than twice the diameter, apply the correction factors given in ASTM C42 to obtain the compressive strength of individual cores.

d. Cores may be taken from the structure in lieu of test panels only with approval of architect and structural engineer.

e. The average compressive strength of 3 cores taken from the structure or test panel, representing a shift or 50 cubic yards of pneumatically placed concrete must equal or exceed \( f'c \) with no individual core less than 0.88 \( f'c \). The average of three cubes taken from a panel representing a shift or 50 cubic yards of concrete must equal or exceed \( f'c \) with no individual cube less than 0.88 \( f'c \).

f. Final acceptance of the pneumatically placed concrete will be based on results obtained from cores or sawed cubes. Use of data obtained from impact hammers, ultrasonic equipment, or other nondestructive testing devices will not be permitted for final acceptance of the concrete.

g. The core through reinforcing shall be visually inspected and graded for complete concrete encasement.

h. A record shall be kept of time panels are made and of location of concrete from which samples were taken.

i. Not less than three 3" core samples shall be taken from the structure and tested. Location of cores shall be as directed by the Structural Engineer. The taking and testing of cores will be at Owner's expense. Holes from coring will be patched at Contractor's expense according to ACI 301 Chapter 9.

D. Submittals: (Submit under the provisions of Section 01 33 00)

1. Product data (certificates of compliance).

2. Mix designs.

3. Reinforcing steel shop drawings under Section 03 21 00.

4. Preconstruction mockup rebar layout shop drawing.

5. ACI Certification of shotcrete nozzlemen.

6. Evaluation results of reinforced core grading for each nozzleman. Provide results prior to production shotcreting.
A. Deliver undamaged products to site in manufacturer's sealed containers or wrappings with legends intact. Store on site secure from weather, soil and physical damage.

B. Store in strict accordance with the manufacturer's recommendations.

1.06 PROJECT CONDITIONS

A. Products shall be available at project when required for installation so as not to delay job progress. Installer for these products shall cooperate with installers performing work under other Sections involved to effect proper installation.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Portland Cement: ASTM C150, Type 1 or Type 2.

B. Aggregate: ASTM C33.

1. Fine and coarse aggregates shall be regarded as separate ingredients. Each size of coarse aggregate, as well as combination of sizes when two or more are used, shall conform to grading requirements of the appropriate ASTM standards. Aggregate shall not exceed 3/4" in size.

C. Water: Clean, fresh, free from injurious amounts of oil, acids, alkali, organic matter or other deleterious substances, and suitable for domestic consumption.

2.02 PNEUMATICALLY PLACED CONCRETE

A. Strength: 28 day compressive strength shall be as noted on drawings. Select material proportions to produce concrete of required strength.

B. Maximum volume of aggregate per 94-pound sack of cement shall be 4.5 cubic feet, dry measure. Cement and fine aggregate shall be thoroughly mixed prior to addition of water. At time of mixing, fine aggregate shall contain from 3 to 6 percent moisture by weight. Exact proportions shall be as designed by testing laboratory.

C. Water content at time of discharge, including any moisture in fine aggregate, shall not exceed a water/cement ratio of 0.45.

D. Mix Design: Initial mix design shall be prepared by a testing laboratory in accordance with CBC Section 1903.1, based upon aggregate sampled for that purpose. In event that additional mix designs are required due to depletion of aggregate sources, aggregate not conforming to specifications, or at request of contractor, these mixes shall be prepared by testing laboratory, but a contractor's expense. Contractor shall submit a mix design which shall be subject to Structural Engineer's review.

E. Mixing: Adequate and suitably calibrated equipment and facilities for accurate measurement and control of materials shall be provided; shovel measurements will not be acceptable. Thoroughly mix cement and aggregate for at least one minute prior to adding water.

F. Cold Weather Placement: Follow recommended ACI 306.1 procedures when average of the highest and lowest air temperature falls below 40°F for more than three consecutive days, as approved by Architect. Concrete placed in these temperatures shall have a minimum temperature based on dimensions of concrete sections placed as shown in ACI 301.

G. Hot Weather Placement: Concrete deposited in hot weather shall have a placing temperature below 90°F per ACI 301. If necessary, ingredients shall be cooled to accomplish this.

2.03 MISCELLANEOUS ITEMS

A. Provide all miscellaneous accessory items as indicated on the Drawings or as required by the product manufacturer for a complete and proper installation of the materials, products or systems specified in this Section.
PART 3 - EXECUTION

3.01 GENERAL

A. Prior to installation of the work of this Section, carefully inspect and verify that the installed work of all other trades is complete to the point where this installation may properly commence.

B. Verify that specified items may be installed in accordance with the approved design.

C. In the event of discrepancy, immediately notify the Architect. Do not proceed in discrepant areas until discrepancies have been fully resolved.

D. Inspect adjacent construction and surfaces to receive pneumatically placed concrete and make sure that all conditions detrimental to the timely or proper performance of this work have been corrected before proceeding.

3.02 PREPARATION

A. Sand blast entire surface to remove all unsound material before applying pneumatically placed concrete. Chip or scarify any area to be repaired to remove offsets which would cause an abrupt change in thickness without suitable reinforcement. Taper edges to leave no square shoulders at the perimeter of a cavity. Remove all loose material from areas receiving concrete.

3.03 PLACEMENT

A. Conform with requirements of CBC Section 1910 and ACI 506. Either Dry-mix or Wet-mix applications are acceptable.

B. Before placing concrete, Structural Engineer shall be notified, and review of the forms and reinforcement shall be obtained. Forms shall be cleaned of all debris. Reinforcement and all handling equipment for placement of pneumatically placed concrete shall be thoroughly cleaned. Notify the Structural Engineer 48 hours in advance of placement of pneumatically placed concrete.

C. Forms: In addition to requirements listed under Section 03 10 00, Concrete Formwork, forms for pneumatically placed concrete shall be constructed to permit escape of air and rebound during gunning operation. Ground wires shall be taut, true to line and of sufficient number and spacing to insure true dimensions. Forms shall be adequately braced to prevent excessive vibration and deformation.

D. Depositing:
   1. All pneumatically placed concrete shall be placed, insofar as possible, in one continuous operation. Construction joints, if required, shall be planned well in advance as to type and location and shall be subject to Structural Engineer's approval. Before placing, adjoining work shall be thoroughly cleaned by wire brushing, then wetted and scoured with an airjet. Just prior to placement, joint shall be slushed with a neat cement mortar.
   2. Deposit pneumatically placed concrete using suitable delivery equipment and procedures that will result in in-place concrete conforming to the requirements of this specification.
   3. Control thickness, method of support, air pressure, and/or water content of pneumatically placed concrete to preclude sagging or sloughing off. Discontinue placing or provide suitable means to screen the nozzle stream if wind or air currents cause separation of the nozzle stream during placement.
   4. Dampen absorptive substrates before depositing pneumatically placed concrete to facilitate bond and to reduce the possibility of shrinkage cracking developing from premature loss of mixing water.
   5. Broom or scarify the surface of freshly placed concrete to which additional layers of pneumatically placed concrete are to be bonded. Dampen concrete surfaces just before applying succeeding layers.
   6. Provide a supply of clean, dry air adequate for maintaining sufficient nozzle velocity for all parts of the work and, if required, for simultaneous operation of a suitable blow pipe for clearing away rebound.
   7. Placement Around Reinforcement:
      a. Hold nozzle at the distance and angle required to deposit the pneumatically placed concrete behind reinforcement before any material is allowed to accumulate on its face. In the dry-mix process, additional water may be added to the mix when encasing reinforcement to facilitate a smooth flow of pneumatically placed concrete.
b. Do not place pneumatically placed concrete through more than 1 layer of reinforcing steel rods or mesh in one application unless demonstrated by preconstruction tests that steel is properly encased. Test to see if any voids or sand pockets have developed around or behind reinforcement by probing with an awl or other pointed tool after the concrete has achieved its initial set, by removal of randomly selected bars, or by coring or other suitable means.
c. Place concrete to provide 1-1/2 inch minimum cover over reinforcement. Minus tolerance on cover shall not be greater than 1/4 inch.

8. Line and Thickness Control: Use adequate wires or other accepted means to establish the thickness, surface planes and finish lines of the pneumatically placed concrete. Maintain specified tolerance by keeping wires secure and taut.

9. Placement Precautions: Do not place pneumatically placed concrete if drying or stiffening of the mix takes place at any time prior to delivery to the nozzle. Do not use rebound or previously expended material in the concrete mix. Removal all overspray or rebound before set and before placement of pneumatically placed concrete on such surfaces.

10. Finishing: Apply a smooth steel trowel finish to unformed pneumatically placed concrete surface. Patch all voids and holes in formed pneumatically placed concrete surfaces to match adjacent surfaces after the forms are removed.

E. Lap splices shall be non contact, with 2" clear between bars. Maintain 2-1/2" clear minimum between bars.

3.04 CURING AND PROTECTION

A. All exposed surfaces of all pneumatically placed concrete shall be maintained in a moist condition above 40°F for at least 24 hours. For six more days, concrete shall receive curing consisting of fog spray, moisture retaining cover or approved liquid curing compound.

B. Formed Surfaces: Forms heated by the sun shall be kept moist during curing period. If forms are to be removed during curing period, curing as described above shall be commenced immediately.

C. Protection: Contractor shall be responsible for protection of finished concrete against injury by vibration, marking by visitors or workmen, etc.

D. Protect work and materials of this Section prior to and during installation, and protect the installed work and materials of other trades.

E. In the event of damage, make all repairs and replacements necessary to the approval of the Structural Engineer at no additional cost to the Owner.

F. Exposed finishes shall be free from scratches, cracks, discolorations and other defects in workmanship or material.

3.05 DEFECTIVE CONCRETE

A. In addition to requirements listed in Section 03 30 00 for "Defective Concrete," any pneumatically placed concrete which subsides after placement shall be considered defective and shall be removed.

3.06 PATCHING

A. Formed Surfaces: Promptly upon removal of contact forms and after pneumatically placed concrete surfaces have been inspected, all necessary patching and pointing shall be expertly done.

1. Sand pockets or rebound areas shall be removed down to sound material, coated with a bonding grout or approved compound and patched using low shrinkage high bond mortar. Patched areas shall be cured by being kept damp for at least 5 days.

B. After pneumatically placed concrete is finished, shrinkage cracks that may appear shall be patched as follows:

1. Where pneumatically placed concrete is not exposed or where appearance is not important, cracks 1/32 inch and larger shall be cleaned and filled with cement grout and struck off level with surface.

2. Where pneumatically placed concrete is exposed and appearance is important, unsightly cracks, chips and abrasions shall be repaired in a manner satisfactory in appearance to Structural Engineer. If this cannot be accomplished, pneumatically placed concrete shall be considered defective.
3.07 FINISHES

A. Surfaces to Receive Ceramic Tile and Plaster: Rodded finish suitable to receive plaster and ceramic tile.

B. Finished surfaces of pneumatically placed concrete work shall be sufficiently even to contact a 10-foot long straightedge with a maximum tolerance of 1/8 inch.

3.08 CLEANUP

A. On completion, clean all excess concrete from embedded items and adjacent surfaces.

B. Keep premises free from accumulated waste materials, rubbish and debris resulting from work herein, and, upon completion of said work, remove tools, appliances, surplus materials, waste materials, rubbish, debris and accessory items used in or resulting from said work, and legally dispose of off the site.

END OF SECTION 03 37 19
SECTION 03 54 19
CONCRETE FLOOR UNDERLAYMENT

PART 1 - GENERAL

1.01 DESCRIPTION
A. This Section describes the requirements for furnishing and installing the following where required to prepare existing surfaces to receive new applied floor coverings:
   1. Concrete floor underlayment.
   2. Self-leveling concrete floor underlayment.

1.02 SUBMITTALS
A. General: As specified in Division 01.
B. Product Data: Manufacturer’s data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation instructions for each product.

1.03 QUALITY ASSURANCE
A. Manufacturer: Regularly providing underlayment materials of types specified or approved for not less than 5-years.
B. Installer: Approved by underlayment manufacturer using approved equipment.

1.04 ENVIRONMENTAL REQUIREMENTS
A. Maintain a temperature above 50-degrees F. until subfloor surface has stabilized.
B. Provide continuous heat and mechanical ventilation until floor underlayment is dry.
C. Follow manufacturer’s additional requirements.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS
A. Concrete Underlayment: Ardex, Inc. “Ardex SD-P Instantpatch”, Bonsal B-1 Leveler* or approved equal.

2.02 MATERIALS
A. Primer: As recommended by underlayment manufacturer.
B. Concrete Underlayment: Underlayment shall have a minimum compressive strength of 4,200-psi at 28-days. Underlayment shall be able to be installed from featheredge to 1-inch and up to 3-inches with aggregate. Minimum thickness shall be 1/8-inch.
C. Self-Leveling Underlayment: Underlayment shall have a minimum compressive strength of 4,000-psi at 28-days. Self-leveling underlayment shall be able to be installed from featheredge to any thickness in one pour.
D. Aggregate: Well-graded, washed gravel for use when underlayment is installed over 1-1/2-inch thick; size of
aggregate as recommended by manufacturer.

E. Water: Clean and potable.

### PART 3 - EXECUTION

#### 3.01 PREPARATION

A. Surfaces to receive underlayment shall be solid, clean and properly primed.

B. Concrete subfloors shall be clean and free of oil, grease, dirt, curing compounds, and other items that may act as bond breakers. Mechanically clean if required using shot-blasting; acid etching is not acceptable.

C. Where required, grind high spots in concrete subfloors as recommended by manufacturer.

D. Wood subfloors shall be clean and free of foreign matter. Sand to bare wood and vacuum to remove dust. Re-nail loose boards.

E. Non-porous surfaces such as tile shall be clean and free of wax and sealers.

F. Repair cracks in the subfloor to prevent telegraphing through the underlayment.

#### 3.02 INSTALLATION

A. Prime subfloor in accordance with manufacturer's recommendations. Do not leave any bare spots and remove puddles and excess primer. Do not apply underlayment until primer is dry.

B. Mixing Ratios: In accordance with manufacturer's instructions.

C. Place underlayment using a wood or magnesium float. When underlayment begins to harden, finish with a steel trowel.

D. Pour or pump self-leveling liquid underlayment and spread in place. Comply with manufacturer's instructions.

E. Prohibit foot traffic until underlayment is dry.

#### 3.03 COMPLETION

A. When complete, underlayment shall be finished to a reasonably smooth and uniform condition, and be free from pin holes, gouges, cuts, and other damage or defects.

B. Transition between finish surfaces of underlayment and adjacent existing flooring shall be free from offsets.

END OF SECTION
PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. The requirements of Division 1 apply to all Work of this Section.

1.02 SCOPE

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

1.03 RELATED WORK (See also Table of Contents):

A. Cast-In-Place Concrete: Section 03 30 00.

B. Concrete Unit Masonry: Section 04 22 00.

C. Clay Unit Masonry: Section 04 21 00.

D. Reinforcing Steel: Section 03 21 00.

1.04 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 C270, Standard Specification for Mortar for Unit Masonry
   5. ASTM C404, Aggregates for Grout
   6. ASTM C476, Standard Specification for Grout for Masonry
   7. ASTM C1019, Method of Sampling and Testing Grout
   8. CBC Section 2103
   9. 2013 California Building (CBC)
   10. Masonry Standards Joint Committee (MSJC)

B. Tests and Inspections:
   1. A testing program is required prior to start of construction. Testing program to be done in Compliance with the 2013 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 building official.
   3. Mortar and Grout Tests: If mortar and grout tests are indicated as required on the Structural drawings, 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 ASTM C1019 for grout and ASTM C780 for mortar.
      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.
   4. If masonry placement and grouting inspection is indicated as required on the Structural Drawings, a special inspector shall be employed per CBC Section 1704 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

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.
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.

F. Admixture: “Sika Grout Aid”

G. Water: Suitable for domestic consumption.

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 CBC Section 2103.
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 ½ 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.

2.03 GROUT

A. Grout 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 2103.
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 and 04 21 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 which is unused within 30 minutes after initial mixing and any mortar 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
SECTION 04 90 00
EXTERIOR BUILDING CLEANING

PART 1 - GENERAL

1.01 DESCRIPTION
A. This Section describes the requirements for building restoration and cleaning work, including the following:
   1. Cleaning exterior masonry surfaces.

1.02 SUBMITTALS
A. General: As specified in Division 01.
B. Product Data: Manufacturer's technical data for each product specified, including recommendations for application and use. Include test reports and certifications substantiating product compliance with Specifications.
C. Cleaning Program: Written program for each phase of cleaning including protection of surrounding materials and site during work.
   1. Describe materials, methods and equipment to be used for each phase of work.
   2. If alternative methods and materials are proposed for phases, furnish written description, including documentation of successful use on other comparable Projects.

1.03 QUALITY ASSURANCE
A. Cleaning materials and methods shall be confirmed with the Architect prior to beginning work.
B. Field Constructed Mock-Up: Prior to start of work, prepare the following panels on building where directed by the Architect. Obtain Architect's approval of visual qualities before proceeding with the work.
   1. Cleaning: Demonstrate materials and methods to be used for cleaning each type of building surface on a 10-sq. ft. area.

1.04 DELIVERY, STORAGE AND HANDLING
A. General: As specified in Division 01.
B. Deliver materials in manufacturer's original and unopened containers and packaging, bearing labels indicating type and names of products and manufacturers.
C. Protect materials during storage and construction from wetting by rain or ground water, and from staining or intermixture with earth and other types of materials.

1.05 PROJECT CONDITIONS
A. Protect persons, motor vehicles, surrounding surfaces, building site, and surrounding buildings from damage resulting from the work.
B. Clean building surfaces when air temperature is at least 40-deg. F. during and for 7-days after completion of cleaning.

PART 2 - PRODUCTS
2.01 CLEANING MATERIALS AND EQUIPMENT

A. Water for Cleaning: Clean, potable, free of oils, acids, alkalis, salts, and organic matter.

B. Brushes: Fiber bristles.

C. Chemical Cleaning Materials: Prosoco “1922 Hard Surface Cleaner”, “Enviro Klean Degreaser” or approved equal.

D. Spray Equipment: Equipment for controlled spray application of water at specified pressures, measured at spray tip.
   1. Water: Fan-shaped spray tip which disperses water at an angle of not less than 15-degrees.
   3. Steam: Steam generator capable of delivering live steam at nozzle head.

PART 3 - EXECUTION

3.01 CLEANING EXISTING EXTERIOR BUILDING SURFACES

A. Determine the general nature and source of dirt in order to remove it in the most effective and least harmful manner.

B. Cleaning methods include water, chemical and mechanical (abrasive). In order to determine the cleaning method(s) to be used, the following conditions shall be considered:
   1. Environmental Concerns: The potential effect of each proposed cleaning method shall be evaluated. The proposed cleaning method and materials may cause damage to landscaping, animal life, and property.
   2. Personal Safety.

C. Test Cleaning Methods: Several cleaning methods shall be tested prior to selection to determine the one most effective.

D. Level of Desired Cleanliness: Determine the desired appearance prior to selection of the cleaning method to be used.

E. Perform cleaning tests on an area of sufficient size to give a true indication of effectiveness. The test area shall include each material required to be cleaned. More than one cleaning method may be required to achieve required results.

F. Water Cleaning: Cleaning methods include low pressure wash over an extended period, moderate to high pressure wash and steam. Bristle brushes may be used to supplement the water wash. Joints, including mortar and sealant, shall be sound in order to minimize water penetration. Water methods shall not be used during periods of cold weather and no water cleaning shall be done for several days prior to the first average frost date.

G. Chemical Cleaning: Before use, verify that surfaces are not subject to direct attack by cleaning chemicals and that a change in the surface color and appearance doesn't occur from the chemical cleaners.

H. Mechanical Cleaning: Methods include grit blasters, grinders, and sanding discs to abrade the dirt from the surface. Do not use mechanical cleaning methods on brick, soft stone, detailed carvings, polishes surfaces or mortar joints.

END OF SECTION
PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Requirements of Division 1 apply to all Work of this Section.

1.02 SCOPE

A. Furnish and install all structural steel as shown and specified including, but not necessarily limited to the following:
   1. Prime coat painting and touch up.
   2. All cast-in-place anchor bolts, nuts, plates, etc.
   3. 10 gauge steel or 3/4 inch plywood templates for column anchor bolts.

1.03 RELATED WORK (See also Table of Contents)

A. Metal Decking: Section 05 30 00.
B. Metal Fabrications: Section 05 50 00.
C. Cast-In-Place Concrete: Section 03 30 00.
D. Welding of Moment Resisting Frames: Section 05 12 24.
E. Metal Stairs: Section 05 50 10.

1.04 QUALITY ASSURANCE

A. General:
   1. Comply with the referenced ASTM standards for materials.
   2. Perform all welding only with AWS certified welders.
   3. Verification of accuracy:
      a. Engage and pay for a registered civil engineer or licensed land surveyor to check the alignment, plumbness, elevation, and overall accuracy of the erected framing at appropriate stages during construction and at completion of erection. Prior to erection, a survey shall be made of the as-built locations of all anchor rods and other embedded items associated with the attachment of structural steel. The party providing the survey shall submit written verification that the entire installation is in accordance with the contract documents and meets the allowable erection tolerances as set forth in the AISC "Code of Standard Practice for Steel Buildings and Bridges".
      b. Columns shall be verified at each lift. Column shim details and procedures shall be submitted for review.
   4. Paint:
      a. Single Source Responsibility: Provide primers and other undercoat paint produced by same manufacturer as finish coats. Use thinners approved by paint manufacturer, and use within recommend limits.
      b. Coordination of Work: Review other Sections in which prime paints are to be provided to ensure compatibility of coatings system for various substrates. Upon request, furnish information or characteristics of finish materials to be used.
      c. Requirements of Regulatory Agencies: Comply with applicable rules and regulations of governing agencies for air quality control.

B. Except where other requirements are specified, comply with the following standards by American Institute of Steel Construction (AISC) and American Welding Association (AWS):
   1. AISC 360-10 "Specification for Structural Steel Buildings".
   2. AISC 303-10 "Code of Standard Practice for Steel Buildings and Bridges".
   3. AISC 341-10 "Seismic Provisions for Structural Steel Buildings"
4. AISC 358-10 “Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications”

5. RCSC "Specifications for Structural Joints Using High Strength Bolts”.

6. AISC 303-10 Section 10, Architecturally Exposed Structural Steel, Code of Standard Practice for Steel Buildings and Bridges

7. AWS D1.1 "Structural Welding Code - Steel” – latest edition


9. ASTM A6 “General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use”.

10. SSPC-Vis 1 Pictorial Surface Preparation Standards for Painting Steel Structures

11. SSPC-SP2 Hand Tool Cleaning

12. SSPC-SP3 Power Tool Cleaning

13. SSPC-SP6 Commercial Blast Cleaning

14. SSPC-PA2 Measurement of Dry Paint Thickness with Magnetic Gauges


C. Submittals: (Submit under provisions of Section 01 33 00)

1. Product Data: Include laboratory test reports and other data to show compliance with specifications (include specified standards). Include certified copies of mill reports covering chemical and physical properties of each type of structural steel.

2. Shop Drawings:
   a. Shop drawings shall include complete details and schedules for fabrication and assembly of structural steel members, procedures, and diagrams.
   b. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard AWS symbols, and show size, length, and type of each weld.
   c. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed by others.
   d. Dimensions required to locate structural steel for manufactured items such as mechanical equipment, electrical equipment, dock levelers, etc., shall be coordinated and provided by the General Contractor. General Contractor shall also coordinate and provide dimensions to locate structural steel for window washing supports such as davits, tie-backs, etc.

3. Procedures:
   a. Provide weld procedures for both prequalified welds and special welds to be submitted to the Owner's Testing Laboratory and the Architect.
   b. Provide installation procedure and inspection for direct tension indicator washers detailed in supplemental specifications provided by the manufacturer for approval.
   c. Procedures shall be submitted for both shop and field welds.

D. Tests and Inspections:

1. A testing program is required prior to start of construction. Testing program to be done in Compliance with the 2013 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. Testing Laboratory:
   a. An inspection and testing laboratory will be selected by the Owner for testing and inspection as required by the Contract Documents. The selected laboratory shall conform to the requirements of ASTM E329 (Recommended Practice for Inspection and Testing Agencies used in Construction). Documentary evidence of such conformance shall be submitted to the Owner and the governing agency.
   b. All materials, work, methods and equipment shall be subject to inspection at the mill, fabricating plant and at the building site. Material or workmanship not complying fully with the Contract Documents will not be accepted. The Contractor shall give the Testing Laboratory reasonable notice when ready for inspection and shall supply samples and test pieces and all facilities for inspection without extra charge. The Owner will assume the expense of making the tests and inspection except as otherwise specified in Division 1.

3. Cost of Testing and Inspection: Costs of testing and inspection of structural steel, except as specified hereunder and in Division 1, will be paid for by the Owner.
   a. All transportation costs and per diem living costs for inspection at fabricators' plant further than 75 miles from the job site will be back-charged to the Contractor.
b. It is assumed that all fabrication will take place in one shop location only. All additional inspection costs will
be back-charged to the Contractor.
c. All mill tests and costs of re-test of plain materials shall be at the expense of the Contractor.
d. Costs of tests required due to Contractor's failure to provide steel identifiable in accordance with the
indicated ASTM designation shall be at the expense of the Contractor.

4. Structural Steel Testing and Inspection:
   a. Structural Steel: If structural steel tests are indicated as required on the structural drawings, one tension and
      one bend test shall be made for each size of structural shape, plate and for each tube and pipe size. Tests
to be made in accordance with requirements of appropriate ASTM designations.
   b. If structural steel tests are not indicated as required on the structural drawings, then for shapes, plates, bars,
      pipe and tubing, manufacturer's certified mill test reports and analysis for each heat will be acceptable for
      steel identifiable in accordance with indicated ASTM designation. Mill test reports shall indicate the physical
      and chemical properties of all structural steel used. Correlate individual heat numbers with each specified
      structural section.
   c. Unidentifiable Steel:
      1) For Fy less than or equal to 36.0 ksi: Provide one tension and elongation test and one bend for each 5
         tons or fraction thereof for each size.
      2) For Fy greater than 36.0 ksi: Provide one tension and elongation test and one bend or flattening for
         each piece.
   d. Costs of retests and additional testing required by the use of unidentifiable steels shall be the Contractor's
      responsibility. Additional costs of testing incurred by the Owner shall be deducted from the Contract Final
      Payment.

5. Expansion Anchors: Load test as indicated on drawings.

6. Welding Inspection:
   a. For Moment Resisting Frame Welding inspection and testing requirements, see specification Section 05 12
      24 - Welding of Moment Resisting Frames.
   b. If shop or field welding inspection is indicated on the structural drawings or required by the applicable
      referenced standards, shop and field welded operations shall be inspected in accordance with AISC 360
      Section N by a qualified welding inspector employed by the Testing Laboratory. Such inspector will be a
      person trained and thoroughly experienced in inspection of welds. The inspector's ability to distinguish
      between sound and unsound welding will be reliably established
   c. The welding inspector will make a systematic record of all welds. This record shall include:
      1) Identification marks of welders.
      2) List of defective welds.
      3) Manner of correction of defects.
   d. The welding inspector will check the material, equipment and procedure, as well as the welds. He will also
      check the ability of the welder. He will furnish the Architect with a report, duly verified by him that the welding
      which is required to be inspected is proper, and has been done in conformity with the Contract Documents,
      and that he has used all means to determine the quality of the welds.
   e. All full penetration groove welds will be subject to ultrasonic testing, as per AWS D1.1, Clause 6 "Inspection,
      Part "F", Ultrasonic Testing (UT) of Groove Welds. All defective welds shall be repaired and retested with
      ultrasonic equipment at the Contractor's expense.
   f. Column Flanges: An area extending 6 inches above and below point where girder flanges are attached will
      be inspected. Column flange edges will be inspected visually and entire area ultrasonically for lamination,
      plate discontinuities, and non-metallic inclusions.
   g. When ultrasonic indications arising from the weld root can be interpreted as either a weld defect or the
      backing strip itself, the Engineer will be notified. The Engineer may require the removal of backing strip. The
      backing strip will be removed at the expense of the Contractor, and if no root defect is visible the weld will be
      retested. If no defect is indicated on this retest, and no significant amount of base and weld metal have been
      removed, no further repair of welding is necessary. If a defect is indicated, it will be repaired and retested at
      Contractor's expense.
   h. The ultrasonic instrumentation will be calibrated by the technician to evaluate the quality of the welds in
      accordance with AWS D1.1.
   i. Other methods of inspection, for example, X-Ray, gamma ray, magnetic particle, or dye penetrant, may be
      used on welds if felt necessary by the inspection laboratory, and with the approval of the Engineer.
   j. Base metal thicker than 1-1/2 inches, when subjected to through thickness weld shrinkage strains, shall be
      ultrasonically inspected for discontinuities directly behind such weld before and after joint completion.
k. End-welded studs shall be sampled, tested, and inspected per the requirements of AWS D1.1, Clause 7 Stud Welding.

l. At the discretion of the owner's testing agency, the ultrasonic testing frequency may be reduced but may not be less than the following:

m. Initially, all welds requiring ultrasonic testing will be tested at the rate of 100 percent in order to establish the qualifications of each individual welder. If the reject rate is demonstrated to be less than 5 percent of the welds tested for each welder, then the frequency of testing for that welder may be reduced to 25 percent. If the reject rate increases to 5 percent or more, 100 percent testing will be re-established until the rate is reduced to less than 5 percent. The percentage of rejects will be calculated for each welder independently.

n. A sampling of at least 40 completed welds will be made for such reduction evaluation. Reject rate is defined as the number of welds containing rejectable defects divided by the number of welds completed. For evaluating the reject rate of continuous welds over 3 ft in length where the effective throat is 1" or less, each 12 inch increment or fraction thereof shall be considered as one weld. For evaluating the reject rate of continuous welds over 3 ft in length where the effective throat is greater than 1", each 6 inch of length or fraction thereof shall be considered one weld.

7. High Strength Bolting Tests and Inspection:
   a. Furnish certified test reports for each lot of bolts in accordance with Section 9 of ASTM A325 and A490. Install bolts under the supervision of a qualified inspector in accordance with Section 9, Research Council "Specifications for Structural Joints using ASTM A325 or A490 Bolts".
   b. If high strength bolting inspection is indicated on the structural drawings or required by the applicable referenced standards, the testing laboratory shall provide inspection in accordance with AISC 360 Section N.
   c. While the work is in progress, the Inspector shall determine that the requirements of this Specification are met in the work. The Inspector shall observe the calibration procedures and shall monitor the installation of bolts to determine that all plies of connected material have been drawn together and that the selected procedure is properly used to tighten all bolts.
      1) In addition to the requirement of the foregoing paragraph, for all connections specified to be slip critical (SC), the Inspector shall assure that the specified procedure was followed to achieve the pretension specified in the AISC. The pretension shall be verified by the inspector for these bolts.
      2) Bolts in connections identified as not being slip-critical nor subject to direct tension need not be inspected for bolt tension other than to ensure that the plies of the connected elements have been brought into snug contact.

1.05 PRODUCT HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.

B. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.06 SEQUENCING/SCHEDULING

A. Cooperate and coordinate this work with other trades for anchor bolts, and other required inserts, templates, etc. Align this work prior to installation of other materials.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Structural Steel: Except where indicated on drawings.
   1. W shapes: ASTM A572-50 or ASTM A992-50 unless indicated otherwise on drawings.
   2. Channels and other rolled shapes: ASTM A36 unless indicated otherwise on drawings.
   3. Angles, plates and bars: ASTM A36 unless indicated otherwise on drawings.

B. AISC group 4 and 5 shapes and plates greater than 2 inches thick: ASTM A36 and/or ASTM A572 Grade 50 with supplementary requirements S91 Fine Austenitic Grain Size and S5 Charpy V-Notch Impact Test. For location of
Charpy V-Notch test, see ASTM A6 Supplementary Requirement S30. Charpy V-Notch test shall be per ASTM A673, frequency P and shall meet a minimum average value of 20 ft-lbs absorbed energy at 70°F.

C. Cold-Formed Steel Tubing: ASTM A500, Grade B.

D. Steel Pipe: ASTM A53, Type E or S, Grade B.

E. Anchor Bolts: All anchor bolts cast in concrete or masonry shall be headed bolts with cut threads conforming to ASTM F1554 grade 36, 55 (weldable per S1 Supplementary Requirements), or 105 as indicated on drawings.


G. High Strength Bolts, Nuts and Washers: Install in accordance with requirements for A325 and A490 slip critical and snug tight conditions as indicated on drawings. Install high strength bolts with snug tight type connections with threads included in shear plane except as otherwise noted. Install hardened washers in conformance with AISC Specifications.
   2. Bolt Geometry: Bolt dimensions shall conform to the current requirements of the American National Standards Institute for Heavy Hex Structural Bolts, ANSI Standard B18.2.1. The length of bolts shall be such that the end of the bolt will be flush with or outside the face of the nut when properly installed.
   3. Nut Specifications: Nuts shall conform to the current chemical and mechanical requirements of the American Society for Testing and Materials Standard Specification for Carbon and Alloy Steel Nuts, ASTM A563, Appendix Table X1.1. Provide Grade A Heavy Hex nuts for Grade 36 and 55 threaded rods. Provide Grade DH or ASTM A194-2H Heavy Hex nuts for Grade 105 threaded rod.
   4. Washers: Flat circular washers and square or rectangular beveled washers shall conform to the current requirements of the American Society for Testing and Materials Standard Specification for Hardened Steel Washers, ASTM F436. Washers for base plates shall conform to ASTM F844 and shall be placed top and bottom of plate.
   5. Tension Control Fastener System: Bolts shall conform to the requirements of the current edition of the Specifications of the American Society for Testing and Materials for Twist Off Type Tension Control Structural Bolt/Nut/Washer Assemblies, ASTM F1852, providing equivalent properties to ASTM A325 or A490 as indicated on drawings.

H. Headed Stud-Type Shear Connectors: ASTM A108 Grade 1015 or 1020 Cold-finished carbon steel with dimensions complying with AISC Specifications.
   1. Tensile strength, 60,000 psi.
   2. Elongation in 2 inches, 20 percent
   3. Reduction of area, 50 percent

I. Provide hexagonal heads and nuts for all connections per ASTM A563, Appendix Table X1.1.

J. Electrodes for Welding: Comply with AWS Code, E70 Series minimum. Fabricator to select proper electrodes according to weld procedures as submitted.

K. Shop Primer – See Section 3.4, Painting and Cleaning

L. Powder Driven Fasteners: Tempered steel pins with special corrosive resistant plating or coating. Pins shall have guide washers to accurately control penetration. Fastening shall be accomplished by low-velocity piston-driven power activated tool. Pins and tool shall be as manufactured by Hilti Fastening Systems.

M. Expansion Bolts: Hilti Fastening Systems “Kwik-Bolt Concrete Expansion Anchors” to concrete; Ramset “Dynabolt Sleeve Anchors” to masonry or approved equal.

PART 3 - EXECUTION

3.01 FABRICATION
A. Shop Fabrication and Assembly: Fabricate and assembly structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final shop drawings. Provide camber in structural members where indicated to provide the flattest floor possible. The contractor shall coordinate member tolerances with finishes.

Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.

Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.

B. Connections: Weld or bolt shop connections, as indicted. Bolt field connections, except where welded connections or other connections are indicated.

C. Unless noted otherwise, make holes 1/16 inches larger than the nominal bolt diameter.

D. Welding, Shop and Field: Weld by shielded arc method, submerged arc method, flux cored arc method, or other method approved by AWS. Perform welding in accordance with AWS Code. All welders, both manual and automatic, shall be certified in accordance with AWS "Standard Qualification Procedure" for the Work to be performed. See paragraph "welding" herein, for detailed requirements. If sizes of fillet welds are not shown on drawings, use AWS minimum weld size but not less than 3/16 inch fillet welds.

E. Bolt Holes for Other Work: Provide holes required for securing other work to structural steel framing.

Provide threaded nuts welded to framing, and other specialty items as indicated to receive other work.

Cut, drill, or punch holes perpendicular to metal surfaces and remove all burrs. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

F. AISC Group 4 and 5 shapes and built up members shall meet the requirements for joints in AISC Sections J1.5, J1.6, J2.7 and M2.2.

G. High Strength Bolts:
   1. Installation and Tightening:
      a. Handling and Storage of Fasteners: Fasteners shall be protected from dirt and moisture at the job site. Only as many fasteners as are anticipated to be installed and tightened during a work shift shall be taken from protected storage. Fasteners not used shall be returned to protected storage at the end of the shift. Fasteners shall not be cleaned of lubricant that is present in as-delivered condition.
      b. Tension Calibrator: A tension measuring device shall be required at all job sites where bolts in slip-critical joints are being installed and tightened. The tension measuring device shall be used to confirm: (1) the suitability to satisfy the requirements of AISC for the complete fastener assembly, including lubrication if required to be used in the work, (2) calibration of wrenches, if applicable, and (3) the understanding and proper use by the bolting crew of the method to be used. The frequency of confirmation testing, the number of tests to be performed and the test procedure shall be as specified in 1.d. below, as applicable. The accuracy of the tension measuring device shall be confirmed through calibration by an approved testing agency at least annually.
      c. Joint Assembly and Tightening of Shear/Bearing Connections: Bolts in connections not within the slip-critical category shall be installed in properly aligned holes, but need only be tightened to the snug tight condition. The snug tight condition is defined as the tightness that exists when all plies in a joint are in firm contact. This may be attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. If a slotted hole occurs in an outer ply, a flat hardened washer or common plate washer shall be installed over the slot.
      d. Joint Assembly and Tightening of Connections Requiring Full Pre-tensioning. Slip-critical connections shall be installed in properly aligned holes and tightened by one of the following methods.
         1) Turn-of-nut Tightening: When turn-of-nut tightening is used, hardened washers are not required except as specified in the AISC. A representative sample of not less than three bolts and nuts of each diameter, length and grade to be used in the work shall be checked at the start of work in a device
capable of indicating bolt tension. The test shall demonstrate that the method of estimating the snug-tight condition and controlling turns from snug tight to be used by the bolting crews develops a tension not less than five percent greater than the tension required for slip-critical connections.

2) Installation of Alternate Design Bolts: A representative sample of not less than three bolts of each diameter, length and grade shall be checked at the job site in a device capable of indicating bolt tension. The test assembly shall include flat hardened washers, if required in the actual connection, arranged as in the actual connections to be tensioned. The calibration test shall demonstrate that each bolt develops a tension not less than five percent greater than the tension required by AISC. Manufacturer's installation procedure shall be followed for installation of bolts in the calibration device and in all connections. When alternate design features of the fasteners involve an irreversible mechanism such as yield or twist-off of an element, bolts shall be installed in all holes of the connection and initially brought to a snug tight condition. All fasteners shall then be tightened, progressing systematically from the most rigid part of the connection to the free edges in a manner that will minimize relaxation of previously tightened fasteners prior to final twist-off or yielding of the control or indicator element of the individual fasteners. In some cases, proper tensioning of the bolts may require more than a single cycle of systematic tightening.

e. Mark bolts that have been completely tightened with an identifying symbol.

3.02 WELDING

A. General: Quality of materials and design and fabrication of all welded connections shall conform to AISC "Specifications for the Design, Fabrication and Erection of Structural Steel for Building," "AWS Code for Welding in Building Construction," and requirements of this section.

Location and type of all welds shall be as shown. Make no other welded splices, except those shown on drawings, without prior approval of the architect.

B. Automatic Welding: Use electrode wire and flux for automatic and semi-automatic welding acceptable to Structural Engineer. All methods, sequences, qualification and procedures, including preheating, and post heating if necessary, shall be detailed in writing and submitted to the Structural Engineer for review.

C. Qualification of Welders:

1. Structural steel welding: Manual and automatic welds for structural steel construction shall be made only by operators who have been previous qualified by tests, as prescribed in AWS D1.1 to perform type of work required.

2. Welders shall be checked by welding inspector. Those not doing satisfactory work may be removed, and may be required to pass qualification tests again. All qualification testing shall be at the Contractor's expense.

3. Only welders whose weld procedures and pre-qualification by testing that have passed shall be considered qualified for such welds.

D. Control cooling process after weld is completed by either step down post heat or thermal blankets as determined by procedures and prequalification.

E. Box columns and built-up members shall have ultrasonic testing before and after welding.

F. Flame cut surfaces shall be ground to remove contaminated steel layer to provide welds proper fusion without impurities.

G. Preparation of surface: Surfaces to be welded shall be free of loose scale, slag, rust, grease, paint, and any other foreign material.

H. Welding equipment: Welding equipment to be used in each case shall be acceptable to welding inspector. Use equipment with suitable devices to regulate speed, and manually adjust operating amperage and voltage. The amperage capacity shall be sufficient to overcome line drop, and to give adequate welding heat.

I. Remove runoff tabs and grind surfaces smooth where the tabs would interfere with fireproofing and architectural finishes.
J. End-welded studs:
   1. Automatic end-welded studs: Automatically end-weld in accordance with the manufacturer's recommendations in such a manner as to provide complete fusion between the end of the stud and the plates. There shall be no porosity or evidence of lack of fusion between the welded end of the stud and the plate. The stud shall decrease in length during welding approximately 1/8 inch for 5/8 inch, and 3/16 inch for 3/4 inch diameter. Stud sizes indicated on drawings represent the finish stud height.
   2. Fillet-end welded studs: Studs may be welded using prequalified FCAW, GMAW, or SMAW processes provided the requirements of the AWS D1.1 Chapter 7 Section 7.5.5 are met as well as any other pertinent requirements of D1.1.

K. Provide mill camber as shown on the construction documents within AISC tolerance. Place mill tolerance upward for all beams specified no camber.

3.03 ERECTION


B. Erection Sequence: Erect steel in accordance with special erection sequences where special erection sequences are indicated on the contract documents.

C. Before and during erection, keep all structural steel clean. Ship, handle and store steel in manner to avoid injury to members. Steel members showing evidence to rough handling or injury will be rejected.

D. Mark each member with erection identification corresponding to mark shown on erection drawings. Carefully plan erection of structural steel so that no cutting and removal of material will be necessary. Do not torch burn in the field, unless specifically permitted by Engineer.

E. Provide sufficient bracing, shoring and guys to effect safe and satisfactory erection. Provide bracing and shoring capable of holding steel work plumb and properly aligned while field connections are being made, and until lateral force resisting elements are deemed by Architect capable of bracing structure. Temporary bracing shall be adequate to resist lateral forces from wind or seismic prior to the completion of the lateral resisting system.

F. Set bearing and base plates with extreme care. Bring level, to line and grade with leveling plates or by leveling nuts and bolts. Grout solid under plates with a flowable non-shrink grout per Section 03 30 00 prior to applying vertical load.

G. Field Assembly: Set structural framing accurately to the lines and elevations indicated. Align and adjust the various members forming a part of a complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces which will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

   Shimming or other adjustments not indicated on drawings shall be approved by the Engineer prior to installation. Level and plumb individual members of the structure within specified AISC tolerances except as noted herein. Column shimming shall be 1/4 inch.

H. All welds shall be full and clean, and conform to AISC and AWS specifications.

I. Erection Tolerances: Individual pieces shall be erected so that the deviation from plumb, level and alignment shall not exceed 1 to 500 plus:
   1. The maximum displacement of the center line of columns adjacent to elevator shafts, from the established column line, shall not be more than 1 inch at any point.
   2. In order to provide a true, flat plane for the exterior elevations, install all steel framing at the exterior walls of the building, so that the center lines of such framing does not vary by more than 1 inch from the length of the building. Also install each vertical member on such grids so that its vertical center line does not vary by more than 1/2 inch from a vertical line for each story and 1 inch for its full height.
   3. All columns and beams shall adhere to Section M2.7 of the referenced "Specification for Structural Steel for Buildings" which states that completed members shall be free of twists, bends, and open joints. Take special care
that column base plates are parallel and perpendicular to faces of columns and that bolt holes are accurately placed.

J. Temporary Flooring:
1. Provide planking and scaffolding necessary in connection with erection of structural steel, support of erection machinery, and construction materials. Temporary floors and use of steel shall be as required by applicable regulatory requirements.
2. If steel decking is used as a working platform, it shall be temporarily tack-welded to supports to extent necessary for such use in accordance with applicable regulatory requirements. The concentrated loading from welding machines and other heavy machinery required for steel erection shall be distributed by planking or other approved means. Metal decking that becomes damaged as the result of being used as a working platform shall be replaced at no additional cost to the Owner.

K. Tower Crane: The design for the support and bracing for a tower crane shall be the responsibility of the General Contractor. The design shall be prepared by a structural engineer licensed in the state of California. Drawings and calculations shall be stamped and signed by the structural engineer. Concentric, torsional, and/or eccentric loading to the main structure shall be resolved by the addition of structural steel for shear tabs, stiffeners, drag ties, bracing struts, etc. Such items shall be designed, detailed, furnished and installed by the contractor.

3.04 PAINTING AND CLEANING

A. Prior to prime coat application, clean all loose rust, mill scale, oil, dirt, and all other materials from all steel to be left exposed. Use hand tool, power tool, sandblasting, chemical cleaning, and any other method necessary to provide a smooth, sound surface for painting.

B. Shop prime all steel except the following:
   1. Steel encased in concrete.
   2. Contact surfaces for slip-critical (sc) high strength bolts.
   3. Areas within 4 inches of field welds.
   4. Tops of members to receive metal decking.
   5. Steel to be fireproofed.
   6. Surfaces to be galvanized.

C. Use the following Type A shop painting systems on all normal environment interior steelwork:
   1. Surface Preparation: SSPC-SP2 Hand Tool Cleaning or SSPC-SP3 Power Tool Cleaning. Where jobsite exposure is expected to exceed 6 months, SSPC-SP6 Commercial Blast Cleaning is required.
   3. Material: Type A Tnemec Company, Inc., Series V10; Sherwin Williams Steel Spec Universal; Metal Case 94-231 Series or approved equal
   4. Number of Coats: One
   5. Dry Film Thickness: 2.0 mils minimum.
   6. Volume Solids: 56.0 +/- 2.0% minimum
   7. Generic Description: Modified Alkyd.

D. Unless noted otherwise in subsection H, use the following Type B shop painting systems on all exterior steelwork and interior steelwork subjected to wet conditions or fumes (see subsection H for additional requirements)
   1. Surface Preparation: SSPC-SP6 Commercial Blast Cleaning
   3. Material: Type B Tnemec 90-97 Tneme-Zinc primer or approved equal
   4. Number of Coats: One
   5. Dry Film Thickness: 2.5 to 3.5 mils
   6. Volume Solids: 63% +/- 2%
   7. Generic Description: Zinc-Rich Urethane

E. Unless noted otherwise in subsection H, use the following finish painting systems on all exterior steelwork and interior steel work subjected to wet conditions or fumes (see subsection H for additional requirements):
   1. Application: Follow coating manufacturer's printed directions. Apply over Type B primer system above.
   2. Material: Tnemec Series 750 UVX paint or approved equal
3. Number of Coats: One
4. Dry Film Thickness: 2.5 to 5 mils
5. Volume Solids: 72% +/- 2%
6. Generic Description: Polyfunctional Hybrid Polyurethane

F. Primers and paints shall meet all federal and state environmental and air quality requirements.

G. Apply two shop prime coats to areas which will be inaccessible after erection.

H. All exterior steelwork and all interior steelwork subjected to wet conditions or fumes, including all welds, bolts, washers and other connection components, shall be primed and painted or hot-dip galvanized, as specified by the Architectural finish specifications. In the absence of Architectural finish specifications, all exterior steelwork and all interior steelwork subjected to wet conditions and fumes, including all welds, bolts, washers and other connection components, shall be hot-dip galvanized, conforming to the requirements set forth in ASTM A123/A123M and ASTM A153/A153M.

I. Clean contact surfaces of high strength bolts of all burrs and material which might prevent solid seating of the parts. Steel to receive bolts shall be primer painted except beneath the contact area of slip-critical bolts.

J. After erection, field touch up all welded areas, high strength bolts and damaged areas. For all steel to remain exposed, remove all blemishes, paint drips, and touch up prime coat.

3.05 HOISTING AND BRACING

A. Provide all hoisting and erecting equipment and power.

B. Provide and maintain any and all safety railings, toe boards, etc., required for the erection of steel framing and metal decking.

C. Brace the erected frame in a manner which will assure safety and proper alignment to receive the metal decking and until the concrete slabs have been poured and have set.

D. Erect building frame true and level. Erect columns in a manner to allow for movement due to welding shrinkage and thermal expansion and contraction of framing. Check plumbness after erection of each level. Maintain structural stability of frame during erection. Provide temporary bracing where necessary to maintain frame stability and to support required loads, including equipment and its operation.

END OF SECTION 05 12 00
PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing metal fabrications made from steel shapes, plates, bars, strips, tubes, pipes and castings not a part of structural steel or specified in other Sections, including but not limited to the following items:

1. Miscellaneous steel framing for partition supports.
2. Handrail brackets.
3. Countertop support brackets.
4. Guardrails, railings and handrails.
5. Steel gates.
6. Steel pipe bollards.
7. Gratings.
8. Miscellaneous angles, plates, bars, rods and other items not specified in other Sections but shown or required to complete the work.

B. Related Sections:

1. Painting is specified in Section 09 91 00.

1.02 SYSTEM PERFORMANCE REQUIREMENTS

A. Handrails and Railings: Design, engineer, fabricate and install railings and handrails to withstand the following structural loads in accordance with California Building Code (CBC) Section 1607.7 and 1012:

1. Handrail and guardrail assemblies shall be designed to resist a load of 50-psf applied in any direction at the top.
2. Handrail and guardrail assemblies shall be able to resist a concentrated load of 200-pounds applied in any direction at any point along the top.
3. Intermediate rails, balusters and panel fillers shall be designed to withstand a horizontally applied load of 50-psf applied horizontally at right angles.
4. Handrails and Railings shall comply with ADA requirements.

1.03 SUBMITTALS

A. General: Comply with Division 01.

B. Product Data: Include information on gratings, paint products, and grout.

C. Shop Drawings: Include plans, elevations and details of metal fabrications and their connections. Show anchorage and accessory items. Furnish templates for anchors and bolts installed under other Sections.

1.04 QUALITY ASSURANCE

A. Stairway handrails shall comply with California Building Code (CBC) Section 11B-505 and 1012.

B. Ramp handrails shall comply with CBC Section 11B-505 and 1012.
C. Ramp guardrails shall comply with CBC Section 11B-505 and 1013.

D. Fabricator Qualifications: Firm experienced in successfully producing metal fabrications similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the work.

E. Welding Qualifications: Qualify welding processes and welding operators in accordance with AWS D1.1, D1.2, and D1.3 as applicable. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved.

1.05 PROJECT CONDITIONS

A. Field Measurements: Check actual locations of walls and other construction to which metal fabrications must fit, by accurate field measurements before fabrication. Show recorded measurements on shop drawings. Coordinate fabrication schedule to avoid delay of work.

1.06 SEQUENCING AND SCHEDULING

A. Mount handrails only on gypsum board assemblies reinforced to receive anchors, and where the location of concealed anchor plates has been marked for the installer.

B. Painting: Items specified in this Section as having a shop applied prime coat will be job painted as specified in Section 09 91 00, unless otherwise noted.

PART 2 - PRODUCTS

2.01 FERROUS METALS

A. General: For fabrication of metal work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness.

B. Steel Plates, Shapes and Bars: ASTM A36.

C. Steel Tubing: Cold-formed, ASTM A500; or hot-rolled, ASTM A501.

D. Structural Steel Sheet: Hot-rolled, ASTM A570; or cold-rolled ASTM A611, Class 1.

E. Galvanized Structural Steel Sheet: ASTM A653, galvanized in accordance with ASTM A525, G90 coating designation.

F. Steel Pipe: ASTM A53; type and grade selected by fabricator; black finish unless galvanizing is indicated or specified; standard weight, schedule 40, unless otherwise indicated.


H. Malleable Iron Castings: ASTM A47, grade selected by fabricator.

2.02 FASTENERS

A. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A, with hex nuts, ASTM A563, and flat washers.

B. Machine Screws: ANSI B18.6.3.

C. Lag Bolts: ANSI B18.2.1.

D. Wood Screws: Flat head, carbon steel, ANSI B18.6.1.


G. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry and equal to 4 times the load imposed when installed in...
2.03 GROUT


2.04 PAINT

A. Metal Primer: SSPC 20, Type 2.

1. Exterior Exposure: Tnemec 90-97 Tnemec Zinc or approved equal.

2. Interior Exposure: VOC compliant rust-inhibitive alkyd primer.

3. Exposed to view items to be field painted shall be primed with a primer compatible with final finish coats specified in Section 09 91 00.

B. Galvanizing Repair Paint: High zinc dust content paint for re-galvanizing welds in galvanized steel; Rust-Oleum Corp. "Zinc-Rich Cold Galvanizing Compound", Tnemec 90-93, ZRC Worldwide "Galvalite" or approved equal.

2.05 FABRICATION, GENERAL

A. Workmanship:

1. Use materials of size and thickness indicated or required to produce strength and durability in finished product for use intended.

2. Work to dimensions indicated,

3. Form exposed work true to line and level with accurate angles and surfaces and straight, sharp edges.

4. Ease exposed edges to a radius of approximately 1/32-inch, unless otherwise indicated.

5. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

6. Weld corners and seams continuously, complying with AWS recommendations. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces. Welds shall be imperceptible in the finished work.

7. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use Phillips flat-head countersunk screws or bolts for exposed fasteners, unless tamperproof security screws are indicated.

8. Cut, reinforce, drill and tap miscellaneous metal work as indicated to receive finish hardware and similar items.

B. Galvanizing: Provide zinc coating for items indicated or specified to be galvanized, as follows:

1. ASTM A153 for galvanizing iron and steel hardware.

2. ASTM A123 for galvanizing both fabricated and un-fabricated iron and steel products made of uncoated rolled, pressed, and forged shapes, plates, bars, and strip 0.0299-inch thick and heavier.

C. Fabricate joints exposed to the weather to exclude water or provide weep holes.

D. Shop Painting:

1. Shop paint miscellaneous metal work, except members or portions of members to be embedded in concrete or masonry, surfaces and edges to be field welded, and galvanized surfaces.

2. Remove scale, rust and other deleterious materials before applying shop coat. Clean off heavy rust and concrete, determined in accordance with ASTM E448.
loose mill scale in accordance with SSPC SP-2, SP-3, or SP-7.

3. Remove oil, grease and similar contaminants in accordance with SP-1.

4. Brush or spray on primer in accordance with manufacturer's instructions, at a rate of 2.0-mils thickness for each coat.

5. Apply one shop coat to fabricated metal items, except apply 2-coats to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish from the first.

7. Primer on exposed to view items to be field painted shall be smooth and suitable for application of final finish coats specified in Section 09 91 00.

8. Apply a heavy coat of bituminous paint, compounded for application in 30-mil coat, to metal surfaces in contact with concrete, masonry and dissimilar metals. Do not apply on exposed surfaces.

2.06 MISCELLANEOUS METAL FABRICATIONS

A. Miscellaneous Framing and Supports:

1. Provide miscellaneous framing and supports not a part of structural steel framework, as required to complete work.

2. Fabricate to sizes, shapes and profiles shown or required.

3. Fabricate from structural steel shapes and plates and steel bars of welded construction using mitered joints for field connection.

4. Cut, drill and tap units to receive hardware and similar items.

5. Furnish integrally welded anchors for casting into concrete or building into masonry.

6. Finish: Galvanize exterior frames and supports, shop prime interior frames and supports. Exposed framing and supports will be field painted as specified in Section 09 91 00.

B. Steel Guardrails, Railings and Handrails: Fabricate to design, dimensions and details indicated. Maximum member size shall be 1-1/2-inch O.D. Railings and handrails shall comply with ADA requirements.

1. Interconnect guardrail, railing and handrail members by butt welding or welding with internal connectors.

2. Provide coped joints at tee and cross sections.

3. Form simple and compound curves by bending tubing in jigs to produce uniform curvature for each repetitive configuration. Maintain cylindrical cross-section of tube or pipe throughout entire bend without buckling, twisting or deforming exposed surfaces.

4. Provide wall returns at ends of wall-mounted handrails.

5. Close exposed ends of tubing or pipe by welding 3/16-inch steel plate in place or by using prefabricated fittings.

6. Flanges, Fittings and Anchors: Provide end closures, flanges, miscellaneous fittings and anchors for interconnections of tubing and attachment of railings and handrails to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry.

7. Finish: Galvanize steel guardrails, railings, and handrails including tubing, pipe, fittings, brackets, fasteners, and other ferrous components. Guardrails, railings and handrails will be field painted as specified in Section 09 91 00.

C. Bollards: Fabricate bollards from galvanized steel pipe of diameter and height indicated. Embed in concrete footings, fill with concrete and close top end by welding a 1/4-inch steel plate in place or provide a smooth concrete domed cap. Where bollards are to be installed on post-tensioned roof deck, provide galvanized steel baseplate as indicated. Bollards will be field painted as specified in Section 09 91 00.
D. Gates:
1. Fabricate from steel tubing of sizes and configurations indicated. Tubing gauges shall be as recommended by fabricator.
2. Each intermediate vertical member shall be solidly welded to top and bottom rails. Exposed welds shall be ground smooth, flush and imperceptible.
3. Hardware: As specified in Section 08 71 00. Reinforce, drill, punch and tap members as required to receive hardware.
4. Gate Operators: As specified in Section 32 21 12.73.
5. Finish: Galvanize exterior gates, including tubing, fittings, brackets, fasteners and other ferrous components. Gates will be field painted as specified in Section 09 91 00.

E. Bar Gratings:
1. Provide steel bar gratings using bars of type, material, sizes, spacing, and construction indicated.
2. Comply with applicable requirements of National Association of Architectural Metal Manufacturers (NAAMM) "Metal Bar Grating Manual".
3. Type: Welded.
5. Steel Finish: Hot-dip galvanized after fabrication.
6. Provide removable grating sections with end-bearing bars for each panel, 4-saddle clip anchors designed to fit over 2-bearing bars, and 4-stud bolts with washers and nuts.
7. Notch gratings for penetrations. Layout units to allow removal without disturbing items penetrating grating.
8. Provide banding for openings in grating separated by more than 4-bearing bars, of same material and size as bearing bars.
9. Weld stud bolts to receive saddle clip anchors to supporting steel members.

PART 3 - EXECUTION

3.01 PREPARATION
A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors.

3.02 INSTALLATION
A. General:
1. Fastening to In-Place Construction: Provide threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required.
2. Cutting, Fitting and Placement:
   a. Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications.
   b. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels.
c. Provide temporary bracing or anchors in formwork for items to be built into concrete, masonry or similar construction.

3. Fit exposed connections together forming tight hairline joints.
   a. Weld connections not shop welded.
   b. Grind exposed joints smooth and imperceptible, and touch-up shop paint coat.
   c. Do not weld, cut or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and intended for bolted or screwed field connections.

4. Field Welding: Comply with AWS for procedures of manual shielded metal-arc welding, appearance and quality of welds, and methods used in correcting welding work.

B. Gratings:
   1. Weld non-removable units to supporting members or framework.
   2. Secure removable units to supporting members or framework with galvanized machine screws, or manufacturer's standard saddle or clip units.

C. Steel Guardrails, Railings and Handrails:
   1. Adjust guardrails and railings prior to anchoring to ensure matching alignment at abutting joints.
   2. Space posts as indicated.
   3. Plumb posts in each direction.
   4. Anchor posts to concrete with steel plates and expansion anchors.
   5. Secure handrails to wall with wall brackets and end fittings.
      a. Locate brackets as indicated.
      b. Secure wall brackets in accordance with manufacturer's instructions.
   6. Expansion Joints: Provide at intervals not exceeding 40-feet. Provide slip joint with internal sleeve extending 2-inches beyond joint on either side; fasten internal sleeve securely to one side; locate joint within 6-inches of posts.

D. Gates: Fit hardware accurately and hang gates to operate freely without sticking or binding. Coordinate with installation of gate operators specified in Section 32 21 12.73.

E. Bollards: Anchor bollards in concrete with preset pipe sleeves. After bollards have been inserted into sleeves, fill annular space between bollard and sleeve solid with non-shrink, non-metallic grout.

3.03 ADJUST AND CLEAN

A. Touch-Up Painting: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material used for shop painting. Apply by brush or spray to provide a minimum dry film thickness of 2.0-mils.

B. Galvanized Surfaces: Clean field welds, bolted connections and abraded areas and spot prime with specified primer applied to a minimum dry film thickness of 2.5-mils.

END OF SECTION
SECTION 06 05 73
WOOD TREATMENT

PART 1 - GENERAL

1.01 DESCRIPTION
A. This Section describes the requirements for preservative treated and fire-retardant treated wood where indicated or specified.
B. Related Sections:
   1. Miscellaneous carpentry items are specified in Section 06 10 53.

1.02 SUBMITTALS
A. General: Comply with Division 01.
B. Wood Treatment Data: Treatment manufacturer’s instructions for handling, storing, installing and finishing of treated material.

1.03 QUALITY ASSURANCE
A. Wood Treatment Plant: Experienced in performing work required in this Section that has specialized in treatment of wood similar to that required for this Project and is licensed by the wood treatment manufacturer.

1.04 DELIVERY, STORAGE AND HANDLING
A. General: Comply with Division 01.
B. Store treated wood materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by manufacturer. Prevent exposure to precipitation during shipping, storage or installation. Store material off ground and under cover.
C. For interior fire-retardant treated wood, avoid exposure to precipitation during shipping, storage and installation. If wood becomes wet, replace or allow to dry to a maximum moisture content of 19-percent for lumber and 15-percent for plywood prior to covering or enclosure by gypsum board, roofing or other construction materials.

PART 2 - PRODUCTS

2.01 PRESERVATIVE TREATED WOOD
A. General: Provide preservative-treated wood at areas where wood is in contact with ground, concrete, masonry and where indicated.
B. Material: Waterborne Alkaline Copper Quaternary (ACQ) preservative system containing no arsenic and no chromium.
C. Approved Manufacturer: Chemical Specialties, Inc. “Preserve” or approved equal.
D. Comply with AWPA Standard U1 and T1.
E. Retention Rates: As recommended by manufacturer for applications required.
F. End Cut Preservative: Acceptable to manufacturer of ACQ preservative.
G. All ACQ preservative treated wood members shall bear an end tag or permanent ink stamp indicating name of wood treating company, treatment plant city and state, symbol for alkaline copper quaternary (ACQ), preservative retention level, approved use, and code report number.

2.02 FIRE-RETARDANT PRESSURE TREATED WOOD
A. General: All lumber and plywood designated to be exterior fire retardant treated shall be pressure impregnated with fire-retardant chemicals and shall have a flame spread rating of 25 or less when tested in accordance with ASTM E84. When test conditions are extended to 30-minutes, the flame spread shall not progress more than 10-1/2-feet beyond the center line of the burners, with no evidence of significant progressive combustion.

B. Each piece of fire-retardant treated lumber and plywood shall be manufactured under Timber Products Inspection or other independent third party follow-up inspection service, and each piece shall bear the appropriate qualified inspection agency’s label indicating surface burning characteristics in the 30-minute ASTM E84 flame spread test. Each piece shall be labeled indicating kiln dried after treatment (KDAT) and identifying the treating company and location.

C. Interior Wood:
   2. Structural performance of fire retardant treated wood shall be evaluated in accordance with ASTM D5664 for lumber and ASTM D5516 for plywood. Evaluation of plywood data shall be in accordance with ASTM D6304. The resulting design value and span rating adjustments shall be published in ICC Evaluation Service Report (ESR) – 1791 issued by the ICC Evaluation Service, Inc. which includes evaluation of high temperature strength testing for roof applications.
   3. Interior fire retardant treated lumber and plywood shall have equilibrium moisture content of not over 28-percent when tested in accordance with ASTM D3201 at 92-percent relative humidity.
   4. Interior fire retardant treated wood shall be kiln dried after treatment to a maximum moisture content of 19-percent for lumber and 15-percent for plywood.
   5. The fire retardant formulation shall be free of halogens, sulfates, chlorides, arsenic, ammonium phosphate, formaldehyde, and urea formaldehyde.
   6. Provide lumber of the appropriate grade and species as specified by the design criteria of the intended application after consideration of design value adjustment.
   7. Provide plywood of the appropriate size, grade and species as specified by the design criteria of the intended application after consideration of span rating adjustments.

D. Exterior Wood:
   1. Approved Manufacturer: Hoover Treated Wood Products, Inc. “Exterior Fire-X” or approved equal.
   2. Exterior fire retardant treated wood shall be kiln dried after treatment to a maximum moisture content of 19-percent for lumber and 15-percent for plywood.
   3. Exterior fire retardant treated lumber and plywood shall use design value adjustments and span ratings as published by the manufacturer.
   4. The fire retardant formulation shall be free of halogens, sulfates, chlorides, and ammonium phosphate.
   5. Provide lumber of the appropriate grade and species as specified by the design criteria of the intended application.
   6. Provide plywood of the appropriate size, grade and species as specified by the design criteria of the intended application.

E. Fire-retardant treatment shall be a clear product and shall not change the appearance of the wood.

PART 3 - EXECUTION
3.01 INSTALLATION, GENERAL
A. Preservative-Treated Wood: Handle, store, and install fire-retardant-treated wood in compliance with recommendations of chemical treatment manufacturer, including those for adhesives where required for installation.
1. Field Cuts: Where cut or drilled in field, treat cut ends with preservative solution used in original treatment by brushing, spraying, dipping, or soaking. Treat end cuts of ACQ preservative treated wood members with field-applied end coat prior to installation.

B. Fire-Retardant Treated Wood: Handle, store, and install fire-retardant-treated wood in compliance with recommendations of chemical treatment manufacturer, including those for adhesives where required for installation.

1. Field Cuts:
   a. Lumber: Do not rip or mill fire retardant treated lumber. Cross cuts, joining cuts, and drilling holes are permitted.
   b. Plywood: Fire retardant plywood may be cut in any direction.

2. Do not install interior fire-retardant treated wood in areas where it is exposed to precipitation, direct wetting, or regular condensation. Do not install as sill plates; use exterior fire-retardant treated wood.

3.02 WASTE MANAGEMENT

A. Hazardous waste shall be separated, stored and disposed of according to local regulations.

END OF SECTION
SECTION 06 10 53
MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for miscellaneous rough carpentry items, including but not limited to the following:
   1. Wood blocking and backing.
   2. Plywood backing at mechanical, electrical and telecommunications rooms and where indicated.

B. Related Sections:
   1. Wood treatment is specified in Section 06 05 73.

1.02 PRODUCT DELIVERY, STORAGE AND HANDLING

A. General: Comply with Division 01.

B. Keep materials under cover and dry. Protect against exposure to weather and contact with wet or damp surfaces.

C. Stack lumber, plywood and other panels; provide for air circulation within and around stacks and under temporary coverings.

PART 2 - PRODUCTS

2.01 LUMBER

A. Manufacture lumber to comply with PS 20 and with applicable grading rules of inspection agencies certified by ALSC Board of Review.

B. Factory-mark each piece of lumber identifying grading agency, grade, species, moisture content at time of surfacing, and mill.

C. Nominal sizes are indicated, except as indicated by detail dimensions. Provide actual sizes as required by PS 20, for moisture content specified for each use. Provide dressed lumber, S4S, unless otherwise indicated.

D. Moisture Content: 19 percent maximum.

E. Species and Grade: Douglas Fir, No. 2 unless otherwise indicated.

2.02 PLYWOOD BACKING


B. Miscellaneous Exposed Plywood: APA A-D Interior, thickness indicated.

2.03 FASTENERS

A. General: Provide fasteners with hot-dip zinc coating in accordance with ASTM A153 or stainless steel.


C. Bolts: ASTM A307, Grade A; with hex nuts and flat washers.
D. Screws: Type, size and length appropriate for securing gypsum and plywood sheathing to metal studs.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Discard units of material with defects which might impair quality of work, and units in sizes that would require an excessive number or poor arrangement of joints.

B. Cut and fit miscellaneous carpentry accurately. Install members plumb and true to line and level.

C. Securely attach carpentry work to substrate by anchoring and fastening as indicated and required.

D. Use fasteners of appropriate type and length and compliant with CBC Chapter 23. Install fasteners without splitting wood; pre-drill as required.

3.02 WOOD GROUNDS, NAILERS, AND BLOCKING

A. Provide where indicated and required for screeding or attachment of other work. Form to shapes indicated and cut as required for true line and level of work to be attached. Coordinate location with other work involved.

B. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces.

C. Provide permanent grounds of dressed, preservative treated, key-beveled lumber not less than 1-1/2-inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.03 PLYWOOD BACKING

A. Saw cut plywood accurately for tight fit.

B. Install with grain of outer plies at right angles to supports.

C. Fasten securely at each support with self-tapping sheet metal screws driven flush with face of plywood, and terminate ends only over supports.

D. Maintain tight joints but do not force panels into place.

E. Comply with additional recommendations in APA Form E30, "Design/Construction Guide - Residential & Commercial".

3.04 WASTE MANAGEMENT

A. Separate the following categories for salvage or re-use on the site:
   1. Sheet materials larger than 2-sq. ft.
   2. Solid wood trim longer than 16-inches and multiple offcuts of any size larger than 12-inches.

B. The following categories may be re-used in the manufacture of particleboard or medium density fiberboard:
   1. Clean dimensional lumber.

C. Separate the following categories for disposal and place in designated areas for hazardous materials:
   1. Treated, stained, painted, or contaminated wood.

END OF SECTION
SECTION 06 41 00
ARCHITECTURAL WOOD CASEWORK

PART 1 - GENERAL

1.01 DESCRIPTION
A. This Section describes the requirements for furnishing and installing architectural wood casework, including but not limited to the following:
   1. Custom plastic laminate faced cabinetwork.
   2. Plastic laminate countertops.
B. Related Sections:
   1. Solid surfacing countertops are specified in Section 12 36 61.

1.02 SUBMITTALS
A. General: Comply with Division 01.
B. Samples: Specified plastic laminate colors for verification of initial selections.
C. Shop Drawings: Show details of fabrication and installation, dimensioned plans, elevations, and sections. Each set of shop drawings shall comply with Architectural Woodwork Standards (AWS) Section 1 – Submittals.
   1. Shop drawings shall bear the Woodwork Institute Certified Compliance Program Label on the first page. Photocopies of architectural drawings are not acceptable. Highlight any modifications to the Specifications or AWS requirements.

1.03 QUALITY ASSURANCE
A. Materials and fabrication of cabinetwork shall be in accordance with the standards of the Architectural Woodwork Standards (AWS) for the grades specified.

1.04 PROJECT CONDITIONS
A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is completed, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.
B. Field Measurements: Check actual dimensions of other construction by accurate field measurements before fabrication, and show recorded measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.
   1. Verify locations of concealed framing, blocking, backing, reinforcements, and other items that support cabinetwork by accurate field measurements before being enclosed and record on shop drawings.
C. Verify that wall, ceiling and floor surfaces to receive casework are within acceptable tolerances.

1.05 COORDINATION
A. Cabinets shall be left in a well ventilated warehouse for a minimum of 72-hours prior to delivery to the Project site.
B. Cabinets shall be acclimated to the field conditions for a minimum of 72-hours prior to installation.

1.06 INDOOR AIR QUALITY
A. Do not use wood products containing urea formaldehyde glues inside the shell of the building.
B. When machining plastic products, protect surrounding areas from dust.
PART 2 - PRODUCTS

2.01 GENERAL

A. Materials and fabrication are to meet the requirements of the Architectural Woodwork Standards for the grade(s) specified.

1. If there is a conflict between the AWS and the drawings and/or specifications, the drawings and specifications shall govern.

2.02 MATERIALS

A. High-Pressure Decorative Laminate (HPDL): Comply with Architectural Woodwork Standards (AWS) Section 4 and NEMA LD3.

1. Horizontal Surfaces: HGS, 0.048-inch nominal thickness.

2. Vertical Surfaces: VGS, 0.028-inch nominal thickness.

3. Horizontal Post-formed Surfaces: HGP, 0.039-inch nominal thickness.

4. Cabinet Liner: CLS, 0.020-inch nominal thickness.

5. Backer: BKL, 0.020-inch nominal thickness.

6. Manufacturer, Pattern, Sheen, Color: As indicated in the Finish Legend.

B. Low-Pressure Decorative Laminate (LPDL): Comply with Architectural Woodwork Standards (AWS) Section 4 and NEMA LD3. LPDL shall consist of melamine, polyester or foil resin-impregnated paper thermally fused under pressure to an approved core and have a balance sheet.

C. Balance Sheet:

1. Plastic Laminate Faced Casework: HPDL or overlay of a compatible thickness.

D. Hardboard: Manufactured of interfelted lignocellulosic fibers, consolidated under heat and pressure to a density of 31-pcf or greater, tempered grade, 1/4-inch thick tempered, smooth both sides.

E. Backing for Plastic Laminate: One of the following, at Contractor's option.

1. Medium Density Fiberboard:

   a. Dry Areas: Medite Corporation "Medite II" or approved equal (no known equal) medium density fiber board, 3/4-inch thick, 48-pcf density. Fiber board shall have a recycled content of 92-percent.

   b. Countertops with Sinks: Medite Corporation "Medex" or approved equal (no known equal) medium density fiber board, 3/4-inch thick, 48-pcf density. Fiber board shall have a recycled content of 92-percent.

   c. Medium density fiberboard shall contain no added urea formaldehyde resins.

2. Plywood: Architectural Woodwork Standards (AWS) Grade B close grain hardwood veneer plywood, smooth, well sanded, thickness indicated. Provide exterior grade with waterproof glue at countertops with sinks. Plywood shall contain no added urea formaldehyde resins.

3. Particleboard: One of the following at Contractor's option:

   a. Roseburg Forest Products "SkyBlend Particleboard" or approved equal complying with ANSI A208.1, Grade M-2. Particleboard shall contain 100-percent pre-consumer recycled wood fiber. Do not use at countertops with sinks.
b. Straw-based particleboard complying with ANSI A208.1, Grade M-2, except for density. Do not use at countertops with sinks.

c. Particleboard shall contain no added urea formaldehyde resins.

F. Subframe Lumber: No. 1 grade Douglas Fir or plain sawn Yellow Poplar.

G. Adhesives: Contact, semi-rigid or rigid adhesives as recommended by laminated plastic manufacturer.

H. Hardware: Furnish and install as required to provide a complete casework installation.

1. Hinges: 120-degree opening, concealed soft-closing hinge, passing 100,000-cycle test. Hinges shall be all-metal construction, meeting or exceeding the ANSI/BHMA Grade 1 performance and permanent set test requirements. Provide three hinges on doors over 48-inches high.

2. Door and Drawer Pulls: To be selected by the Architect.

3. Drawer Guides: Accuride, Blum, Grant, K&V or approved equal, soft-closing.

   b. General Purpose Drawers: Full extension, minimum 100-pound capacity.
   c. File Drawers: Full extension, minimum 150-pound capacity; 200-pound capacity at lateral file drawers wider than 30-inches.

4. Adjustable Shelf Pins: 5 mm polished nickel in drilled holes.

5. Grommets: Provide at penetrations through countertops. Material, size and finish/color as approved by the Architect. Coordinate location with Owner.

2.03 FABRICATION

A. Fabricate products in accordance with the approved Shop Drawings and specified Architectural Woodwork Standards (AWS) Grade requirements. The architectural drawings indicate form and profile concept only. Fabrication and construction details shall comply with AWS unless otherwise specified.

B. Fabricate laminated plastic casework in accordance with Architectural Woodwork Standards (AWS) Section 10, Construction Type A – Frameless Construction; Interface Style 1 – Flush Overlay.

1. Grade: Custom except as otherwise specified.

2. Exposed exterior portions shall be covered with a HPDL as specified.

3. Exposed interior surfaces, except at doors and drawer fronts shall be covered with a HPDL matching exposed exterior surfaces.

4. Exposed interior surfaces of door and drawer fronts shall be covered with the same material, pattern, color and thickness as the door face.

5. Edge Banding: HPDL or PVC, minimum 0.02-inch thick, color-matched to the exposed face.

6. Semi-exposed surfaces of cabinet tops and bottoms, cabinet ends, fixed and adjustable shelves, cabinet back, shall be finished with a polyester laminate; exposed edges of semi-exposed surfaces shall be finished with extruded PVC or self-edged plastic laminate.

7. Door and Drawer Edge: Square edge with thin applied band.

8. Shelf Thickness: As specified in Architectural Woodwork Standards (AWS) for a uniform load of 50-lb./sq. ft.

9. Drawer Construction: Dowel or dovetail construction. Sides of 7 or 9 ply hardwood plywood with no voids. Bottoms of hardwood plywood of the same species and cut as the sides.
C. Laminated Plastic Countertops: Fabricate in accordance with Architectural Woodwork Standards (AWS) Section 11, Premium grade.
   1. Countertop Splash Assembly: AWS Assembly 2, deck-mount back and end splashes.
   2. Countertop Edges: Self-edged with plastic laminate or hardwood trim as indicated.
   3. Back Splash: Horizontal square butt joints or integral cove as indicated.
   4. Top of Back Splash: Square with self edge.
   5. Back Splash Height: As indicated.

D. Make cuts required to accommodate the work of other Sections in the shop where possible. Review other drawings and work to determine extent of items to be mounted in cabinetwork. Notify the Architect of discrepancies.

E. Shop-fabricate cabinets and countertops in whole units or partial units practical for handling and transporting. Assemble partial units in place so that each complete unit becomes a unified whole visually and structurally. Fabricate fillers and scribe strips of same materials and finishes as adjacent units.

F. Make cuts for hardware and equipment neat and true. Install hardware and fit securely.

G. Adjust drawers, doors, and movable shelves to operate easily and smoothly without binding.

PART 3 - EXECUTION

3.01 INSTALLATION
   A. Install cabinetwork in accordance with Architectural Woodwork Standards (AWS) Premium Grade requirements.
   B. Install products plumb and level.
   C. Securely fasten cabinetwork to supporting substrate as indicated.
   D. Anchor tops to base units and other supports as indicated. Seal space between backsplash and wall with sanitary sealant specified in Section 07 92 00. Install with no more than 1/8-inch in 8'-0" sag, bow, or other variation from straight line.
   E. Fit tight and scribe to walls, ceilings, and other surfaces so no open joints occur.
   F. Remove and replace materials damaged beyond repair or stained beyond cleaning.

3.02 ADJUSTMENT, CLEANING, AND PROTECTION
   A. Repair damaged and defective cabinetwork where possible to eliminate defects; where not possible to properly repair, replace.
   B. Clean, lubricate and make final adjustments to hardware for proper operation.
   C. Clean cabinetwork on exposed and semi-exposed surfaces. Touch-up shop-applied finishes to restore damaged or soiled areas.
   D. Protect cabinetwork to ensure work will be without damage at time of Substantial Completion. Cover completed cabinetwork with 4-mil polyethylene film protective enclosure, applied in a manner to permit easy removal.

3.03 WASTE MANAGEMENT
   A. Separate the following categories for salvage or re-use on the site:
      1. Sheet materials larger than 2-sq. ft.
2. Solid wood trim longer than 16-inches and multiple offcuts of any size larger than 12-inches.

B. Separate the following for recycling. Material shall be placed in source-separated or comingled recycling bins.
   1. Composite wood.
   2. Clean dimensional lumber.

C. Separate the following categories for disposal and place in designated areas for hazardous materials:
   1. Treated, stained, painted, or contaminated wood.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section includes fiberglass reinforced plastic (FRP) coated wall panels, trim, adhesive, and accessories.

B. Related Sections:

1. Joint sealants are specified in Section 07 92 00.

1.02 SUBMITTALS

A. General: Comply with Division 01.

B. Shop Drawings: Indicate panel layouts and seaming diagrams. Provide details at all joints, transitions of panels and materials.

C. Product Data: Furnish literature for FRP system and installation instructions.

D. Samples: Furnish finish and color samples from manufacturer's full range of colors. Furnish two 12-inch long samples of each type of trim.

1.03 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Division 01.

B. Provide factory wrapping, packaging, and other means necessary to prevent damage or deterioration during shipment, handling, and storage.

C. Maintain protective coverings in place and in good repair until removal is necessary.

D. Store products inside enclosed storage facilities or closed building, supported above grade and slabs-on-grade.

E. Maintain storage spaces and products in dry condition within temperature extremes recommended by manufacturer.

F. Follow special instructions of manufacturer.

1.04 PROJECT CONDITIONS

A. Do not begin installation until building is enclosed, permanent heating and cooling equipment is in operation and residual moisture has dissipated.

B. Maintain an ambient temperature and relative humidity within limits required by type of adhesive used and recommendations of adhesive manufacturer.

C. Provide ventilation to disperse fumes during application of adhesive as recommended by the adhesive manufacturer.

PART 2 - PRODUCTS

2.01 WALL PANELS

A. Approved Manufacturers: Crane Composites "Sequentia Flat Wall Panels" or approved equal.

B. Texture: Smooth.

C. Thickness: Minimum .060-inch.
D. Color: White.
E. Flame Spread: 25 or less, ASTM E84.
F. Smoke Developed: 450 or less, ASTM E84.

2.02 MISCELLANEOUS MATERIALS

A. Adhesive: VOC-compliant waterproof adhesive as recommended by panel manufacturer for installation conditions.
B. Moldings: PVC. Provide inside corners, outside corners, edging, division strips, and base molding.
C. Fasteners: Non-corrosive drive rivets.
D. Sealant: As specified in Section 079 20 00.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install panels in accordance with panel manufacturer’s instructions using moldings and adhesive. Install panels with manufacturer’s recommended gap for panel field and corner joints.
B. Before installing panels in moldings, fill grooves in moldings with silicone sanitary sealant specified in Section 07 92 00.
C. If fasteners are used, pre-drill 1/8-inch oversize holes.

3.02 COMPLETION

A. When complete, panels shall be securely adhered to substrates and moldings shall be plumb and level.
B. Exposed surfaces shall be clean and free from scratches, dents, tool marks, stains, discoloration, fingerprints, and other defects and damage.

END OF SECTION
SECTION 07 14 16

ELASTOMERIC LIQUID WATERPROOFING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing cold fluid-applied waterproofing at the following locations:
   1. Under thin-set floor tile.
   2. Under thin-set wall and floor tile at showers and where indicated.

B. Related Sections:
   1. Cementitious backing boards are specified in Section 09 82 13.
   2. Tile is specified in Section 09 30 00.

1.02 SUBMITTALS

A. General: Comply with Division 01.

B. Product Data: Manufacturer's specifications, installation instructions, and general recommendations for each waterproofing material. Include data substantiating compliance with specified requirements.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Documented experience in the installation of waterproofing systems of the type specified, and approved by the manufacturer of the waterproofing materials.

B. Waterproofing membrane shall meet or exceed extra heavy duty rating when tested in accordance with ASTM C627.

1.04 JOB CONDITIONS

A. Substrate: Proceed with waterproofing work only after substrate construction and penetrating work have been completed.

B. Coordinate finishing and curing of concrete surfaces to receive waterproofing with work of Section 03 30 00. Concrete surfaces shall have a steel trowel finish and shall be covered and wet cured for a minimum of 7-days.

C. Weather: Proceed with waterproofing work when existing and forecasted conditions will permit work to be performed in accordance with manufacturer's instructions.

D. Ventilation: Provide adequate ventilation to prevent accumulations of hazardous fumes during application of solvent-based components in enclosed spaces, and maintain ventilation until coatings have cured.

1.05 WARRANTY

A. Warrant elastomeric liquid waterproofing to be free from defects in materials and workmanship for a period of 10-years from Date of Substantial Completion. This warranty shall include the cost to replace covering materials applied over cold fluid-applied waterproofing. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

2.02 MATERIALS
A. Membrane: Cold-applied liquid rubber latex with fabric reinforcement.

PART 1 - EXECUTION
3.01 PREPARATION
A. Clean substrate of projections and substances detrimental to work; comply with recommendations of membrane manufacturer.
B. Rough or uneven surfaces shall be made smooth or leveled with underlayment material in accordance with manufacturer's recommendations.
C. Concrete surfaces shall be smooth, clean, free from dirt, grease, concrete sealers or curing compounds.
D. Dry, dusty slabs shall be dampened and swept off.
E. Do not allow waterproofing materials to enter and clog drains and conductors. Prevent spillage and migration onto other surfaces of work, by masking.

3.02 INSTALLATION
A. Comply with ANSI A108.1, ANSI A108.13 and manufacturer's instructions.
B. Precut reinforcing fabric allowing 2-inches for overlap at ends and sides. Extend fabric 6-inches through door openings.
C. Reinforce Joints: Spread a layer of waterproofing liquid at joints and cracks. Imbed a 6-inch wide strip of reinforcing fabric into the liquid. Spread a layer of waterproofing liquid over the fabric to seal it.
D. Coves: Spread a layer of waterproofing liquid in coves, imbed fabric and allow 6-inches of the fabric to flash up to walls. Spread a coat of liquid over the fabric to seal it. Flash the fabric and waterproofing liquid into drains and around projections.
E. Cracks: Clean and fill cracks greater than 1/16-inch with a scratch coat of latex portland cement mortar and allow to cure. Spread a layer of waterproofing liquid on crack, imbed a 6-inch strip of reinforcing fabric into the liquid, and spread a coat of liquid over the fabric to seal it.
F. Using a paint roller or brush, apply a coat of liquid membrane to the floor and/or wall, slightly wider than the fabric width. Include joints and coves previously reinforced. While the surface is still wet, embed fabric and smooth out wrinkles and press with brush or roller until membrane bleeds through to surface..
G. Apply liquid membrane to completely cover the fabric and allow to dry to the touch.
H. Apply an additional coat of liquid membrane and allow to dry.
I. Inspect final surface for pinholes, voids or thin spots. Use additional membrane liquid to seal any defects.

3.03 PROTECTION
A. Do not permit traffic on completed membrane prior to application of surfacing material.

END OF SECTION
SECTION 07 18 16
VEHICULAR TRAFFIC COATINGS

PART 1 - GENERAL

1.01 DESCRIPTION
A. This Section describes the requirements for furnishing and installing the following types of fluid-applied traffic coating:
   1. Replacement of vehicular traffic coating at parking surfaces at an existing facility where existing elastomeric deck coatings are being removed and structural repairs are occurring at the post tensioned concrete deck.

B. Related Sections:
   1. Selective structural demolition is specified in Section 02 41 19.
   2. Fiber Reinforced Polymer Coatings are specified in Section 03 25 00.
   3. Elastomeric liquid waterproofing is specified in Section 07 14 16.

1.02 SUBMITTALS
A. General: Comply with Division 01.
B. Samples: 12-inch square samples of fully cured exposed finish materials, in standard colors for the Architect's selection.
C. Product Data: Traffic coating manufacturer's application specifications, maintenance instructions, and locations of 5 installations applied by factory-trained applicators.
D. Warranty.

1.03 QUALITY ASSURANCE
A. Design Criteria: Traffic coating shall be UL rated Class A, in conformance with ASTM E108.
B. Manufacturer: Provide traffic coating produced by a single manufacturer with not less than 5-years prior production and installation of specified materials.
C. Perform a review of existing substrate, structural repair methods and materials, surface preparation methods, and confirm the compatibility of proposed traffic coatings with the final repaired substrate.
D. Substrate Adhesion Testing: Prior to material installation, apply test installations sections and perform adhesion and pull testing to the satisfaction of the system manufacturer
E. Installer: Traffic coating materials shall be installed by an applicator approved and trained by the materials manufacturer.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING
A. General: Comply with Division 01.
B. Deliver and store materials in manufacturer's unopened containers and packaging, identified with manufacturer's name, and name and type of material. Containers shall contain UL label.
C. Follow additional instructions of the manufacturer.

1.05 JOB CONDITIONS
A. Proceed with work only after substrate construction and penetrating work have been completed. Substrate work includes removal of existing elastomeric coatings and structural deck repairs.
B. Weather Conditions: Proceed with installation when weather conditions are in compliance with manufacturer's recommended limitations.

C. Pre-Installation Conference: Meet at Project site prior to commencement of work and review requirements for work and conditions which could interfere with successful performance. Where required for warranty, require manufacturer's technical representative to participate in conference.

1.06 WARRANTY

A. Furnish manufacturer's warranty signed by the applicator and authorized representative of manufacturer, warranting traffic coating materials for 3-years against failures resulting from normal exposure, excluding failures due to unusual weather, failure of substrate, or abuse. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 - PRODUCTS

2.01 VEHICULAR TRAFFIC COATING AT PARKING SURFACES

A. Approved Manufacturer: Gaco Western, Sika, Siplast or approved equal.


C. Materials:

1. Primer for Masonry and Vertical Concrete Substrates: Siplast “Pro Primer W”, fast-curing, PMMA-based, acrylic primer for use over masonry, concrete repair materials and vertical concrete substrates.

2. Primer for Horizontal Concrete Substrates: Siplast “Pro Primer T”, fast-curing, PMMA-based, acrylic primer for use over horizontal concrete substrates.

3. Flashing Resin: Siplast “Terapro Flashing Resin”, thixotropic, flexible, acrylic, PMMA-based resin for use in combination with a fleece fabric to form a monolithic, reinforced flashing membrane used in conjunction with a reinforced or unreinforced waterproofing system.

4. Base Resin: Siplast “Terapro Base Resin”, flexible, acrylic PMMA-based resin for use as waterproofing in a reinforced or unreinforced PMMA waterproofing system.

5. Fleece: Siplast “Pro Fleece”, non-woven, needle-punched polyester fabric used as a reinforcement in catalyzed resin flashing and field membrane systems.

a. Nominal Thickness: 40 mils.

b. Weight: 110 grams per square meter

6. Waterproofing/Wearing Layer Resin: Siplast “Terapro VTS Resin”, PMMA-based, acrylic resin, when combined with aggregate filler, used to provide a waterproofing/wearing layer in a reinforced or unreinforced PMMA waterproofing system.

7. Aggregate Filler for Waterproofing/Wearing Layer Resin: Siplast “Terapro VTS Aggregate Filler”, quartz aggregate blend added to the waterproofing/wearing layer resin to produce a PMMA-based resin/aggregate slurry waterproofing/wearing layer.


D. Waterproofing Accessories:

1. Cleaning Solution/Solvent: Siplast “Pro Prep”, clear solvent used to clean and prepare transition areas of in-place catalyzed resin to receive subsequent coats of resin and to clean substrate materials to receive resin.
2. Paste: Siplast “Pro Paste”, flexible PMMA-based paste used for remediation of depressions in substrate surfaces prior to the application of the waterproofing system or used as a leveling layer at fleece overlaps of reinforced waterproofing systems.


5. Natural Quartz: Siplast “Pro VTS Quartz”, natural-colored, kiln-dried, silica aggregate suitable for broadcast into the wearing layer of the waterproofing system and subsequently coated with a color finish. Quartz shall be supplied by the manufacturer of the waterproofing membrane.

6. Thixotropic Agent: Siplast “Pro Thixo”, liquid additive used to increase the viscosity of the PMMA-based resin products, allowing the resins to be applied over vertical or sloped substrates.

PART 3 - EXECUTION

3.01 VEHICULAR TRAFFIC COATING AT PARKING SURFACES

A. Examination:

1. General: Verify that the substrate is suitable to receive work. Notify the Architect in writing of conditions detrimental to the proper and timely completion of work. Bring substrate deficiencies into an acceptable condition prior to commencing work.

2. Concrete Substrate Requirements: Structural concrete shall be cured a minimum of 28 days in accordance with ACI-308, have a minimum compressive strength of 3,500 psi (24 N/mm²) and have a moisture content that conforms with the waterproofing system manufacturer’s requirements prior to commencement of work.

3. Moisture Content Evaluation: Evaluate the level of moisture in the substrate to determine that the moisture content is acceptable for application of the specified waterproofing system. Concrete substrates shall have a maximum moisture content of 6% by weight and a maximum internal relative humidity of 75%.

4. Adhesion Testing for Concrete Substrates to Receive Resin Materials: Test the concrete substrate using a device conforming to ASTM D 4541 using a 50 mm dolly adhered with the specified catalyzed primer. Utilize the same concrete preparation methods as that which will be used prior to application of the waterproofing for areas to be evaluated for adhesion. Ensure that a minimum adhesion value of 220 psi is obtained before application of the PMMA primer. If multiple areas or substrates are involved in the scope of work, evaluate each to determine suitability. Maintain testing/evaluation records.

B. Surface Preparation:

1. Protection: Provide protection to prevent dust/debris accumulation, spillage and resin overruns.

2. Cleaning: Remove oil and grease with a commercial grade cleaner; thoroughly rinse and dry. Sweep, blow, or vacuum loose surface debris in areas to receive resin.

3. Taping: Utilize masking tape at perimeters and joints of the area to be waterproofed to provide neat terminations.

4. Masonry/Concrete Walls: Shot-blast or grind concrete or masonry wall surfaces to provide a sound substrate free from laitance and all residue from bitumen, coal tar, primer, coatings, adhesives, sealer or any material that may inhibit adhesion of the primer. Following application of the specified primer, but prior to application of the waterproofing system, fill cracks, voids, fractures, depressions, small indentations, and low areas in the substrate using the specified paste. The use of paste or sealant is not an acceptable alternative to repointing mortar joints. Do not apply waterproofing materials over soft or scaling brick or masonry, faulty mortar joints, or walls with broken, damaged or leaking coping components.
5. Preparation of Newly Placed Concrete Substrates to Receive Resin Materials: Newly placed concrete shall be cured a minimum of 28 days in accordance with ACI-308, and have a minimum compressive strength of 3,500 psi (24 N/mm²). Following evaluation for moisture content and confirmation that the moisture content is at an acceptable level, shot-blast or scarify/shot blast the surface to provide a sound substrate free from laitance, and contaminants, generating a concrete surface profile of CSP-2 to CSP-4 as defined by the ICRI. Grinding may be used as a preparation method for localized areas that cannot be reached by a shot blasting equipment provided that a surface profile of CSP-2 to CSP 4 can be generated. Repair spalls and voids on vertical or horizontal surfaces using the specified primer and preparation paste.

6. Preparation of Existing Concrete/Masonry Substrates to Receive Resin Materials: Existing concrete substrates shall have a minimum compressive strength of 3,500 psi. Following evaluation for the presence of contaminants and confirmation that the moisture content is at an acceptable level, shot blast or scarify/shot blast concrete or masonry surfaces to provide a sound substrate free from laitance, carbonated concrete, residue from bitumen, coal tar, primer, coatings, adhesives, sealer, topically applied waterproofing materials or any material that may inhibit adhesion of the specified primer. Generate a concrete surface profile of CSP-2 to CSP-4 as defined by the ICRI. Grinding may be used as a preparation method for localized areas that cannot be reached by a shot blasting equipment provided that a surface profile of CSP-2 to CSP 4 can be generated. Repair spalls and voids on vertical or horizontal surfaces using the specified primer and preparation paste.

7. Repair and Leveling of Concrete to Receive Resin Materials: Before application of the waterproofing membrane, and after priming, fill all joints, cracks, voids, fractures, depressions, small indentations, and low areas in the substrate using the specified paste or repair mortar.

8. Concrete Substrate Repair: Prime areas of the concrete substrate intended for repair using the specified PMMA primer. Fill the areas using the specified paste or repair mortar and allow to cure. Follow the paste or repair mortar manufacturer's published minimum and maximum product thickness limitations per lift.

9. Preparation of Steel/Aluminum Substrates: Grind to generate a "white-metal" surface and remove loose particles. Extend preparation area a minimum of 1/2-inch beyond the termination of the waterproofing/flashing system. Notch steel surfaces to provide a rust-stop where detailed.

10. Rigid Plastic Flashing Substrates: Evaluate the plastic for compatibility with the resin materials. Clean plastic substrates using the specified the cleaner/solvent and allow to dry. Lightly abrade the surface to receive the flashing system. Extend the preparation area a minimum of 1/2 inch beyond the termination of the flashing system.

11. Static Crack Preparation – reinforced systems: Remove foreign materials from cracks and chase using appropriate equipment to bring the exposed concrete surfaces into a condition suitable to receive the primer. Clean cracks/joints and treat with the specified PMMA primer. Fill the cracks and joints using the specified preparation paste and allow to catalyze.

12. Static Crack Preparation – unreinforced systems: Remove foreign materials from cracks and chase using appropriate equipment to bring the exposed concrete surfaces into a condition suitable to receive the primer. Apply the specified primer to vertical walls of prepared cracks using a brush or other method to avoid over application. Allow the primer to cure. Fill cracks using the specified preparation paste and allow to cure. Wipe the previously applied primer and paste using the specified cleaning solution in areas having a 6 inch width centered over the crack. Apply a base coat of catalyzed base resin to the prepared substrate with a roller at the minimum rate specified by the resin manufacturer. Extend the catalyzed base resin ¼-inch beyond where the fleece reinforcement will be placed. Embed 6 inch wide strips of the specified fleece reinforcement into the wet, catalyzed flashing resin base coat using a roller or brush to fully embed the fleece and remove trapped air. Apply an additional coat of catalyzed base resin between layers of overlapping fleece. Fleece overlaps shall be a minimum 2 inches. Apply a finish coat of catalyzed base resin immediately following the embedment of the fleece with a roller or brush at the minimum rate specified by the resin manufacturer, ensuring full saturation of the fleece reinforcement.

C. Vehicular Traffic Liquid Applied Waterproofing Installation:

1. Mixing and Catalyzing of Resins: Thoroughly mix the entire drum of uncatalyzed resins for 2 minutes if pouring the resin into a second container when batch mixing. Catalyze only the amount of material that can be used within its pot life. Add pre-measured catalyst powder to the resin component and stir for 2-minutes using a slow-speed mechanical agitator or mixing stir stick. The amount of catalyst added is
based on the weight of the resin used. Refer to the waterproofing system manufacturer’s literature for mixing ratios.

2. Mixing and Catalyzing of Waterproofing Resin/Aggregate Filler Blends: Thoroughly mix the entire drum of uncatalyzed resin and slowly add amount of filler specified by the waterproofing system manufacturer. Once the filler has been mixed into the resin component, add pre-measured catalyst powder to the resin/filler mixture and stir for 2-minutes using a slow-speed mechanical agitator. The amount of catalyst added is based on the weight of the resin used. Refer to the waterproofing system manufacturer’s literature for mixing ratios.

3. Priming: Using the appropriate primer, apply to masonry, concrete and plywood surfaces that will receive the waterproofing membrane or flashing. Apply the primer using a roller at the minimum rate specified by the primer manufacturer and allow to cure for a minimum of 45 minutes. Increase application rates over other absorbent substrates. Do not let resin pool or pond. Do not over-apply primers as this may interfere with proper primer catalyzation. When calculating application rates, make allowances for saturation of roller covers and application equipment.

4. Flashing Membrane Application: Complete flashing application prior to the waterproofing membrane application in the field of the roof area. Using masking tape, mask the perimeter of the area to receive the flashing system. Pre-cut fleece to ensure a proper fit at transitions and corners prior to flashing membrane application. Apply a base coat of catalyzed flashing resin to the substrate with a roller or brush at the minimum rate specified by the resin manufacturer. Extend the catalyzed flashing resin 1/8 inch beyond where the fleece reinforcement will be placed. Embed the specified fleece reinforcement into the wet, catalyzed flashing resin base coat using a wet, but not saturated, roller or brush to remove trapped air. Overlap the fleece a minimum of 2 inches. Apply an additional coat of catalyzed flashing resin between layers of overlapping fleece. Apply a finish coat of catalyzed flashing resin immediately following the embedment of the fleece with a roller or brush at the minimum rate specified by the resin manufacturer, ensuring full saturation of the fleece reinforcement. Remove the tape before the catalyzed resin sets. Make allowances for saturation of roller covers and application equipment when calculating resin quantities. Allow to cure for a minimum of 45 minutes.

5. Reinforced Waterproofing System Application
   a. Using cleaner/solvent, wipe flashing membrane and primer surfaces to receive the field membrane. Allow the surface to dry for a minimum 20 minutes before continuing work.
   b. Using a roller, apply a layer of catalyzed base resin over the primed substrate at the minimum rate specified by the resin manufacturer. Embed the fleece reinforcement into the wet, catalyzed base resin waterproofing layer using a wet, but not saturated, roller to remove trapped air. Overlap side and end laps of the fleece a minimum of 2 inches (51 mm). Apply an additional coat of catalyzed base resin between layers of overlapping fleece. Apply a second coat of catalyzed resin immediately following the embedment of the fleece with an application roller or brush at the minimum rate specified by the resin manufacturer, ensuring full saturation of the fleece reinforcement. Allow to cure for a minimum of 45 minutes before application of the wearing layer of resin.
   c. Apply a layer of catalyzed waterproofing resin/aggregate filler mixture using a trowel at the minimum rate specified by the waterproofing system manufacturer. Use a spiked roller to remove trowel marks and to even the application of the waterproofing resin/aggregate filler mixture.
   d. Immediately broadcast quartz into the wet resin/aggregate filler mixture to refusal. Allow to cure for 2 hours. Sweep excess quartz from the surface.
   e. Install color finish using a roller or squeegee at the rate specified by the resin manufacturer.
   f. Make allowances for saturation of roller covers and application equipment when calculating resin application rates.
   g. If work is interrupted for more than 12 hours, or the surface of a catalyzed resin layer becomes dirty or contaminated from exposure to the elements, thoroughly clean the area with cleaner/solvent. Allow a minimum of 20 minutes for the solvent to evaporate before continuing work. Complete the next application procedure within 60 minutes following the evaporation of the cleaner/solvent.
3.02 FIELD QUALITY CONTROL AND INSPECTIONS

A. Site Condition. All areas around job site shall be free of debris, waterproofing materials, equipment, and related items after completion of job.

B. Notification of Completion: Contractor shall notify manufacturer by means of manufacturer's printed Notification of Completion form of job completion in order to schedule a final inspection date.

C. Final Inspection: Hold a meeting at the completion of the membrane application attended by all parties that were present at the pre-job conference. A punch list of items required for completion shall be compiled by the Contractor and the manufacturer's representative. Complete, sign, and mail the punch list form to the manufacturer's headquarters.

END OF SECTION
SECTION 07 21 00
THERMAL INSULATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing thermal insulation.

B. Related Sections:
   1. Roof board insulation is specified in Section 07 22 16.
   2. Firestopping insulation is specified in Section 07 84 00.
   3. Acoustic insulation is specified in Section 09 81 00.

1.02 SUBMITTALS

A. General: Comply with Division 01.

B. Product Data: Manufacturer’s specifications for each type of insulation required.

1.03 QUALITY ASSURANCE

A. Thermal Conductivity: Where insulation is indicated or specified by "R" value, provide thickness required to achieve indicated value. Use aged and settled values for thermal resistance factors (R-values), tested in accordance with ASTM C518 at 75-deg. F. and 50-percent relative humidity for at least 6-months.

B. Fire Ratings: Comply with fire-resistance and flammability ratings specified.

C. Insulation shall be certified by the manufacturer to comply with California standards for insulating materials.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Division 01.

B. Protect insulation from physical damage and from becoming wet or soiled. Comply with manufacturer’s recommendations for handling, storage and protection during installation.

1.05 TESTING AND INSPECTIONS

A. Inspect insulation for proper installation. Correct defects such as voids, gaps or insulation compressed behind pipes before accepting work.

1.06 INDOOR AIR QUALITY

A. Protect ducts and HVAC system from loose insulation particulates.

B. Provide temporary ventilation of building areas where building insulation is being installed.

PART 2 - PRODUCTS

2.01 BOARD INSULATION

A. Polyisocyanurate Board Insulation: Closed cell polyisocyanurate foam core bonded on each side to a trilaminate foil facer, complying with ASTM C1289, Type I, Class 1.

   1. Approved Manufacturers: Johns Manville “AP Foil-Faced” or approved equal.
3. Dimensional Stability, ASTM D2126: 2-percent max., 7-days.


6. Surface Burning Characteristics: Maximum flame spread and smoke developed values of 75 and 200 when tested in accordance with ASTM E84.

7. Thickness: As required to match existing.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. Comply with manufacturer's instructions for installation conditions.

2. Do not install insulation until building is sufficiently enclosed or protected against absorption of moisture by the insulation, and do not install insulation unless supporting framing and construction is in a thoroughly dry condition.

3. Install snugly between framing members with ends snugly fitted between units and against adjacent construction.

4. Carefully cut and fit insulation around pipes, conduit, and other obstructions and penetrations.

5. Where door, window and skylight frames occur in framing, cut additional strips of insulation and hand-pack as required to fill voids in and around such frames.

6. Use insulation free of ripped backs and edges.

B. Thermal Insulation: Install to completely fill typical and odd spaces in framing where required to match existing.

3.02 PROTECTION

A. Protect installed insulation and vapor barriers from harmful exposures and from physical damage.

END OF SECTION
SECTION 07 22 16
ROOF BOARD INSULATION

PART 1 - GENERAL

1.01 DESCRIPTION
A. This Section describes the requirements for furnishing and installing roof board insulation and cover board.
B. Related Sections:
   1. Thermal insulation is specified in Section 07 21 00.
   2. Thermoplastic-polyolefin roofing is specified in Section 07 54 23.
   3. Firestopping insulation is specified in Section 07 84 00.
   4. Acoustic insulation is specified in Section 09 81 00.

1.02 SUBMITTALS
A. General: Comply with Division 01.
B. Shop Drawings: Show layout and identification of tapered roof insulation pieces. Include a scaled CAD-produced drawing showing insulation board layout, joint locations, slopes, spot elevations and drain locations. Coordinate with architectural roof plans and roof details.
C. Certification from roofing system manufacturer that insulation proposed for use is acceptable for application of roofing.

1.03 QUALITY ASSURANCE
A. Design Criteria: Insulation and roof assembly shall provide a minimum thermal rating of LTTR R-30 over conditioned spaces. At roof areas with tapered insulation, provide average LTTR R-values.
B. Labels and Approvals: Roof insulation shall be listed by UL for use with UL Class A roof covering systems, and bear the UL label or be delivered with a UL certification of compliance.
C. Roof insulation shall be approved by the manufacturer of the thermoplastic-polyolefin roofing materials specified in Section 07 54 23.
D. Roof insulation shall comply with EPA Energy Star – Program Requirements for Roof Products.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING
A. General: Comply with Division 01.
B. 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.

PART 2 - PRODUCTS

2.01 ROOF INSULATION
A. Polyisocyanurate Board Roof Insulation: HCFC-free rigid closed-cell, non-composite, polyisocyanurate board insulation integrally laminated tofacings, complying with ASTM C1289, Type II, Class 1, Grade 2 (20-psi).
   1. Approved Manufacturers: Johns Manville “ENRGY 3.E” or approved equal.
   2. Thickness: As required to result in specified LTTR-value.


5. Provide tapered units where indicated or required for slope to drain. Minimum thickness at tapered boards shall be 1/2-inch. Minimum slope to drains shall be 1/4-inch per foot.

6. Provide in multiple layers. Minimum thickness of first layer shall be 1-inch or as recommended by roof insulation manufacturer. Maximum thickness of any layer shall not exceed 1-1/2-inches.

B. Cant Strips and Tapered Edge Pieces: Rigid tapered perlite complying with ASTM C728.

   1. Approved Manufacturers: GAF “GAF CANT” and “GAF EDGE”, Johns Manville “FesCant Plus Cant Strips” and “Fesco Tapered Edge Strips” or approved equal.

C. Cover Board: USG “Securock Gypsum-fiber Roof Board”, Georgia-Pacific “Dens Deck” or approved equal complying with ASTM C1177, glass-mat, water-resistant gypsum substrate, minimum 1/4-inch thick.

2.02 INSULATION FASTENERS

A. Mechanical Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to metal decking and as required for Factory Mutual wind uplift resistance rating of I-90.

B. Urethane Adhesive: Manufacturer’s two component urethane adhesive formulated to adhere cover board, cant strips and tapered edge pieces to rigid insulation boards.

PART 3 - EXECUTION

3.01 ROOF BOARD INSTALLATION

A. Coordinate installation of roof system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Install roof insulation in conformance with manufacturer’s printed instructions.

C. Install tapered insulation where required to conform to roof slopes indicated.

D. Install insulation with long joints in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4-inch with insulation.

   1. Cut and fit insulation within 1/4-inch of nailers, projections, and penetrations.

E. Install one or more layers of insulation to achieve required thickness. Where overall insulation thickness is 1-1/2-inches or greater, install 2 or more layers with joints of each layer staggered from joints of previous layer a minimum of 6-inches in each direction.

F. Trim surface of insulation where required at roof drains so completed surfaces is flush and does not restrict water flow.

G. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.

E. Install insulation with long joints in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4-inch with insulation.

   1. Cut and fit insulation within 1/4-inch of nailers, projections, and penetrations.

F. Mechanically Fastened Insulation: Loose lay insulation with staggered joints and secure top layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board type to deck type.

   1. Fasten top layer according to requirements in FMG’s “Approval Guide” for specified Windstorm Resistance Classification.
2. Fasten top layer to resist uplift pressure at corners, perimeter and field of roof.

3.02 COVER BOARD INSTALLATION

A. Coordinate installation of roof system components so cover board is not exposed to precipitation or left exposed at the end of the workday.

B. Install cover board in conformance with manufacturer’s printed instructions.

C. Install cover board with long joints in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4-inch with cover board.

1. Cut and fit cover board within 1/4-inch of nailers, projections, and penetrations.

D. Trim surface of cover board where required at roof drains so completed surface is flush and does not restrict water flow. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.

E. Adhered Cover Board: Adhere cover board to roof insulation using urethane adhesive in accordance with manufacturer’s instructions.

3.03 CLEANUP

A. Remove debris resulting from work under this Section from roof surfaces and Project site,

B. Leave surfaces in a condition acceptable to roof membrane installer.

END OF SECTION
SECTION 07 26 23
BELOW-GRAGE VAPOR RETARDERS

PART 1 - GENERAL

1.01 DESCRIPTION
A. This Section describes the requirements for furnishing and installing vapor retarder under concrete slabs-on-grade.
B. Related Sections:
   1. Cast-in-place concrete is specified in Section 03 30 00.

1.02 SUBMITTALS
A. General: Comply with Division 01.
B. Product Data: Include independent laboratory test results showing compliance with ASTM and ACI Standards. Include manufacturer’s installation instructions for placement, seaming, and pipe boot installation.

1.03 PRODUCT DELIVERY, STORAGE, AND HANDLING
A. General: Comply with Division 01.
B. Protect products against damage during field handling and installation.

PART 2 - PRODUCTS

2.01 MATERIALS
   1. Maximum After-Conditioning Water Vapor Permeance: 0.05-perms, ASTM E1745 Section 7.1 subparagraphs 7.1.205.
   2. Water Vapor Retarder: Meets or exceeds Class B, ASTM E1745.
   3. Thickness: Not less than 10-mils, complying with ACI 302.
B. Seam Tape: High density polyethylene tape with pressure sensitive adhesive, minimum 4-inches wide. Tape shall have a water vapor transmission rate of 0.3-perms or less in accordance with ASTM E96.
C. Mastic: As recommended by vapor retarder manufacturer. Mastic shall have a water vapor transmission rate of 0.3-perms or less in accordance with ASTM E96.
D. Pipe Boots: Construct from vapor retarder sheeting material and pressure sensitive tape in accordance with manufacturer’s instructions.

PART 3 - EXECUTION

3.01 INSPECTION
A. Below-grade and grading work and items penetrating vapor retarder shall be complete prior to start of installation.

3.02 INSTALLATION REQUIREMENTS
A. Vapor Retarder Sheeting:
   1. Install in accordance with manufacturer’s instructions and ASTM E1643.
   2. Unroll with the longest dimension parallel with the direction of the pour.
3. Lap vapor retarder over footings and seal to foundation walls.

4. Overlap joints 6-inches and seal with pressure sensitive tape.

5. Seal penetrations, including pipes, with pipe boot.
   a. Single pipe penetrations may be sealed using pipe boot constructed from the product. Cut a piece of plastic 12-inches wide x 1-1/2 times the circumference of the pipe. With scissors, cut slits half the width of the film Wrap boot around pipe; tape onto pipe and completely tape the base to the vapor retarder.
   b. Multiple pipe penetrations in close proximity and very small pipes shall be sealed using mastic. Cut out a small area around pipes. Cut a patch of vapor retarder extending at least 6-inches past the cut out in all directions. Cut X’s or small circles in the patch and install over pipes. Overlap at least 6-inches and tape. Build up 40- to 60-mils of mastic or as required to completely fill voids between the pipe and the vapor retarder.

6. Penetrations through vapor retarder sheeting except for reinforcing steel and permanent utilities are not permitted.

7. Repair damaged areas by cutting patches of vapor retarder sheeting, overlapping damaged area 6-inches and taping all four sides with pressure sensitive tape.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing totally adhered thermoplastic-polyolefin (TPO) elastomeric singly ply roofing system.

B. Related Sections:

1. Roof board insulation is specified in Section 07 22 16.
2. Sheet metal flashing and trim is specified in Section 07 62 00.

1.02 PERFORMANCE REQUIREMENTS

A. General: Provide installed roofing membrane and flashings that remain watertight, do not permit the passage of water and resist uplift pressures, thermally induced movement, and exposure to weather without failure.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.

C. Jobsite Safety: Execute all operations and provide a safe work environment in accordance to OSHA standards and regulations. This requirement applies to all Contractor personnel, associated subcontractors, workers and jobsite visitors.

1. Follow industry fire prevention guidelines for storage of materials, staging areas, roof access, and application means and methods.
2. Applicable local fire codes supersede industry guidelines.

D. Roofing System Design: Provide a membrane system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE 7.

1. Fire/Windstorm Classification: Class 1A-90.
2. Hail Resistance: MH.

1.03 SUBMITTALS

A. General: Comply with Division 01.

B. Product Data: Specifications, installation instructions and general recommendations from manufacturers of single ply membrane system for types of roofing required. Include data substantiating that materials comply with specified requirements.

C. Shop Drawings: Show roof configuration and sheet layout at 1/8-inch = 1'-0" minimum, seam locations, details at perimeter, penetrations at mechanical equipment, plumbing and electrical penetrations, and other conditions as required, drawn at 3"=1'-0" minimum. Indicate adjacent conditions.

D. Pre-Roofing Conference: Copies of pre-roofing conference records.

E. Certification that materials comply with local VOC limitations.

F. Certification that materials are compatible with sealants and waterproof flashings at perimeter conditions.

G. Furnish manufacturer’s test data on reflectance and emissivity of roofing.
H. Warranty.

1.04 QUALITY ASSURANCE

A. Manufacturer: Qualified with a UL listing and FMG approval for membrane roofing system identical to that used for this Project.

B. Installer: Approved, authorized or licensed by roofing system manufacturer to install manufacturer’s product and that is eligible to receive manufacturer’s warranty.

C. Testing Agency: An independent testing agency with the experience and capability to conduct the specified testing, as documented according to ASTM E548.

D. Source Limitations: Obtain all components from single source roofing manufacturer.

E. Fire-Test-Response Characteristics: Provide membrane roofing materials with the fire-test-response characteristics specified as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.

1. Exterior Fire-Test Exposure: Class A; ASTM E108, for application and roof slopes indicated.

2. Fire-Resistance Ratings: ASTM E119, for fire-resistance-rated roof assemblies of which roofing system is a part.

F. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site. Review methods and procedures related to roof deck construction and roofing system including, but not limited to, the following:

1. Meet with Owner, Architect, Owner’s insurer, testing and inspecting agency representative, roofing installer, roofing system manufacturer’s representative, deck installer, and installers whose work interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment.

2. Review methods and procedures related to roofing installation, including manufacturer’s written instructions.

3. Review and finalize construction schedule and verify availability of materials, installer’s personnel, equipment, and facilities needed to make progress and avoid delays.

4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.

5. Review structural loading limitations of roof deck during and after roofing.

6. Require electrical, plumbing, HVAC and framing trades to be present at the conference.

7. Review flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.

8. Review governing regulations and requirements for insurance and certificates.

9. Review temporary protection requirements for roofing system during and after installation.

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

G. Pre-installation Conference: Conduct conference at the Project site. Review methods and procedures related to roofing system including, but not limited to, the following:

1. Meet with Owner, Architect, Owner’s insurer, testing and inspecting agency representative, roofing installer, roofing system manufacturer’s representative, deck installer, and installers whose work interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.

3. Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.

4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.

5. Review structural loading limitations of roof deck during and after roofing.

6. Review 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.

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. General: Comply with Division 01.

B. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer’s name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

C. 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. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.06 PROJECT CONDITIONS

A. Weather: Proceed with roofing work when existing and forecasted weather conditions permit work to be performed in accordance with manufacturer’s recommendations and warranty requirements.

B. Substrate Conditions: Do not begin roofing installation until substrates have been inspected and are determined to be in satisfactory condition.

1.07 WARRANTY

A. Furnish manufacturer’s no dollar limit written warranty, signed by manufacturer, agreeing to repair or replace defective materials and workmanship for a period of 20-years after date of Substantial Completion of work. Warranty includes roofing membrane, flashings, roofing membrane accessories, fasteners, walkway products, and other single-source components of roofing system marketed by the manufacturer.

B. Furnish installer’s warranty including all components of roofing system for a period of 2-years from date of Substantial Completion.

C. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURER

A. Johns Manville “JM TPO – 60 MIL”

B. GAF “EverGuard TPO – 60 MIL”

C. Carlisle “Sure-Weld Reinforced Membrane TPO – 60 MIL”
2.02 THERMOPLASTIC POLYOLEFIN ROOFING MEMBRANE

A. Fabric-Reinforced Thermoplastic Polyolefin Sheet: ASTM D6878, uniform, flexible sheet formed from a thermoplastic polyolefin, internally fabric or scrim reinforced, nominal 60-mils thick, white color. Roofing membrane shall have a SRI of 78.

2.03 AUXILIARY MATERIALS

A. General: Provide auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.

1. Liquid-type auxiliary materials shall be classified as no-VOC.

B. Sheet Flashing: Manufacturer’s sheet flashing of same material, type, reinforcement, thickness and color as sheet membrane.

C. Bonding Adhesive: Manufacturer’s standard water-based bonding adhesive for membrane, and solvent-based bonding adhesive for flashings.

D. Metal Termination Bars: Manufacturer’s standard predrilled stainless-steel bars, with anchors.

E. Metal Battens: Manufacturer’s standard zinc-coated steel sheet, prepunched.

F. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate, and acceptable to membrane manufacturer.

G. Expansion Joints: Factory-fabricated weatherproof, exterior covers for expansion joint openings consisting of flexible rubber membrane, supported by a closed cell foam to form flexible bellows, with two metal flanges, adhesively and mechanically combined to the bellows by a bifurcation process.

H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, termination reglets, cover strips and other accessories required for a complete, watertight installation.

2.04 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads sourced from membrane roofing system manufacturer.

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 set and braced and that roof drains are securely clamped in place.

2. Verify that wood cants, blocking, curbs and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thickness of insulation.

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 in accordance with 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. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 ADHERED ROOFING MEMBRANE INSTALLATION

A. Install roofing membrane in accordance with manufacturer’s written instructions. Unroll roofing membrane and allow to relax before installing.

B. Start installation of roofing membrane in presence of membrane roofing system manufacturer’s personnel.

C. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Bonding Adhesive: Apply water-based bonding adhesive to substrate at rate required by membrane manufacturer and immediately install roofing membrane. Do not apply bonding adhesive to splice area of membrane.

E. Mechanically fasten roofing membrane at terminations, penetrations and perimeter of roofing.

F. Apply roofing membrane with side laps shingled with slope of roof deck where possible.

G. Seams: Clean seam areas, overlap roofing membrane, and hot-air weld side and end laps of roofing membrane according to manufacturer’s written instructions to ensure a watertight seam installation.
   1. Test lap edges with probe to verify weld continuity. Apply lap sealant to seal cut edges of roofing membrane.
   2. Verify field strength of seams a minimum of twice daily and repair seam sample areas. Remove and repair unsatisfactory sections before proceeding with work.
   3. Repair tears, voids, and lapped seams in roofing membrane that do not meet manufacturer’s requirements.

H. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.

I. Install roofing membrane and auxiliary materials to tie into existing roofing.

J. Proceed with installation only after unsatisfactory conditions have been corrected.

3.04 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 solvent-based bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with sheet flashing.

D. Clean seam areas and overlap and firmly roll sheet flashing into the adhesive. 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.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.05 WALKWAY INSTALLATION

A. Install walkway products where indicated. Heat-weld to substrate or adhere to substrate with compatible adhesive in accordance with roofing system manufacturer’s instructions.
3.06 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform roof tests and inspections and to prepare test reports.

B. Final Roof Inspection: Arrange for roofing system manufacturer’s technical personnel to inspect roofing installation on completion and submit report to the Architect. Notify the Owner and Architect 48-hours in advance of date and time of inspection.

C. Repair or replace components of membrane roofing system where test results or inspections indicate that they do not comply with specified requirements.

D. Additional testing and inspecting, at Contractor’s expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.07 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 Owner and Architect.

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
SECTION 07 62 00
SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.01 DESCRIPTION
A. This Section describes the requirements for furnishing and installing flashing and sheet metal.
   1. Provide all sheet metal flashing and trim required to provide a weathertight enclosure.
   2. Modify existing sheet metal flashing and trim where indicated.
B. Related Sections:
   1. Self-adhering sheet flashing is specified in Section 07 65 26.
   2. Expansion control is specified in Section 07 95 00.

1.02 PERFORMANCE REQUIREMENTS
A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation or other defects. Completed sheet metal flashing and trim shall not rattle, leak, or loosen and shall remain watertight.
B. Fabricate and install roof edge flashing and copings capable of resisting forces required by the California Building Code (CBC) according to recommendations in FMG Loss Prevention Data Sheet 1-49.
C. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes of 120-deg. F. ambient and 180-deg. F. material surfaces.

1.03 SUBMITTAL
A. General: Comply with Division 01.
B. Product Data: Manufacturer's product data, installation instructions and general recommendations for each specified sheet material and fabricated product. Include construction details, material descriptions, dimension of components and profiles, and finishes for each manufactured product or accessory.
C. Samples: 8-inch square samples of specified sheet materials to be exposed as finished surfaces.
D. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, and details. Distinguish between shop- and field-assembled work. Include the following:
   1. Identification of material, thickness, weight, and finish for each item and location.
   2. Details of forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
   3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips and other attachments. Include pattern of seams.
   4. Details of termination points and assemblies, including fixed points.
   5. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings, as applicable.
   6. Details of special conditions.
   7. Details of connections to adjoining work.

1.04 QUALITY ASSURANCE
A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA “Architectural Sheet Metal Manual” unless more stringent requirements are indicated or specified.

C. Pre-installation Conference: Conduct conference at Project site.
   1. Meet with Owner, Architect, Owner’s insurer, installer and installer whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, skylights, and roof-mounted equipment.
   2. Review methods and procedures related to sheet metal flashing and trim.
   3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
   4. Review special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect sheet metal flashing and trim.
   5. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.05 DELIVERY, STORAGE AND HANDLING

A. General: Comply with Division 01.

B. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

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

PART 2 - PRODUCTS

2.01 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

B. Sheet Metal Thickness: The following table may be used to covert specified sheet metal thickness to gauges. Not all materials will be used in the Project.

<table>
<thead>
<tr>
<th>Gauge No.</th>
<th>Aluminum</th>
<th>Stainless Steel</th>
<th>Zinc-Tin Coated Stainless Steel</th>
<th>Galvanized</th>
<th>Aluminum-Zinc Coated Steel</th>
<th>Zinc</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>.028</td>
</tr>
<tr>
<td>13</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>.032</td>
</tr>
<tr>
<td>14</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>.036</td>
</tr>
<tr>
<td>15</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>.040</td>
</tr>
<tr>
<td>16</td>
<td>.063&quot;</td>
<td>.063&quot;</td>
<td>---</td>
<td>.064&quot;</td>
<td>.064&quot;</td>
<td>.045</td>
</tr>
<tr>
<td>18</td>
<td>.060&quot;</td>
<td>.060&quot;</td>
<td>---</td>
<td>.052&quot;</td>
<td>.052&quot;</td>
<td>.055</td>
</tr>
<tr>
<td>20</td>
<td>.040&quot;</td>
<td>.038&quot;</td>
<td>---</td>
<td>.040&quot;</td>
<td>.040&quot;</td>
<td>.070</td>
</tr>
<tr>
<td>22</td>
<td>.034&quot;</td>
<td>.031&quot;</td>
<td>---</td>
<td>.034&quot;</td>
<td>.034&quot;</td>
<td>.090</td>
</tr>
<tr>
<td>23</td>
<td>.032&quot;</td>
<td>.028&quot;</td>
<td>---</td>
<td>.031&quot;</td>
<td>.031&quot;</td>
<td>.100</td>
</tr>
<tr>
<td>24</td>
<td>.028&quot;</td>
<td>.025&quot;</td>
<td>---</td>
<td>.028&quot;</td>
<td>.028&quot;</td>
<td>.125</td>
</tr>
<tr>
<td>25</td>
<td>.024&quot;</td>
<td>.022&quot;</td>
<td>.024&quot;</td>
<td>.025&quot;</td>
<td>.025&quot;</td>
<td>.150</td>
</tr>
<tr>
<td>26</td>
<td>.022&quot;</td>
<td>.019&quot;</td>
<td>.018&quot;</td>
<td>.022&quot;</td>
<td>.022&quot;</td>
<td>.180</td>
</tr>
<tr>
<td>28</td>
<td>---</td>
<td>.016&quot;</td>
<td>.015&quot;</td>
<td>.019&quot;</td>
<td>.019&quot;</td>
<td>.225</td>
</tr>
</tbody>
</table>

C. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A755.

1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653, G90 coating designation; structural quality.
2. Surface: Smooth, flat and mill phosphatized for field painting as specified in Section 09 91 00.

2.02 UNDERLAYMENT MATERIALS
A. Self-Adhering, High-Temperature Sheet: As specified in Section 07 56 26.

2.03 MISCELLANEOUS
A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants and other miscellaneous items as required for complete sheet metal flashing and trim installation.
B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts and other suitable fasteners designed to withstand design loads and recommended by manufacturer.
   1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
      a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
      b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
      c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
   2. Fasteners for Zinc-Coated (Galvanized) and Aluminum-Zinc Alloy-Coated Steel Sheet: Hot-dip galvanized steel according to ASTM A153 or ASTM F2329 or Series 300 stainless steel.
C. Solder:
   1. For Zinc-Coated (Galvanized) Steel: ASTM B32, Grade Sn50, 50-percent tin and 50-percent lead or Grade Sn60, 60-percent tin and 40-percent lead.
D. Sealant Tape: Pressure-sensitive, 100-percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, non-sag, non-toxic, non-staining tape 1/2-inch wide and 1/8-inch thick.
E. Elastomeric Sealant: ASTM C920, elastomeric polyurethane, polysulfide or silicone polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
F. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
H. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187.

2.04 MANUFACTURED SHEET METAL FLASHING AND TRIM
A. Reglets: Cheney Flashing Company, Fry Reglet Corporation, Hohmann & Barnard, Inc., Keystone Flashing Company, Inc. or approved equal. Form to provide secure interlocking of separate reglet and counterflashing pieces, compatible with flashing material. Provide factory-mitered and -welded corners and junctions and interlocking counterflashing on exterior face of same metal as reglet.
   1. Material: 0.022-inch galvanized steel.
   2. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers and with channel for sealant at top edge.
3. Provide counterflushing wind-resistant clips to be installed before counterflushing to prevent wind uplift of counterflushing lower edge.

2.05 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA’s “Architectural Sheet Metal Manual” that apply to design, dimensions, geometry, metal thickness and other characteristics. Fabricate items to the shop to the greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight required to comply with performance requirements, but not less than that specified for each application and metal.

2. Obtain field measurements for accurate fit before shop fabrication.

3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels, with exposed edges folded back to form hems.

4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4-inch in 20-feet on slope and location lines and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

C. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant.

D. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1-inch deep, filled with butyl sealant concealed within joints.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or form compatible, non-corrosive metal. Fabricate of sizes as recommended by SMACNA’s “Architectural Sheet Metal Manual” and FMG Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

F. Seams: Fabricate non-moving seams with flat-lock seams. Form seams and seal with elastomeric sealant. Rivet joints where required for strength.

2.06 ROOF DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes, and other accessories. Fabricate in minimum 96-inch long sections. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars and gutter accessories from same metal as gutters.

1. Expansion Joints: Butt type with cover plate.

2. Accessories: Continuous removable leaf screen with sheet metal frame and hardware cloth screen.

3. Gutter Style: As indicated or as selected by the Architect.

4. Material and Thickness:

<table>
<thead>
<tr>
<th>Material</th>
<th>Gutter Girth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>up to 15”</td>
</tr>
<tr>
<td>Galvanized Steel</td>
<td>0.022”</td>
</tr>
</tbody>
</table>

B. Downspouts: Fabricate downspouts complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors. Downspout profile and hanger style as indicated or as selected by the Architect. Fabricate from the following material:

<table>
<thead>
<tr>
<th>Material</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Galvanized Steel</td>
<td>0.022”</td>
</tr>
</tbody>
</table>
C. Parapet Scuppers: Fabricate scuppers of dimensions required with closure flange trim to exterior, 4-inch wide wall flanges to interior, and base extending 4-inches beyond cant or tapered strip into field of roof. For gravel surfaced roofs, fasten gravel guard angles to base of scupper. Fabricate from the following material:

```
<table>
<thead>
<tr>
<th>Material</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Galvanized Steel</td>
<td>0.028&quot;</td>
</tr>
</tbody>
</table>
```

D. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape indicated complete with outlet tubes, exterior flange trim, and built-in overflows. Fabricate from the following material:

```
<table>
<thead>
<tr>
<th>Material</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Galvanized Steel</td>
<td>0.028&quot;</td>
</tr>
</tbody>
</table>
```

2.07 LOW SLOPE ROOF SHEET METAL FABRICATIONS

A. Copings: Fabricate in minimum 96-inch long, but not exceeding 10-foot long sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and interior leg. Miter corners, seal, and solder or weld watertight.

1. Profile: As indicated.
2. Joint Style: Butt with 12-inch wide concealed backup plate and 6-inch wide exposed cover plates.
3. Fabricate from the following material:

```
<table>
<thead>
<tr>
<th>Material</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Galvanized Steel</td>
<td>0.040&quot;</td>
</tr>
</tbody>
</table>
```

B. Roof Penetration Flashing: Fabricate from the following material:

```
<table>
<thead>
<tr>
<th>Material</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Galvanized Steel</td>
<td>0.028&quot;</td>
</tr>
</tbody>
</table>
```

2.08 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following material:

```
<table>
<thead>
<tr>
<th>Material</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Galvanized Steel</td>
<td>0.028&quot;</td>
</tr>
</tbody>
</table>
```

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions with installer present, to verify actual locations, dimensions and other conditions affecting performance of the work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

B. For the record, prepare written report, endorsed by installer, listing conditions detrimental to performance of the work.

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

3.02 UNDERLAYMENT INSTALLATION

A. Self-adhering Sheet Underlayment: Install as specified in Section 07 65 26.

3.03 INSTALLATION
A. General: Anchor sheet metal flashing and trim and other components securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants and other miscellaneous items as required to complete sheet metal flashing and trim.

1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.

2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

3. Space cleats not more than 12-inches apart. Anchor each cleat with two fasteners, Bend tabs over fasteners.

4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.

5. Install sealant tape where indicated and required for a watertight installation.

6. Torch cutting of sheet metal flashing and trim is not permitted.

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

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.

1. Coat back side of uncoated aluminum and stainless steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.

2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10-feet with no joints allowed within 24-inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1-inch deep, filled with sealant concealed within joints.

D. Seal joints as required for watertight construction.

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1-inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40- and 70-deg. F., set joint members for 50-percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant type joints at temperatures below 40-deg. F.

2. Prepare joints and apply sealants to comply with requirements specified in Section 07 92 00.

E. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2-inches, except reduce pre-tinning where pre-tinned surface would show in completed work.

1. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Remove flux and spatter from exposed surfaces.

3.04 ROOF DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

B. Hanging Gutters: Join sections with riveted and soldered joints or with lapped joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to anchored gutter brackets or straps spaced not more than 36-inches apart. Provide end closures and seal watertight with sealant. Slope to downsputs.

1. Fasten gutter spacers to front and back of gutter.
2. Loosely lock straps to front gutter bead and anchor to roof deck.

3. Anchor and loosely lock back edge of gutter to continuous cleat or eave or apron flashing.

4. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24-inches apart.

5. Install gutter with expansion joints at locations not exceeding 50-feet apart. Install expansion joint caps.

6. Install continuous gutter screens on gutters with non-corrosive fasteners.

C. Downspouts: Joint sections with 1-1/2-inch telescoping joints.

1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60-inches o.c. in between.

2. Provide elbows at base of downspout to direct water away from building.

3. Connect downspouts to underground drainage system.

D. Parapet Scuppers: Install scuppers through parapet walls. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips and under roofing membrane.

1. Anchor scupper closure trim flange to exterior wall and solder or seal with elastomeric sealant to scupper.

2. Loosely lock front edge of scupper with conductor head.

3. Solder or seal with elastomeric sealant exterior wall scupper flanges into back of conductor head.

E. Conductor Heads: Anchor securely to wall with elevation of conductor head rim 1-inch below scupper or gutter discharge.

3.05 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written instructions, and SMACNA's “Architectural Sheet Metal Manual.” Provide concealed fasteners where possible, set units true to line, and level. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

B. Copings: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for required wind pressures.

1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate.

2. Anchor interior leg of coping with screw fasteners and washers at 24-inch centers.

C. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4-inches over base flashing. Install stainless steel draw band and tighten.

D. Roof Penetration Flashing: Coordinate installation of roof penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric or butyl sealant and clamp flashing to pipes that penetrate roof.

3.06 MISCELLANEOUS FLASHING INSTALLATION

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

3.07 INSTALLATION TOLERANCES
A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4-inch in 20-feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.08 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.

E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

3.09 WASTE MANAGEMENT

A. Scrap metal shall be collected for recycling.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION
A. This Section describes the requirements for furnishing and installation modified bituminous sheet flashing material under metal flashings and where indicated.
B. Related Sections:
   1. Sheet metal flashing and trim is specified in Section 07 62 00.

1.02 SUBMITTALS
A. General: Comply with Division 01.
B. Product Data: Furnish manufacturer’s standard product data sheets and installation recommendations and instructions. Include written instructions for evaluating, preparing and treating substrates as well as technical data including tested physical and performance properties.
C. Installer qualifications.

1.03 QUALITY ASSURANCE
A. Installer: Certified or approved by the self-adhering sheet flashing manufacturer to install the specified products with a minimum of 5-years continuous experience installing the specified materials.

1.04 JOB CONDITIONS
A. Apply flexible flashings in fair weather at temperatures of 40-degrees F. and above.
B. Provide adequate ventilation of enclosed spaces where primer is used.

1.05 DELIVERY, STORAGE AND HANDLING
A. General: Comply with Division 01.
B. Store materials in their original, sealed packages, labeled with manufacturer’s name, product brand name and type, date of manufacture, lot number, and directions for storing.
C. Store materials in clean, dry and protected location and within temperature range required by the manufacturer. Protect stored materials from direct sunlight.
D. Remove and replace materials that cannot be applied within stated shelf life.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

2.02 MATERIALS
A. Self-Adhering Sheet Flashing: 40-mil thick consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing, cold applied.

2. Low Temperature Flexibility, ASTM D1970: Passes after testing at minus 20-deg. F.
3. Water Vapor Permeance: <.05 perms 40-Mil (waterproof); ASTM F1249.

B. Primer: As recommended by membrane manufacturer for priming substrates to receive modified bituminous sheet flashing.

C. Joint Sealant: Certified by self-adhering flashing manufacturer as being compatible with flashing.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions under which self-adhering sheet flashing will be applied with installer and manufacturer’s representative present for compliance with requirements and for other conditions affecting performance of the self-adhering sheet flashing system. Do not proceed with installation until unsatisfactory conditions have been corrected and reviewed by the Architect.

B. Installation of self-adhering sheet flashing constitutes acceptance of substrate conditions.

3.02 PREPARATION

A. Remove dust, dirt, loose fasteners and other protrusions. Clean, prepare and treat substrates according to manufacturer’s written instructions. Provide clean, sound and dry substrate.

B. Prime substrates to receive self-adhering sheet flashing if required by manufacturer. Allow primer to dry for one hour or until tack-free. Re-prime surfaces not covered within 36-hours.

3.03 INSTALLATION

A. Self-Adhering Sheet Flashing:

1. Install self-adhering sheet flashing in accordance with manufacturer’s written instructions. Ensure that flashing adheres continuously with the substrate and is free of wrinkles, fishmouths, bubbles, creases and other irregularities.

2. Comply with temperature restrictions of underlayment manufacturer for installation. Use primer rather than nails for installing at low temperatures.

3. Apply in shingle fashion to shed water, with end laps of not less than 6-inches staggered 24-inches between courses.

4. Overlap side edges not less than 3-1/2-inches.

5. Carefully notch and fold flashing corners and returns.

6. Roll installed flashing with roller.

7. Installed membrane shall be covered as soon as possible with subsequently applied covering material. Do not leave membrane exposed to the weather for longer periods than approved by the manufacturer.
3.04 COMPLETION

A. Remove and replace self-adhering sheet flashing that does not comply with specified requirements. Holes in the flashing shall be patched with a minimum 6-inch overlap or in accordance with the self-adhering sheet flashing manufacturer's instructions.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION
A. This Section describes the requirements for furnishing and installing firestopping.
B. Related Sections:
   1. Joint sealants are specified in Section 07 92 00.
   2. Acoustic insulation is specified in Section 09 81 00.
   3. Plumbing is specified in Division 22.
   4. Electrical is specified in Division 26.

1.02 SYSTEM PERFORMANCE REQUIREMENTS
A. General: Provide firestopping systems capable of closing or filling through-penetrations created by the burning or melting of combustible pipes, cable jacketing, or pipe insulation materials, or by the deflection of sheet metal due to thermal expansion.
B. For firestopping exposed to view, traffic, moisture, and physical damage, provide products that do not deteriorate when exposed to these conditions.
C. For firestopping exposed to view, provide products when flame-spread values of less than 25 and smoke-developed values of less than 450, when tested in accordance with ASTM E84.

1.03 SUBMITTALS
A. General: Comply with Division 01.
B. Product Data: Manufacturer's descriptive, technical data and illustrations. Include manufacturer's installation instructions.
C. Certification:
   1. Manufacturer's certification that products comply with local regulations controlling use of volatile organic compounds (VOC's) and are nontoxic to building occupants.
   2. Manufacturer's certification that firestopping materials comply with ASTM E814 and UL 1479.
D. UL Design Numbers: Furnish UL Design No. from the "Fire Resistance Directory - Volume II" for each required penetration type and configuration. Indicate which materials will be used in firestopping the penetration. Reference architectural, mechanical, plumbing and electrical drawings.
E. Furnish documentation indicating deflection and elongation capacity of all head of wall assemblies are equivalent in capacity to design assemblies.

1.04 QUALITY ASSURANCE
A. Firestopping materials and systems shall be listed and labeled in accordance with requirements of Underwriters Laboratories, Inc. (UL) Building Materials Directory.
B. Firestopping materials shall conform to California Building Code (CBC) for fire resistance standards and requirements for penetrations in walls, partitions, and floor/ceiling and floor/roof assemblies.
C. Firestopping materials shall comply with ASTM E814 and UL 1479.
D. Form materials to remain in place in the completed work and sealant used for firestopping work shall be UL listed and labeled.

E. Firestopping materials shall be rated as required when tested in accordance with ASTM E119.

F. Firestopping materials shall be asbestos free and shall not incorporate nor require the use of hazardous solvents.

G. Firestopping materials shall not shrink upon drying as evidenced by cracking or pulling back from contact surface.

H. Installer shall have a minimum of 5-years experience installing UL listed firestop systems in similar type construction.

1.05 JOB CONDITIONS

A. Follow manufacturer's instructions for temperature, ventilation, and other conditions for mixing and installing foam seals.

B. Observe and follow manufacturer's precautions when using materials considered toxic and hazardous.

C. Maintain current copy of UL "Fire Resistance Directory" on Project site.

D. Installation of firestopping shall precede finishing of gypsum board.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Division 01.

B. Deliver materials in the manufacturer's unopened containers and packages with manufacturer's name, labels, product identification, lot numbers, and mixing and installation instructions, as applicable.

C. Store materials in unopened containers and packages, and under conditions recommended by manufacturer.

D. Store and handle firestopping materials in accordance with manufacturer's Material Safety Data Sheets.

1.07 PROJECT CONDITIONS

A. Environmental Conditions: Do not install firestopping when ambient or substrate temperatures are outside limits permitted by firestopping manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilation: Ventilate firestopping in accordance with manufacturers' instructions by natural means or forced air circulation.

1.08 SEQUENCING AND SCHEDULING

A. Perform work of this and other Sections in proper sequence to prevent damage to the firestopping materials and to ensure that their installation will occur prior to enclosing or concealing work.

B. Do not cover firestopping materials until they have been properly inspected and accepted by the authority having jurisdiction.

PART 2 - PRODUCTS

2.01 FIRESTOPPING, GENERAL

A. Compatibility: Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the penetrating items.

B. Accessories: Provide components of each firestopping system required to install fill materials. Use only components specified by firestopping manufacturer and which are approved by UL for the designated fire-resistance-rated system.
C. Manufacturers or systems not listed in UL "Fire Resistance Directory" but who can furnish certification of UL approval may be used in the work.

2.02 THROUGH-PENETRATION FIRESTOPPING MATERIALS

A. General: Listed manufacturers of through-penetration firestopping are intended as guidelines only; manufacturer and material type shall be as required by the UL Design No. for each penetration to receive firestopping.


C. Provide mortar, sealants and caulk, putty, wrap strips, pillows, bags, and other types required for UL Design No. for each penetration to receive firestopping.

2.03 MINERAL FIBER FIRESTOPPING MATERIALS

A. Material: Semirigid mineral fiber insulation, minimum 4-pcf density; USG Interiors "Thermafiber Safing", Johns Manville "Insul-Shield", Thermal Ceramics Inc. "Cerablanket F.S" or approved equal.

B. Support Clips: Manufacturer's standard impaling clips or custom designed to suit installation conditions, fabricated from galvanized sheet steel.

2.04 FIRESTOPPING AT ELECTRICAL BOXES AND UTILITY OUTLETS

A. Utility penetrations in walls, ceilings, or floors requiring protected openings shall be firestopped and sealed with an approved material securely installed, capable of maintaining its integrity when subjected to test temperatures specified in ASTM E814.

B. Steel electrical outlet boxes on opposite sides of walls requiring protected openings shall be separated by a horizontal distance of 24-inches.

C. Steel electrical outlet boxes which occur in combination with outlet boxes of any size such that the aggregate area of unprotected outlet boxes exceeds 100-square inches in any 100-square feet of wall area shall be protected by an approved material or detail to decrease the aggregate area of unprotected utility boxes to less than 100-square inches in any 100-square feet of wall.

D. Steel electrical outlet boxes which exceed 16-square inches in area shall be protected by 3M "Moldable Putty Pads", Specified Technologies, Inc. "SpecSeal Series SSP Putty Pads" or approved equal.

E. Utility and electrical outlets or boxes shall be securely fastened to the stud or framing of the wall or ceiling assembly. The opening in the gypsum board shall be cut so that the clearance between the box and the gypsum board does not exceed 1/8-inch.

1. Fill the 1/8-inch gap with an approved fire-rated sealant.

2.05 FIRESTOPPING AT METAL DECK FLUTES

A. Steel Deck Insert: Fyre Sleeve Industries, Inc., “Q-Stop” or approved equal one-piece fire-retardant plug for steel deck flutes.


C. Mineral Wood: Minimum 4-pcf density.

2.06 MIXING

A. For those products requiring mixing prior to application, comply with manufacturer’s instructions.

2.07 ESCUTCHEONS

A. Provide brushed stainless steel escutcheon plates at pipes and conduit exposed to view. Size to suit penetration.
PART 3 - EXECUTION

3.01 INSPECTION

A. Inspect openings and voids to be sealed to determine if conditions are satisfactory for the proper installation of firestopping. Do not commence work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning: Clean out openings and joints immediately prior to installing firestopping to comply with recommendations of firestopping manufacturer.

1. Remove foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of firestopping.

2. Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping.

3. Remove laitance and form release agents from concrete.

B. Priming: Prime substrates where recommended by manufacturer using manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking: Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of the work. Remove tape as soon as possible.

3.03 EXTENT OF FIRESTOPPING WORK

A. General: Provide solid continuous firestopping wherever the penetration or addition of a construction element through or adjacent to a fire-rated floor, wall or partition, or roof creates a discontinuity of such a rated separation. Application limited in size and configuration to tested systems. Do not install insulation types specified in other Sections in lieu of specified firestopping materials.

B. Interior Walls and Partitions: Where top edge of a fire-rated wall or partition abuts a fluted-type metal deck, provide mineral fiber and fire-rated sealant to fill flute spaces for the full depth or width of the wall or partition.

C. Penetrations:

1. Penetrations include conduit, cable, wire, pipe, duct, and other elements which pass through one or both outer surfaces of a fire-rated floor, roof, wall, or partition.

2. Verify that annular space around sprinkler pipes through fire-rated walls and floors is provided as required by NFPA 13.

D. Fire Rated Partitions:

1. Gaps exceeding 1/2-inch at smoke rated and fire-rated partitions shall be firestopped with a firestop sealant as listed in UL "Fire Resistance Directory" and as specified. Apply minimum 3/8-inch bead at intersection of finish material and adjacent surface, both sides and along entire perimeter.

2. Intersections at fire-rated partitions and steel deck type floor-ceiling or roof-ceiling assemblies shall be firestopped as required.

E. Provide firestopping to fill miscellaneous voids or openings at fire-rated construction as specified.

3.04 INSTALLATION

A. Do not install firestopping until building is sufficiently enclosed or protected against adverse weather conditions, and supporting framing and surrounding construction is in a dry condition.

B. Prepare and install firestopping in accordance with manufacturer's instructions.

C. Mineral Fiber:
1. Provide in thickness for compressing into voids for a tight friction fit when installed.
2. Provide in width sufficient to fill the depth of the void space using single width pieces.
3. Install with ends tight against terminal end construction, and with intermediate joints well compressed together and tight.
4. For vertical void spaces, provide support clips near each end, spaced not over 24-inches on center.

D. Foam:
1. Provide form materials to retain foam when placed.
2. Prime contact surfaces as recommended by foam manufacturer.
3. Inject foam into void spaces so foam develops full and complete contact with adjoining surfaces, and the space is free from air pockets.
4. Cure foam 24-hours, remove form materials not required to remain, and inspect.
5. Provide additional foam or sealant to fill insufficient depth and remaining voids.

E. Sealants:
1. Prepare penetrations in vertical and horizontal surfaces as required to receive finish products.
2. Install damming materials as required.
3. Apply caulk or putty in accordance with manufacturer's recommendations.

F. Steel Deck Plugs: Provide at steel deck flutes at all full-height sound-rated partitions unless otherwise indicated.

G. Finish surfaces of exposed to view firestopping to a uniform and level condition.

H. Firestopping shall not extend past edges of cover plates, escutcheons, etc. or where it will be exposed to view in the final assembly.

I. Install escutcheon plates at pipes and conduit exposed to view.

3.05 FIELD QUALITY CONTROL

A. Identify firestop systems after installation. Identify the firestop system that has been installed and include the appropriate UL Design Number.

B. At fire-rated walls, partitions, smoke barriers and other walls required to have protected openings or penetrations, provide a sign or stenciling on each side of the wall above the accessible ceiling stating that penetrations through fire-rated walls and partitions are not permitted unless such penetrations or openings are protected with firestopping meeting code requirements. Letters shall not be less than 1/2-inch in height. Repeat at intervals not exceeding 10-feet measured horizontally. Signs or stenciling shall comply with CBC Section 703.6 requirements.

3.06 CLEANING

A. Remove spilled and excess materials without damaging adjacent surfaces.

B. Leave finished work in neat, clean condition with no evidence of spill-overs or damage to adjacent surfaces.

3.07 WASTE MANAGEMENT

A. Close and seal tightly all partly used sealant containers and store protected in well ventilated fire-safe area at moderate temperatures.

B. Place used sealant tubes and containers in areas designated for hazardous materials.
PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing joint sealants.

B. Related Sections:
   1. Firestopping sealants are specified in Section 07 84 00.
   2. Joint sealants related to flashing and sheet metal work are specified in Section 07 62 00.
   3. Acoustical joint sealants are specified in Section 07 92 19.
   4. Glazing sealants are specified in Section 08 80 00.

1.02 SUBMITTALS

A. General: Comply with Division 01.

B. Product Data: Manufacturer's technical data for each product required, including instructions for joint preparation and sealant application. Include certification by joint sealant manufacturer that sealants, primers, and cleaners comply with local regulations controlling the use of volatile organic compounds (VOC). Include tested physical and performance properties. Include data sheets for substrate cleaners and substrate primers recommended by sealant manufacturer for specific substrate surface conditions.

C. Joint Sealant Schedule: Include the following information:
   1. Joint sealant application and typical joint locations to receive sealants.
   2. Joint sealant manufacturer and product name.
   3. Joint sealant formulation and color.

D. Samples: Manufacturer's bead samples of actual products showing full range of colors for each product exposed to view, including custom colors if required.

E. Certificates: Manufacturer's certification that joint sealants comply with specified requirements and are suitable for uses indicated.

F. Installer qualifications.

G. Warranty.

1.03 QUALITY ASSURANCE

A. Installer's Qualifications: Approved by the sealant manufacturer with a minimum of 5-years' experience on Projects of similar scope and scale.

B. Obtain joint sealant materials from a single manufacturer for each product required unless otherwise approved.

C. Preconstruction Field Testing: Prior to installation of joint sealants, field-test adhesion to joint substrates.

   0. Install joint sealants in 5-foot joint lengths. Allow to cure before testing. Test adhesion by pulling sealant out of joint according to “Method A, Field-Applied Sealant Joint Hand Pull Tab”, in Appendix X1 in ASTM C1193. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

   1. Perform field tests for each type of elastomeric sealant and joint substrate.
2. Arrange for tests to take place with joint sealant manufacturer's technical representative present.

3. 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.

4. Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrate during testing.

D. Pre-installation Meeting: Conduct at the Project site to review requirements for sealant work.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Division 01.

B. 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.

C. Store materials in the original, unopened containers or packages, and under conditions recommended by manufacturers. Store materials in a clean, dry protected location on raised platforms with weather-protective coverings, within temperature range required by sealant manufacturer.

D. Protect stored materials from direct sunlight.

E. Sealant manufacturer's standard packaging and covering is not considered adequate protection.

1.05 PROJECT CONDITIONS

A. Environmental Conditions: Do not install sealants when ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer, or to wet joint substrates.

B. Joint Width Conditions: Do not install sealants when joint widths are less than permitted by sealant manufacturer.

C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

1.06 WARRANTY

A. Exterior Sealants: Furnish a written warranty against leaks or other defects of materials and workmanship for a period of 10-years. Defects include but are not limited to changes in the structural, physical or chemical properties of the sealant materials that impair function or require abnormal maintenance, changes in surface finish, color or texture, failure in adhesion, weather resistance or durability, failure to prevent entry of water, or failure to comply with specified requirements.

B. This warranty shall not cover formation of cracks or defects in substrate materials adjacent to the seal, joint movement in excess of movement rating of sealant, or physical damage caused by others.

C. Repair or replace defective materials and workmanship during warranty period without expense to Owner, including removal and replacement of other items as required.

D. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

A. Provide color of exposed joint sealants as selected by Architect from manufacturer’s standard colors.

B. Provide joint sealers, joint fillers and other materials that are compatible with one another and with joint substrates, as demonstrated by testing and field experience.
2.02 ELASTOMERIC JOINT SEALANTS

A. Exterior Building Sealant: Either one-part silicone complying with ASTM C920, Type S, Grade NS, Class 25, 50 or 100 depending on product used, Use NT, M, A, and O or multi-component polyurethane complying with ASTM C920, Type M, Grade NS, Class 25, Use NT, M, A, and O. Dow Corning Corp. “790” or “795”, Tremco “Spectrem 1” or approved equal. Sealant shall resist ultra-violet, heat, ozone and moisture exposure and shall withstand substrate surface temperatures as high as 250-deg. F. and a surface temperature range of 150-deg. F.

B. 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”, General Electric Co. “Sanitary 1700”, Tremco Tremsil 200 or approved equal.

C. Horizontal Joint Sealant: Two-part pourable urethane; ASTM C920, Type M; Grade P; Class 25; Uses T, M, A and O; Pecora Corp. “NR-200 Urexpan”, Tremco, Inc. “THC-900/901” or approved equal. Horizontal joint sealant shall have a minimum Shore A hardness of 30.

2.03 LATEX JOINT SEALANTS

A. Interior Building Sealant: Acrylic-emulsion; one-part, nonsag, mildew-resistant, complying with ASTM C834, formulated to be paintable; Pecora Corp. “AC-20”, Tremco Inc. “Tremco Acrylic Latex 834” or approved equal.

2.04 JOINT FILLERS FOR CONCRETE PAVING

A. Joint Filler: Preformed cork strips complying with ASTM D1752 for Type II or preformed sponge rubber strips complying with ASTM D1752 for Type I.

2.06 JOINT SEALANT BACKING

A. General: Provide sealant backings which are non-staining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved by sealant manufacturer.

B. Plastic Foam Joint-Fillers: Preformed, compressible, resilient, non-waxing, non-extruding strips of plastic foam, of size, shape and density to control sealant depth.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer. Provide self-adhesive tape where applicable.

2.07 MISCELLANEOUS MATERIALS

A. Primer: As recommended by joint sealant manufacturer for adhesion of sealant to joint substrates.

B. Cleaners for Nonporous Surfaces: Non-staining, chemical cleaner of type acceptable to manufacturer of sealant and sealant backing materials which are not harmful to substrates and adjacent nonporous materials.

C. Masking Tape: Non-staining, non-absorbent type compatible with joint sealants and to surfaces adjacent to joints.

PART 3 - EXECUTION

3.01 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants.

1. Remove foreign material from joint substrates which could interfere with adhesion of joint sealant, including dust, paints, oil, grease, waterproofing, water repellents, water, and surface dirt.

2. Clean 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.

3. Remove laitance and form release agents from concrete.
4. Clean 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.

B. Joint Priming: Prime joint substrates where recommended by joint sealant manufacturer. Apply primer to comply with joint sealant manufacturer's recommendations. Confine primers to areas of joint sealant bond, do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces. Remove tape immediately after tooling without disturbing joint seal.

3.02 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint sealant manufacturers' printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply. Provide temporary ventilation during installation of interior joint sealants.

B. Sealant Installation Standard: Comply with recommendations of ASTM C1193 for use of joint sealants as applicable to materials, applications and conditions indicated.

C. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:

1. Install joint-fillers to provide sealant support for optimum performance cross-sectional shapes and depths.
   a. Do not leave gaps between ends of joint-fillers.
   b. Do not stretch, twist, puncture or tear joint-fillers.
   c. Remove absorbent joint-fillers which have become wet prior to sealant application and replace with dry material.

2. Install bond breaker tape between sealants and joint-fillers, compression seals or back of joints where required to prevent third-side adhesion of sealant to back of joint.

D. Installation of Sealants: Install sealants by proven techniques to contact and fully wet joint substrates, completely filling recesses provided for each joint configuration and providing uniform, optimum performance cross-sectional shapes and depths.

E. Tooling of Non-sag Sealants: Tool sealants to form smooth, uniform beads of slightly concave profile that is slightly below the adjacent surfaces unless otherwise indicated. Tool to eliminate air pockets and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents.

3.03 PROTECTION AND CLEANING

A. Protect joint sealants during and after curing period from contact with contaminating substances or from damage.

B. Cut out and remove damaged or deteriorated joint sealers and reseal joints with matching new materials.

C. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by sealant manufacturer.

3.04 FIELD QUALITY CONTROL

A. Conduct field adhesion testing in accordance with ASTM C1521 with the sealant manufacturer’s representative present. Conduct 10 tests in the first 1,000-feet of each sealant type and substrate followed by 1 test for every 1,000-feet thereafter if no test failure occurs.

3.05 WASTE MANAGEMENT

A. Close and seal tightly all partly used sealant containers and store protected in well ventilated fire-safe area at moderate temperatures.
B. Place used sealant tubes and containers in areas designated for hazardous materials.

END OF SECTION
SECTION 07 92 19
ACOUSTICAL JOINT SEALANTS

PART 1 - GENERAL

1.01 DESCRIPTION
A. This Section describes the requirements for furnishing and installing acoustical joint sealants.
B. Related Sections:
   1. Joint sealants are specified in Section 07 92 00.
   2. Acoustical insulation is specified in Section 09 81 00.

1.02 SUBMITTALS
A. General: Comply with Division 01.
B. Product Data: Manufacturer's technical data for each product required, including instructions for joint preparation and sealant application. Include certification by joint sealant manufacturer that sealants, primers, and cleaners comply with local regulations controlling the use of volatile organic compounds (VOC).
C. Samples: Manufacturer's bead samples of actual products showing full range of colors available, for each product exposed to view.
D. Certificates: Manufacturer's certification that joint sealants comply with specified requirements and are suitable for uses indicated.

1.03 QUALITY ASSURANCE
A. Installer's Qualifications: Completion of at least 3 installations similar in type and size to this Project.
B. Obtain joint sealant materials from a single manufacturer for each product required unless otherwise approved.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING
A. General: Comply with Division 01.
B. 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.
C. Store materials in the original, unopened containers or packages, and under conditions recommended by manufacturers.

1.05 PROJECT CONDITIONS
A. Environmental Conditions: Do not install sealants when ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer, or to wet joint substrates.
B. Joint Width Conditions: Do not install sealants when joint widths are less than permitted by sealant manufacturer.
C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

PART 2 - PRODUCTS

2.01 ACOUSTICAL JOINT SEALANTS
A. Acoustical Sealant for Concealed Joints: Non-drying, non-hardening, non-skinning, non-staining, gunnable, 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.
B. Acoustical Sealant for Exposed Joints: Non-oxidizing, skinnable, paintable, gunnable sealant recommended for sealing interior exposed joints to reduce transmission of airborne sound; Pecora Corp. "AC-20 FTR Acoustical and Insulation Sealant", USG "Sheetrock Acoustical Sealant" or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with manufacturer's instructions for installation conditions.

B. Acoustical Sealant Application Standard: Comply with recommendations of ASTM C919 for use of joint sealants in acoustical applications as applicable to materials, applications and conditions indicated. Install sealants in accordance with manufacturer's instructions.

3.02 PROTECTION

A. Protect installed insulation from harmful exposures and from physical damage.

3.03 WASTE MANAGEMENT

A. Close and seal tightly all partly used sealant containers and store protected in a well ventilated fire-safe area at moderate temperatures.

B. Place used sealant tubes and containers in areas designated for hazardous materials.

END OF SECTION
PART 1 – GENERAL

1.01 DESCRIPTION

A. Furnish and install metal expansion-joint covers, including all fasteners, seals, and accessories and compression seals.

B. Related Sections:
   1. Construction waste management is specified in Section 01 74 19.
   2. Flashing and sheet metal is specified in Section 07 62 00.
   3. Joint sealants are specified in Section 07 92 00.

1.02 SUBMITTALS

A. General: Comply with Division 01.

B. Product Data: Submit copies of manufacturer’s latest published literature for materials specified herein for approval, and obtain approval before materials are fabricated and delivered to the job site. Data to clearly indicate movement capability of cover assemblies and suitability of material used in exterior seals for UV exposure.

C. Certificates: Material test reports from qualified independent testing laboratory indicating and interpreting test results relative to compliance of fire-rated expansion joint assemblies with requirements indicated.

D. Shop Drawings: Submit shop drawings for work specified herein for approval, and obtain approval prior to fabrication and shipment of materials to the job site. Shop Drawings showing full extent of expansion joint cover assemblies; include large-scale details indicating profiles of each type of expansion joint cover assembly, splice joints between sections, joinery with other types, special end conditions, anchors, fasteners, and relationship to adjoining work and finishes. Include description of materials and finishes and installation instructions.

E. Warranty.

1.03 QUALITY ASSURANCE

A. Loading Characteristics: Floor joints shall be designed to withstand a minimum point load of 500-lbs. without damage or permanent deformation.

B. Single-Source Responsibility: Obtain expansion joint cover assemblies from one source from a single manufacturer.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. General: Comply with Division 01.

B. Exercise proper care in the handling of all work so as not to injure the finished surface, and take proper precautions to protect the work from damage after it is in place.

C. Deliver materials to the job site ready for use and fabricated in as large sections and assemblies as practical. Assemblies shall be identical to submitted and reviewed shop drawings, samples and certificates.
D. Store materials under cover in a dry and clean location off the ground. Remove materials that are damaged or otherwise not suitable for installation from the job site and replace with acceptable materials at no additional cost.

1.05 PROJECT CONDITIONS

A. Where necessary, check actual locations of walls and other construction to which work must fit, by accurate field measurements before fabrication. Show recorded measurements on final shop drawings and coordinate fabrication schedule with construction progress to avoid delay of Work.

1.06 WARRANTY

A. Warrant expansion joint covers to be watertight for a period of 10-years from date of Substantial Completion. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

A. Metal Seismic Joint Covers: Balco, Inc., C/S Construction Specialties, Ltd., MM Systems or approved equal.

B. Compression Seals: Emseal “Emshield DFR2” or approved equal.

2.02 MATERIALS

A. Metal Expansion Joint Covers:

1. Retainers (Extrusions): Aluminum, ASTM B221, alloy 6063-T5. Protect aluminum surfaces in contact with cementitious materials with zinc chromate primer or chromate conversion coating.

2. Sheet and Plate: Aluminum, ASTM B209 alloy 6061-T6. Protect aluminum surfaces in contact with cementitious materials with zinc chromate primer or chromate conversion coating.


4. Extruded Preformed Seals: Single or multi-layered rubber extrusions as classified under ASTM D2000, designed with or without continuous, longitudinal, internal baffles and formed to fit compatible frames, in color to match adjacent surface or as selected by the Architect.

5. Exterior Seals: Two single layered flexible extrusions, one interior PVC and one exterior thermoplastic rubber, as classified under ASTM D2000, retained in a set of compatible frames, in color to match adjacent surface.

6. Fire Barrier Material: Manufacturer’s standard 2-hour fire barrier assembly tested by a certified laboratory in accordance with ASTM E119 and E84 procedures. Provide assembly complete with retainer and anchors.

7. Accessories: Manufacturer’s standard anchors, fasteners, set screws, spacers, flexible vapor seals and materials, drain tubes, adhesives and other accessories compatible with material in contact, as indicated or required for complete installations.

B. Compression Seal: UL-certified, 2-hour fire-rated, watertight, sound suppressing expansion joint with traffic-grade silicone sealing surface on both the upper and lower faces, adhered to a fire-retardant impregnated foam backing.

1. Joint Size: As indicated.

2. Depth: 4-inches.

4. Adhesive: Epoxy as recommended by compression seal manufacturer.

5. Provide factory-fabricated transitions and terminations as required.

2.03 FABRICATION

A. Provide expansion joint cover assemblies of design, basic profile, materials and operation indicated. Select units comparable to those indicated or required to accommodate joint size, variations in adjacent surfaces and structural movement. Furnish units in longest practicable lengths to minimize number of end joints.

B. Provide hairline mitered corners where joint changes direction or abuts other materials. Include factory-fabricated closure materials and transition pieces, tee-joints, corner, curbs, cross-connections and other accessories as required to provide continuous joint cover assemblies.

2.04 METAL FINISHES

A. Aluminum Finishes

1. Exposed Surfaces: Factory-applied minimum 70-percent "Kynar 500" fluoropolymer resin-based coating. Custom color to match color samples furnished by the Architect. Provide number of coats required for specified warranty.

2. Factory-Primed Concealed Surfaces – Protect concealed metal surfaces that will be in contact with concrete and masonry surfaces when installed by applying a shop coat of manufacturer’s standard primer to contact surfaces. Provide minimum dry film thickness of 2.0-mils.

2.05 EXPANSION JOINT COVERS

A. Provide metal expansion joint covers of profiles indicated.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Make a thorough examination of all surfaces receiving the work of this Section and before starting the installation, notify the Architect in writing of any defect which would affect the satisfactory completion of the work of this Section.

3.02 PREPARATION

A. Verify measurements and dimensions at the job site and cooperate in the coordination and scheduling of the work of this Section with the work of related trades, with particular attention given to the installation of items embedded in concrete and masonry so as not to delay job progress.

B. Provide templates as required to related trade for location of all support and anchorage items.

3.03 INSTALLATION

A. In addition to requirements of these specifications, comply with manufacturer’s instructions and recommendations for all phases of work, including preparation of substrate, applying materials and protection of installed units.

B. Provide anchor devices and fasteners where necessary for securing expansion joint cover assemblies to inplace construction, including threaded fasteners with drilled-in fasteners for masonry and concrete where anchoring members are not embedded in concrete. Provide fasteners of metal, type and size to suit type of construction indicated and provide for secure attachment of expansion joint cover assemblies.
C. Perform cutting, drilling and fitting required for installation of expansion joint covers. Install joint cover assemblies in true alignment and proper relationship to expansion joints and adjoining finished surfaces measured from established lines and levels.

D. Allow adequate free movement for thermal expansion and contraction of metal to avoid buckling.

E. Set floor covers at elevations to be flush with adjacent finished floor materials. If necessary, shim to level, but ensure base frames have continual support to prevent rocking and vertical deflection.

F. Locate wall, ceiling, and roof covers in continuous contact with adjacent surfaces. Securely attach in place with all required accessories.

G. Maintain continuity of expansion joint cover assemblies with end joints held to a minimum and metal members aligned mechanically using splice joints. Cut and fit ends to produce joints that will accommodate thermal expansion and contraction of metal to avoid buckling of frames.

H. Installation of Compression Seals: Install in accordance with manufacturer’s instructions.

3.04 CLEANING AND PROTECTION

A. Do not remove strippable protective material until finish work in adjacent areas is complete. When protective material is removed, clean exposed metal surfaces to comply with manufacturer’s instructions.

3.05 CONSTRUCTION WASTE MANAGEMENT

A. General: Comply with the requirements of Section 01 74 19 Construction Waste Management for removal and disposal of construction debris and waste.

B. Separate and recycle waste materials to the maximum extent possible.

END OF SECTION
SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 DESCRIPTION
A. This Section describes the requirements for furnishing and installing hollow metal doors, door frames, and associated accessories.

B. Related Sections:
1. Flush wood doors are specified in Section 08 14 16.
2. Door hardware is specified in Section 08 71 00.
3. Glass and glazing is specified in Section 08 80 00.
4. Painting is specified in Section 09 91 00.

1.02 SUBMITTALS
A. General: Comply with Division 01.
B. Product Data: Furnish for each type of door and frame, including details of construction, materials, dimensions, hardware preparation, core, label compliance, profiles, and finishes.
C. Shop Drawings: Include details of each frame type, elevations of door types, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items. Include details of moldings, removable stops and glazing. Reference architectural details, door number and hardware group.
D. Door Schedule: Furnish complete schedule of doors and frames using same reference numbers for details and openings as those on the drawings.

1.03 QUALITY ASSURANCE
A. Steel doors and frames shall comply with ANSI A250.8 "Recommended Specifications Standard Steel Doors and Frames" and the specified requirements.
B. Fire-Rated Doors: Provide hollow metal doors and frames that comply with California Building Code (CBC) Section 715; are identical in materials and construction to units tested in door and frame assemblies in accordance with NFPA 252 or UL 10C; and are labeled and listed by UL, Warnock Hersey, or other testing and inspection agency acceptable to authorities having jurisdiction. Labels shall comply with NFPA 80 and be permanently affixed to the door.
C. Hollow metal doors and frames shall comply with positive pressure test requirements of NFPA 252 or UL 10C and shall be labeled accordingly by the door and frame manufacturer in a manner approved by authorities having jurisdiction. Door label shall include hourly rating followed by the letter "S" indicating conformance with air leakage resistance testing, serial number, and the listing agency’s certification mark.
D. Temperature-Rise Rating: At exit enclosures and exitways, provide doors that have a temperature-rise rating of 450 deg F maximum in 30 minutes of fire exposure. In addition to the requirements specified for positive pressure test requirements in Paragraph D. above, the door label shall include temperature rise rating.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING
A. General: Comply with Division 01.
B. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage.
C. Inspect doors and frames upon delivery for damage. Minor damage may be repaired provided finish items are equal to new work and acceptable to Architect; otherwise remove and replace damaged items as directed.

D. Store doors and frames at building site under cover. Place units on minimum 4-inch high wood blocking. Avoid use of non-vented plastic or canvas shelters that could create humidity chamber. If cardboard wrapper on door becomes wet, remove carton immediately. Provide 1/4-inch space between stacked doors to promote air circulation.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

A. Amweld Hollow Metal Doors and Frames, Ceco Door Products, Curries Company, Stiles, Steelcraft or approved equal.

2.02 MATERIALS

A. Hot-Rolled Steel Sheets and Strip: Commercial quality carbon steel, pickled and oiled, complying with ASTM A569.

B. Cold-Rolled Steel Sheets: Commercial quality carbon steel, complying with ASTM A366, commercial quality or ASTM A620, drawing quality.

C. Galvanized Steel Sheets: Zinc-coated carbon steel complying with ASTM A526, commercial quality, or ASTM A642, drawing quality, hot dipped galvanized in accordance with ASTM A653, A60 or G90 coating designation, mill phosphatized.

D. Supports and Anchors: Fabricate of not less than 16-gauge, galvanized where used with galvanized frames.

E. Inserts, Bolts and Fasteners: Manufacturer's standard units. Where items are built into exterior walls, hot-dip galvanize in accordance with ASTM A153, Class C or D as applicable.

F. Shop Applied Primer: Rust-inhibitive enamel or paint, either air-drying or baking, suitable as a base for specified finish paints.

G. Inert Filler: Noncorrosive compound free of asbestos fibers, sulfur components and other deleterious impurities.

2.03 DOORS

A. Provide metal doors of ANSI A250.8 grades and models specified.

1. Interior Flush Doors: Level 2, heavy duty, Model 2 except minimum 16-gauge cold-rolled sheet steel faces.

2. Exterior Flush Doors: Level 3, extra heavy duty, Model 2, minimum 16-gauge galvanized steel faces.

B. Door Louvers: Sight-proof stationary louvers, constructed of inverted V-shaped or Y-shaped blades formed of 24-gauge cold-rolled steel set into minimum 20-gauge steel frame. Provide galvanized louvers and frames in exterior doors.

C. Internal Construction: Unitized steel grid or vertical steel stiffeners with core sound deadener on inside of face sheets, in accordance with ANSI A250.8 requirements.

1. At fire-rated doors, provide core material as required to provide fire-protection and temperature-rise ratings.

D. Clearance: Not more than 1/8-inch at jambs and heads. Not more than 3/8-inch at bottom. Threshold clearances as indicated.

1. Where new doors are to be provided in existing frames, field measure opening to verify size prior to ordering.
2. Fire Doors: Provide clearances according to their listing except where more stringent requirements are specified.

E. Edges:
0. General: Beveled latch stile for single doors, and meeting stile for pair doors; square elsewhere.
1. Stile Edges: No seams are allowed on vertical stile edges.
2. Top and Bottom Edges: Reinforced with 16-gauge steel channels; both edges flush and made watertight for exterior doors, top edge flush for interior doors.

F. Glazing: Provide minimum 20-gauge steel non-removable glazing stops on the outside of exterior doors and on the secure side of interior doors. Glazing beads on the inside of glass panels shall be removable. Glazing beads shall be fabricated from the same materials as door face sheets.
1. Comply with requirements of specifications section 08 80 00 Glazing.
2. Fire Doors: comply with requirements of specifications section 08 80 00, 2.02 D – Safety Rated Wire Glass.

2.04 DOOR FRAMES
A. One-Piece Welded Frames: 16-gauge. Fabricate frames with mitered or coped and continuously welded corners.
B. Anchors:
1. Provide jamb anchors spaced not more than 32-inches on center and locate anchors not more than 18-inches from top and bottom of frame.
2. Fabricate from minimum 16-gauge sheet steel.
3. Vary anchor types to provide positive fastening to adjacent construction.
4. Secure a metal clip angle at bottom of each jamb member for anchoring to floor, with a minimum of two fasteners.
5. Items to be built into exterior walls shall be hot-dip galvanized after fabrication in accordance with ASTM A153, Class B.
C. Door Silencers: Except on weatherstripped or smoke gasketed frames, drill stops to receive 3-silencers on strike jambs of single-swing frames and 2-silencers in heads of double-swing frames.
D. Plaster Guards: Provide 26-gauge steel plaster guards or mortar boxes at back of hardware cutouts.

2.05 FABRICATION
A. Fabricate steel doors and frames to be rigid, neat in appearance and free from defects, warp or buckle. Wherever practicable, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory-assembled before shipment, to assure proper assembly at Project site. Comply with ANSI A250.8 requirements.
B. Fabricate exposed faces of doors, including stiles and rails of non-flush units, from cold-rolled steel.
C. Tolerances: Comply with SDI-117, "Manufacturing Tolerances Standard Steel Doors and Frames" unless otherwise indicated or specified.
D. Fabricate frames, concealed stiffeners, reinforcement, edge channels, louvers and moldings from either cold-rolled or hot-rolled steel.
E. Fabricate exterior doors and frames from galvanized sheet steel in accordance with SDI-112. Close top and bottom edges of exterior doors as integral part of door construction or by addition of minimum 16-gauge inverted steel channels with channel webs placed even with top and bottom edges. Seal joints in top edges of doors against water penetration.

F. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat heads for exposed screws and bolts.

G. Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware in accordance with final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A250.6 for door frame preparation for hardware.
   1. For concealed overhead door closers, provide space, cutouts, reinforcing and provisions for fastening in top rail of doors or head of frames, as applicable.

H. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping of surface-applied hardware may be done at Project site.

I. Locate hardware as indicated on final shop drawings and in accordance with Door Hardware Institute (DHI) "Recommended Locations for Builder's Hardware on Standard Steel Doors and Frames".

J. Shop Painting: Clean, treat, and paint exposed surfaces of steel door and frame units, including galvanized surfaces.
   1. Clean steel surfaces of mill scale, rust, oil, grease, dirt, and other foreign materials before application of paint.
   2. Apply shop coat of prime paint of even consistency to provide a uniformly finished surface ready to receive paint finish.
   3. Primer shall comply with ANSI/SDI 250.3 and shall be compatible with substrate and field-applied finishes despite prolonged exposure.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Install steel doors, frames, and accessories in accordance with the manufacturer's instructions, the requirements of ANSI/SDI, and final reviewed Shop Drawings.

B. Placing Frames: Comply with provisions of ANSI A250.8 and SDI-112 unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
   1. Except for frames located in concrete, place frames before constructing enclosing walls or ceilings.
   2. In masonry construction, install at least 3 wall anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry T-shaped anchors.
   3. At existing concrete or masonry construction, install at least 3 completed opening anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Set frames and secure to adjacent construction with bolts and masonry anchorage devices.
   4. In stud partitions, install at least 4 wall anchors per jamb at hinge and strike levels. Attach wall anchors to studs with screws.
   5. Install fire-rated frames according to their listings.
   6. Install head anchors at mid span for openings exceeding 48-inches.

C. Door Installation: Fit hollow metal doors accurately in frames, within specified clearances.
1. Fire-Rated Doors: Install with clearances specified in their listings and as specified

3.02 ADJUST AND CLEAN

A. Immediately after installation, sand smooth rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.
   1. Remove rust before touch-up is applied.
   2. Touch-up shall not be obvious.

B. Repair damaged galvanizing with a galvanizing repair paint.

C. When complete, exposed surfaces and edges shall be clean, straight, and free from dents, scratches, and other damage and defects.

D. Doors and finish hardware shall operate smoothly, quietly, and free from bind.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing access doors at all required locations.

B. Related Sections:

1. Non-structural metal framing is specified in Section 09 22 16.
2. Metal suspension systems are specified in Section 09 22 26.23.
3. Gypsum board is specified in Section 09 29 00.
4. Gypsum board shaft wall assemblies are specified in Section 09 21 16.23.
5. Fire suppression work is specified in Division 21.
6. Plumbing work is specified in Division 22.
7. Heating, ventilating and air conditioning work is specified in Division 23.
8. Electrical work is specified in Division 26.

1.02 SUBMITTALS

A. General: Comply with Division 01.

B. Product Data: Manufacturer's technical data and installation instructions for each type of access door assembly, including setting drawings, templates, instructions and directions for installation of anchorage devices. Include complete schedule including types, general locations, sizes, wall and ceiling construction details, finishes, latching or locking provisions and other data pertinent to installation.

C. Location Drawing: Required access doors may not be indicated on the Drawings. Show proposed location of every required access door with dimensions in plan and elevation. Verify locations with the Architect. Access doors shall be located within walls and ceilings for access including but not limited to the following: automatic valves, automatic dampers, air terminal units, and fire/smoke dampers. Show location of adjacent materials, trim pieces, and hardware required to complete the work. Do not begin installation until location is approved. Submit access door locations superimposed on piping layout and duct layout shop drawings.

1.03 QUALITY ASSURANCE

A. Fire-Rated Door Assemblies: Units shall comply with NFPA 80, be identical to door and frame assemblies tested for fire-test-response characteristics, and are labeled and listed by UL, Warnock Hersey, or other testing and inspecting agency acceptable to authorities having jurisdiction.

1.04 COORDINATION

A. Furnish inserts and anchoring devices required to be built into other work. Coordinate delivery to avoid delay.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Division 01.

B. Deliver and store access doors in manufacturer's standard protective packaging.

C. Do not remove protective packaging until ready for installation.

D. Follow manufacturer's instructions for storage and handling.
PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

A. Nystrom Building Products, J.L. Industries, Karp Associates, Milcor or approved equal.

2.02 MATERIALS AND FABRICATION

A. Furnish access doors of proper size for access to concealed equipment. Unless otherwise indicated, minimum size shall be 12-inch x 12-inch for hand access and minimum 18-inch x 18-inch for valve and actuator access and 24-inch x 24-inch for equipment access.

B. Non-Fire-Rated Access Doors with Exposed Trim:
   1. Door Design: Flush panel.
   2. Material: Commercial grade cold-rolled steel with 16-gauge frame and 14-gauge door.
   3. Finish: Phosphate dipped with baked-on rust-inhibitive gray primer for field painting as specified in Section 09 91 00.
   5. Hinge: Manufacturer’s standard.
   6. Latch/Lock: Flush screwdriver operated stainless steel cam latch. Provide keyed locks at access doors located in public areas.

C. Non-Fire-Rated Access Doors with Exposed Trim in Toilet Rooms, Custodial Rooms, and other Wet Areas:
   1. Door Design: Flush panel.
   4. Exposed Trim: Flange integral with frame, 1-inch wide, overlapping surrounding finished surface.
   5. Hinge: Manufacturer’s standard.
   6. Latch/Lock: Flush screwdriver operated stainless steel cam latch. Provide keyed locks at access doors located in public areas.
   7. Provide insulated doors in insulated or acoustically rated construction.

D. UL Fire-Rated Access Doors with Exposed Trim:
   1. Door Design: Flush panel.
   2. Material: Commercial grade cold-rolled steel with 16-gauge frame and 20-gauge door.
   3. Finish: Phosphate dipped with baked-on rust inhibiting primer for field painting as specified in Section 09 91 00.
   4. Insulation: 2-inch thick fire-rated insulation sandwiched between two pieces of 20-gauge steel.
   5. Exposed Trim: Flange integral with frame, 1-inch wide, overlapping surrounding finished surface.
   7. Continuous Closer: Automatic spring closer to automatically close and latch door.
8. Latch/Lock: Ball bearing cylinder lock operated by a recessed flush key lock. Panels shall have interior latch release mechanism allowing the door to be unlocked from the inside. Provide keyed locks at access doors located in public areas.

E. UL Fire-Rated Access Doors with Exposed Trim at Toilet Rooms, Custodial Rooms, and Other Wet Areas:

1. Door Design: Flush panel.
4. Insulation: 2-inch thick fire-rated insulation sandwiched between two pieces of 20-gauge steel.
5. Exposed Trim: Flange integral with frame, 3/4-inch wide, overlapping surrounding finished surface.
7. Continuous Closer: Automatic spring closer to automatically close and latch door.
8. Latch/Lock: Ball bearing cylinder lock operated by a recessed flush key lock. Panels shall have interior latch release mechanism allowing the door to be unlocked from the inside.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install access doors in accordance with manufacturer’s instructions.
B. Coordinate installation with work of other Sections.
C. Set frames accurately in position and securely attach to supports with face panels plumb and level in relation to adjacent finish.
D. Frames, doors and trim pieces shall not vary from straightness or snug contact fit by more than 1/16-inch.
E. Coordinate location of access doors in hung ceilings, furred spaces and walls to provide access to concealed work items requiring maintenance and/or adjustment. Obtain approval of the Architect for the locations of such access doors.
F. Locate and group equipment requiring access doors. Coordinate location of equipment with other trades to minimize number of access doors in one area.
G. Provide access doors for maintenance or adjustment purposes for mechanical system components, including but not limited to the following:
   1. Valves.
   2. Dampers.
   3. Concealed equipment.

3.02 ADJUST AND CLEAN

A. Adjust hardware and panels after installation for proper operation.
B. Remove and replace panels and frames that are warped, bowed, dented, or otherwise damaged.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing interior sliding heavy duty aluminum sliding pass window assemblies.

1.02 SUBMITTALS

A. General: Comply with Division 01.
B. Product Data: Manufacturer's descriptive and technical data and illustrations.
C. Shop Drawings: Show layouts, elevations, relationship to adjacent work, and anchorage details.
D. Operating and Maintenance Instructions: Complete data for maintenance and operation.
E. Warranty.

1.03 QUALITY ASSURANCE

A. Manufacturer: Regularly providing assemblies of the type required for not less than 5-years, capable of maintaining, repairing, and servicing the Project location within reasonable time when service is called for by Owner, and shall retain responsibility for installation of doors.

1.04 WARRANTY

A. Warrant pass windows to be free from defects in materials and workmanship for a period of 2-years from the Date of Substantial Completion. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 - PRODUCTS

2.01 PASS WINDOWS

A. Approved Manufacturer: CR Laurence Company, Inc. DW Series or approved equal.
B. Frames: 4-inch aluminum frame modules shall be constructed of 6063-T5 extruded aluminum.
C. Replacement and servicing of glass shall be from the clerk side of the window by means of an access panel in the top header and does not require the removal of the frame from the opening.
D. Window glides on top-hung heavy-duty ball bearing slides. Poly-pile weather stripping and self-latching handle.
E. Overall frame sizes as indicated.
F. Finish: Clear anodized.
G. Glazing: 1/4-inch thick clear tempered glass.
H. Lock: Keyed lock.
I. Track: Full bottom track.
PART 3 - EXECUTION

3.01 INSTALLATION

A. Install and secure windows in accordance with manufacturer's instructions.

B. Separate dissimilar metals by a bituminous coating.

C. Set units plumb, level, and true to line, without warp or rack of frames or panels.

3.02 ADJUST AND CLEAN

A. Adjust pass windows to operate smoothly, quietly, and free from binding.

B. Protect pass windows from scratches, dents, stains, discolorations and other damage and defects during construction.

END OF SECTION
SECTION 08 71 00
DOOR HARDWARE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 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. Power supplies for electric hardware.
4. Low-energy door operators plus sensors and actuators.
5. Thresholds, gasketing and weather-stripping.
6. Door silencers or mutes.

C. Related Sections: The following sections are noted as containing requirements that relate to this Section, but may not be limited to this listing.

1. Division 8: Section - Steel Doors and Frames.
2. Division 8: Section - Wood Doors.

1.03 REFERENCES  (USE DATE OF STANDARD IN EFFECT AS OF BID DATE.)

A. 2013 California Building Code, CCR, Title 24.
B. BHMA – Builders’ Hardware Manufacturers Association
C. DHI – Door and Hardware Institute
   1. NFPA 80 - Fire Doors and Other Opening Protectives
   2. NFPA 105 - Smoke and Draft Control Door Assemblies
E. UL - Underwriters Laboratories.
   1. UL 10C - Fire Tests of Door Assemblies
   2. UL 305 - Panic Hardware
F. WHI - Warnock Hersey Incorporated
**1.04 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. Contractors 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:**

<table>
<thead>
<tr>
<th>Heading Number 1 (Hardware group or set number – HW -1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) 1 Single Door #1 - Exterior from Corridor 101 (b) 90° (c) RH</td>
</tr>
<tr>
<td>(d) 3' 0&quot;x7' 0&quot; x 1-3/4&quot; x (e) 20 Minute (f) WD x HM</td>
</tr>
<tr>
<td>(g) 1 (h) (i) ea (j) Hinges - (k) 5BB1HW 4.5 x 4.5 NRP (l) ½ TMS (m) 626 (n) IVE</td>
</tr>
<tr>
<td>2 6AA 1 ea Lockset - ND50PD x RHO x RH x 10-025 x JTMS 626 SCH</td>
</tr>
</tbody>
</table>

(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.

1.05 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.
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.
1.06 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. Inventory door hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.

1.07 WARRANTY

A. Provide warranties of respective manufacturers’ regular terms of sale from day of final acceptance as follows:

1. Locksets: Ten (10) years.
2. Electronic Locks: One (1) year.
3. Closers: Thirty (30) years.
4. Exit devices: Three (3) years.
5. All other hardware: Two (2) years.

1.08 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.

1.09 PRE-INSTALLATION CONFERENCE

A. Convene a pre-installation conference at least one week prior to beginning work of this section.


C. Agenda: Review hardware schedule, products, installation procedures and coordination required with related work.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

<table>
<thead>
<tr>
<th>Item</th>
<th>Manufacturer</th>
<th>Acceptable Substitutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Hinges</td>
<td>Ives</td>
<td>Hager, Stanley, McKinney</td>
</tr>
<tr>
<td>B. Locks, Latches &amp; Cylinders</td>
<td>Schlage</td>
<td>Or Approved Equal</td>
</tr>
<tr>
<td>C. Exit Devices</td>
<td>Von Duprin</td>
<td>Or Approved Equal</td>
</tr>
</tbody>
</table>
D. Closers
   LCN
   Or Approved Equal

E. Push, Pulls
   & Protection Plates
   Ives
   Trimco, BBW, DCI

F. Flush Bolts
   Ives
   Trimco, BBW, DCI

G. Dust Proof Strikes
   Ives
   Trimco, BBW, DCI

H. Coordinators
   Ives
   Trimco, BBW, DCI

I. Stops
   Ives
   Trimco, BBW, DCI

J. Overhead Stops
   Glynn-Johnson
   Or Approved Equal

K. Thresholds
   National Guard
   Pemko, Zero

L. Seals & Bottoms
   National Guard
   Pemko, Zero

2.02 MATERIALS

A. Hinges: Exterior out-swinging door butts shall be non-ferrous material and shall have stainless steel hinge pins. All doors to have non-rising pins.

   1. 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.

   2. Furnish non-removable pins (NRP) at all exterior out-swing doors and interior key lock doors with reverse bevels.

B. Floor Closers: Shall be equipped with compression springs, cam and roller operating mechanism and a one piece spindle-cam for maximum operating performance and longevity.

C. Pivots: High strength forgings and castings with precision bearings for smooth operation. Positive locking vertical adjustment mechanism to allow installer to precisely position the door and balance the load.

D. Continuous Hinges: As manufactured by Ives, an Allegion Company. UL rated as required.

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

   1. Locksets to comply with ANSI A156.2, Series 4000, Grade 1; tested to exceed 3,000,000 cycles. Locksets shall meet ANSI A117.1, Accessible Code.
   2. Chassis: One piece modular assembly and multi-functional allowing function interchange without disassembly of lockset.
   3. Spindle shall be deep-draw manufactured not stamped. Spindle and spring cage to be one-piece integrated assembly.
   4. Anti-rotation plate to be interlocking to the lock chassis. Lock design utilizing bit-tabs are not acceptable.
5. **Lever Trim:** Accessible design, bi-directional, independent assemblies.
6. **Locks:** shall be of such construction that when locked, the door may be opened from within by using lever and without the use of a key or special knowledge.
7. Thru-bolts to secure anti-rotation plate without sheer line. Fully threaded thru-bolts are not acceptable.
8. Spring cage to have double compression springs. Manufacturers utilizing torsion springs are not acceptable.
9. Latchbolt to be steel with minimum ½" throw deadlatch on keyed and exterior functions; ¾" throw anti-friction latchbolt on pairs of doors.
10. **Strikes:** ANSI curved lip, 1-1/4" x 4-7/8", with 1" deep dust box (K510-066). Lips shall be of sufficient length to clear trim and protect clothing.

**F. Exit devices:** Von Duprin as scheduled.

1. 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.
2. All internal parts shall be of cold-rolled steel with zinc dichromate coating.
3. Mechanism case shall have an average thickness of .140".
4. Compression spring engineering.
5. Non-handed basic device design with center case interchangeable with all functions.
6. All devices shall have quiet return fluid dampeners.
7. All latchbolts shall be deadlocking with ¾" 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.
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 1008.1.9 and shall be mounted between 34" and 44" above the finished floor surface.
   a. 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.

**G. Closers:** LCN as scheduled. Place closers inside building, stairs, room, etc.

1. 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.
2. 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.
3. 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.
4. Closers shall be installed to permit doors to swing 180 degrees.
5. 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.
6. Provide the manufacturers drop plates, brackets and spacers as required at narrow head rails and special frame conditions. NO wood plates or spacers will be allowed.

7. 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. Door shall take at least 3 seconds to move from an open position of 70 degrees to a point of 3 inches from the latch jamb.

8. Provide sex-bolted or through bolt mounting for all door closers.

H. Flush Bolts & Dust Proof Strikes: Automatic Flush Bolts shall be of the low operating force design. Utilize the top bolt only model for interior doors where applicable and as permitted by testing procedures.

1. Manual flush bolts only permitted on storage or mechanical openings as scheduled.
2. Provide dust proof strikes at openings using bottom bolts.

I. Door Stops:

1. 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.
2. Do not install floor stops more than four (4) inches from the face of the wall or partition (CBC Section 11B-307).
3. 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.

J. Protection Plates: 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.

K. 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 ¼" fasteners, red-head flat-head sleeve anchors (SS/FHSL).
4. Thresholds shall comply with CBC Section 11B-204.1.

L. Seals: Provide silicone gasket at all rated and exterior doors.

1. Fire-rated Doors, Resilient Seals: UL10C Classified complies with NFPA 80 & NFPA 252. Coordinate with selected door manufacturers' and selected frame manufacturers' requirements.
2. 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.
M. Door Shoes & Door Top Caps: Provide door shoes at all exterior wood doors and top caps at all exterior out-swing doors.

N. Silencers: 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.

2.03 KEYING

A. Furnish a Schlage masterkey system as directed by the owner or architect.

B. A detailed keying schedule is to be prepared by the owner and/or architect in consultation with a representative of the lock manufacturer. 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.

C. Establish a new masterkey system for this project as directed by the keying schedule.

D. Furnish all cylinders in the Schlage conventional style except the exit device and removable mullion cylinders which will be supplied in Schlage Full Size Interchangable Core (FSIC). Pack change keys independently (PKI).

E. Furnish construction keying for doors requiring locking during construction.

F. Furnish mechanical keys as follows:

1. Furnish 2 cut change keys for each different change key code.
2. Furnish 1 uncut key blank for each change key code.
3. Furnish 6 cut masterkeys for each different masterkey set.
4. Furnish 3 uncut key blanks for each masterkey set.
5. Furnish 2 cut control keys cut to the top masterkey for permanent I/C cylinders.
6. Furnish 1 cut control key cut to each SKD combination.

G. Furnish Schlage Padlocks and the cylinders to tie them into the masterkey system for gates, storage boxes, utility valve security, roof hatches and roll-up doors keyed as directed in the keying schedule.

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.

2.05 FASTENERS

A. 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.

B. Screws for butt hinges shall be flathead, countersunk, full-thread type.
C. Fastening of closer bases or closer shoes to doors shall be by means of sex bolts and spray painted to match closer finish.

D. Provide expansion anchors for attaching hardware items to concrete or masonry.

E. All exposed fasteners shall have a phillips head.

F. Finish of exposed screws to match surface finish of hardware or other adjacent work.

G. All Exit Devices and Lock Protectors shall be fastened to the door by the means of sex bolts or through bolts.

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) 2007 Edition. 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 30” 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.

3.03 ADJUST AND CLEAN

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.

3.04 HARDWARE LOCATIONS

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

3.05 FIELD QUALITY CONTROL

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

Manufacturers Abbreviations (Mfr.)

<table>
<thead>
<tr>
<th>MFR</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IVE</td>
<td>Ives Hinges, Pivots, Bolts, Coordinators, Dust Proof Strikes, Push Pull &amp; Kick Plates, Door Stops &amp; Silencers</td>
</tr>
<tr>
<td>LCN</td>
<td>LCN Door Closers</td>
</tr>
<tr>
<td>NGP</td>
<td>National Guard Products Astragals</td>
</tr>
<tr>
<td>SCH</td>
<td>Schlage Lock Company Locks, Latches &amp; Cylinders</td>
</tr>
<tr>
<td>VON</td>
<td>Von Duprin Exit Devices</td>
</tr>
<tr>
<td>ZER</td>
<td>Zero International Thresholds, Gasketing &amp; Weather-stripping</td>
</tr>
</tbody>
</table>

SP EXTRA: 211303

HARDWARE GROUP NO. E-01

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VANDL STOREROOM LOCK</td>
<td>ND96PD RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td></td>
<td>RE-USE BALANCE OF DOOR, FRAME &amp; HARDWARE MODIFICATION</td>
<td>SEE DOOR SCHEDULE FOR DOOR &amp; FRAME MODIFICATIONS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HARDWARE GROUP NO. E-02

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>ND80PD RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>2</td>
<td>SURFACE CLOSER</td>
<td>4040XP</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>2</td>
<td>DOOR SWEEP</td>
<td>154A</td>
<td>AL</td>
<td>ZER</td>
</tr>
<tr>
<td></td>
<td>RE-USE BALANCE OF DOOR, FRAME &amp; HARDWARE MODIFICATION</td>
<td>SEE DOOR SCHEDULE FOR DOOR &amp; FRAME MODIFICATIONS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HARDWARE GROUP NO. E-03

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PRIVACY LOCK</td>
<td>ND40S RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B4E</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>MOP PLATE</td>
<td>8400 4&quot; X 2&quot; LDW B4E</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>QTY</td>
<td>DESCRIPTION</td>
<td>CATALOG NUMBER</td>
<td>FINISH</td>
<td>MFR</td>
</tr>
<tr>
<td>-----</td>
<td>---------------------------</td>
<td>----------------</td>
<td>--------</td>
<td>-----</td>
</tr>
<tr>
<td>1</td>
<td>SET SEALS</td>
<td>188S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td>PER DETAIL</td>
<td>AL</td>
<td>ZER</td>
</tr>
</tbody>
</table>

**HARDWARE GROUP NO. E-04**

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ELECTRIC HW HINGE</td>
<td>5BB1HW 4.5 X 4.5 TW8</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VERIFY EXISTING HINGE SIZE &amp; WEIGHT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>ELEC PANIC HARDWARE</td>
<td>RX-AX-98-L-E996-06-FS</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>RIM CYLINDER</td>
<td>20-057</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RE-USE BALANCE OF DOOR, FRAME &amp; HARDWARE</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>MODIFICATION</td>
<td>SEE DOOR SCHEDULE FOR DOOR &amp; FRAME MODIFICATIONS</td>
<td></td>
</tr>
</tbody>
</table>

CARD READER, DOOR CONTACT & WIRING FURNISHED BY ACCESS CONTROL SUPPLIER

**HARDWARE GROUP NO. E-05**

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>FIRE EXIT HARDWARE</td>
<td>AX-98-L-F-06</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>RIM CYLINDER</td>
<td>20-057</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP EDA</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>FLOOR STOP</td>
<td>FS441</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>SET SEALS</td>
<td>188S</td>
<td>BLK</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td>PER DETAIL</td>
<td>AL</td>
<td>ZER</td>
</tr>
</tbody>
</table>

**HARDWARE GROUP NO. E-06**

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>ND80PD RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RE-USE BALANCE OF DOOR, FRAME &amp; HARDWARE</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>MODIFICATION</td>
<td>SEE DOOR SCHEDULE FOR DOOR &amp; FRAME MODIFICATIONS</td>
<td></td>
</tr>
</tbody>
</table>

**HARDWARE GROUP NO. E-07**

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>ND80PD RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MODIFICATION</td>
<td>SEE DOOR SCHEDULE FOR DOOR &amp; FRAME MODIFICATIONS</td>
<td></td>
</tr>
</tbody>
</table>
### HARDWARE GROUP NO. E-08

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>ENTRANCE/OFFICE LOCK</td>
<td>ND50PD RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SGL CYL DEADBOLT</td>
<td>B660P</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD MODIFICATION</td>
<td>AL ZER</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Modification:** See Door Schedule for Door & Frame Modifications

### HARDWARE GROUP NO. E-09

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SEALS</td>
<td>188S</td>
<td>BLK</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>DOOR SWEEP</td>
<td>154A</td>
<td>AL</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD MODIFICATION</td>
<td>AL ZER</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Modification:** See Door Schedule for Door & Frame Modifications

### HARDWARE GROUP NO. E-10

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP REG OR PA AS REQ</td>
<td>689</td>
<td>LCN</td>
</tr>
</tbody>
</table>

**Modification:** See Door Schedule for Door & Frame Modifications

### HARDWARE GROUP NO. E-11

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>CONST LATCHING BOLT</td>
<td>FB51P</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PASSAGE SET</td>
<td>ND10S RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>COORDINATOR</td>
<td>COR X FL</td>
<td>628</td>
<td>IVE</td>
</tr>
<tr>
<td>2</td>
<td>SURFACE CLOSER</td>
<td>4040XP</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>2</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>ASTRAGAL</td>
<td>139SP</td>
<td>600</td>
<td>NGP</td>
</tr>
<tr>
<td>2</td>
<td>SILENCER</td>
<td>SR64</td>
<td>GRY</td>
<td>IVE</td>
</tr>
</tbody>
</table>

### HARDWARE GROUP NO. E-12

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>ND80PD RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP REG OR PA AS REQ</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>SEALS</td>
<td>188S</td>
<td>BLK</td>
<td>ZER</td>
</tr>
</tbody>
</table>

**Modification:** See Door Schedule for Door & Frame Modifications

---

**ACTransit D3 Reactivation**

**Richmond, CA**

**DOOR HARDWARE**

**SECTION 08 71 00 - 13**
MODIFICATION: SEE DOOR SCHEDULE FOR DOOR & FRAME MODIFICATIONS

HARDWARE GROUP NO. E-13

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RE-USE BALANCE OF DOOR, FRAME &amp; HARDWARE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MODIFICATION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SEE DOOR SCHEDULE FOR DOOR &amp; FRAME MODIFICATIONS</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HARDWARE GROUP NO. E-14

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 EA</td>
<td>CLASSROOM LOCK</td>
<td>ND70PD RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td></td>
<td>RE-USE BALANCE OF DOOR, FRAME &amp; HARDWARE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MODIFICATION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SEE DOOR SCHEDULE FOR DOOR &amp; FRAME MODIFICATIONS</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HARDWARE GROUP NO. E-15

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 EA</td>
<td>HW HINGE</td>
<td>5BB1HW 4.5 X 4.5 NRP</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1 EA</td>
<td>PANIC HARDWARE</td>
<td>CD-AX-98-L-06</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>1 EA</td>
<td>MORTISE CYLINDER</td>
<td>20-001 114 XQ11-949</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1 EA</td>
<td>RIM CYLINDER</td>
<td>20-057</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1 EA</td>
<td>SURFACE CLOSER</td>
<td>4040XP EDA</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1 EA</td>
<td>FLOOR STOP</td>
<td>FS441</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1 SET</td>
<td>SEALS</td>
<td>188S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 EA</td>
<td>DOOR SWEEP</td>
<td>39A</td>
<td>AL</td>
<td>ZER</td>
</tr>
<tr>
<td>1 EA</td>
<td>THRESHOLD</td>
<td>PER DETAIL</td>
<td>AL</td>
<td>ZER</td>
</tr>
</tbody>
</table>

HARDWARE GROUP NO. E-16

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 SET</td>
<td>CONST LATCHING BOLT</td>
<td>FB51P</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1 EA</td>
<td>CLASSROOM LOCK</td>
<td>ND70PD RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>2 EA</td>
<td>SURFACE CLOSER</td>
<td>4040XP EDA</td>
<td>689</td>
<td>LCN</td>
</tr>
</tbody>
</table>

     | MODIFICATION               |                 |        |     |
|     | SEE DOOR SCHEDULE FOR DOOR & FRAME MODIFICATIONS |                       |        |     |

HARDWARE GROUP NO. E-17

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 EA</td>
<td>PANIC HARDWARE</td>
<td>CD-AX-98-L-06</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>1 EA</td>
<td>MORTISE CYLINDER</td>
<td>20-001 114 XQ11-949</td>
<td>626</td>
<td>SCH</td>
</tr>
</tbody>
</table>

ACTTransit D3 Reactivation
DOOR HARDWARE
Richmond, CA
SECTION 08 71 00 - 14
<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PRIVACY LOCK</td>
<td>ND40S RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B4E</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>MOP PLATE</td>
<td>8400 4&quot; X 2&quot; LDW B4E</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>SEALS</td>
<td>188S</td>
<td>BLK</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td>PER DETAIL</td>
<td>AL</td>
<td>ZER</td>
</tr>
</tbody>
</table>

**HARDWARE GROUP NO. E-19**

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>CONST LATCHING BOLT</td>
<td>FB51P</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>DUST PROOF STRIKE</td>
<td>DP2</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>ND80PD RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>COORDINATOR</td>
<td>COR X FL</td>
<td>628</td>
<td>IVE</td>
</tr>
<tr>
<td>2</td>
<td>SURFACE CLOSER</td>
<td>4040XP</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>2</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>ASTRAGAL</td>
<td>139SP</td>
<td>600</td>
<td>NGP</td>
</tr>
<tr>
<td>2</td>
<td>SILENCER</td>
<td>SR64</td>
<td>GRY</td>
<td>IVE</td>
</tr>
</tbody>
</table>

**HARDWARE GROUP NO. E-20**

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SEALS</td>
<td>188S</td>
<td>BLK</td>
<td>ZER</td>
</tr>
<tr>
<td>2</td>
<td>DOOR SWEEP</td>
<td>39A</td>
<td>AL</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td>PER DETAIL</td>
<td>AL</td>
<td>ZER</td>
</tr>
</tbody>
</table>

**HARDWARE GROUP NO. E-21**

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CLASSROOM LOCK</td>
<td>ND70PD RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP EDA</td>
<td>689</td>
<td>LCN</td>
</tr>
</tbody>
</table>

**ACTransit D3 Reactivation**

**Richmond, CA**

**SECTION 08 71 00 - 15**
### HARDWARE GROUP NO. E-22

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SET CONST LATCHING BOLT</td>
<td>FB51P</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>DUST PROOF STRIKE</td>
<td>DP2</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>ND80PD RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>2</td>
<td>SURFACE CLOSER</td>
<td>4040XP</td>
<td>689</td>
<td>LCN</td>
</tr>
</tbody>
</table>

**MODIFICATION**
- SEE DOOR SCHEDULE FOR DOOR & FRAME MODIFICATIONS

### HARDWARE GROUP NO. E-23

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PASSAGE SET</td>
<td>ND10S RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP EDA</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>3</td>
<td>SILENCER</td>
<td>SR64</td>
<td>GRY</td>
<td>IVE</td>
</tr>
</tbody>
</table>

**MODIFICATION**
- SEE DOOR SCHEDULE FOR DOOR & FRAME MODIFICATIONS

### HARDWARE GROUP NO. E-24

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ELECTRIC STRIKE</td>
<td>6111 FS</td>
<td>630</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>FLOOR STOP</td>
<td>FS441</td>
<td>626</td>
<td>IVE</td>
</tr>
</tbody>
</table>

**MODIFICATION**
- SEE DOOR SCHEDULE FOR DOOR & FRAME MODIFICATIONS

### HARDWARE GROUP NO. E-25

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ENTRANCE/OFFICE LOCK</td>
<td>ND50PD RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
</tbody>
</table>

**MODIFICATION**
- SEE DOOR SCHEDULE FOR DOOR & FRAME MODIFICATIONS
### HARDWARE GROUP NO. E-26

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>ND80PD RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td></td>
<td>RE-USE BALANCE OF DOOR, FRAME &amp; HARDWARE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SEE DOOR SCHEDULE FOR DOOR &amp; FRAME MODIFICATIONS</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### HARDWARE GROUP NO. E-27

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP EDA</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>SEALS</td>
<td>188S</td>
<td>BLK</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>DOOR SWEEP</td>
<td>154A</td>
<td>AL</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD MODIFICATION</td>
<td></td>
<td>AL</td>
<td>ZER</td>
</tr>
<tr>
<td></td>
<td>RE-USE BALANCE OF DOOR, FRAME &amp; HARDWARE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SEE DOOR SCHEDULE FOR DOOR &amp; FRAME MODIFICATIONS</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### HARDWARE GROUP NO. E-28

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PRIVACY LOCK</td>
<td>ND40S RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td></td>
<td>RE-USE BALANCE OF DOOR, FRAME &amp; HARDWARE</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### HARDWARE GROUP NO. E-29

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SEALS</td>
<td>188S</td>
<td>BLK</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>DOOR SWEEP</td>
<td>154A</td>
<td>AL</td>
<td>ZER</td>
</tr>
<tr>
<td></td>
<td>RE-USE BALANCE OF DOOR, FRAME &amp; HARDWARE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SEE DOOR SCHEDULE FOR DOOR &amp; FRAME MODIFICATIONS</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### HARDWARE GROUP NO. E-30

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>MANUAL FLUSH BOLT</td>
<td>FB457</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>ASTRAGAL</td>
<td>158NA</td>
<td>CL</td>
<td>NGP</td>
</tr>
<tr>
<td></td>
<td>RE-USE BALANCE OF DOOR, FRAME &amp; HARDWARE</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### HARDWARE GROUP NO. E-31

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CLASSROOM LOCK</td>
<td>ND70PD RHO 14-042</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>COORDINATOR</td>
<td>COR X FL</td>
<td>628</td>
<td>IVE</td>
</tr>
</tbody>
</table>

MODIFICATION
SEE DOOR SCHEDULE FOR DOOR & FRAME MODIFICATIONS

### HARDWARE GROUP NO. E-32

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>ND80PD RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
</tbody>
</table>

MODIFICATION
SEE DOOR SCHEDULE FOR DOOR & FRAME MODIFICATIONS

### HARDWARE GROUP NO. E-33

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FIRE EXIT HARDWARE</td>
<td>AX-98-L-F-06</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>RIM CYLINDER</td>
<td>20-057</td>
<td>626</td>
<td>SCH</td>
</tr>
</tbody>
</table>

MODIFICATION
SEE DOOR SCHEDULE FOR DOOR & FRAME MODIFICATIONS

### HARDWARE GROUP NO. E-34

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PASSAGE SET</td>
<td>ND10S RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP EDA</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B4E</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>MOP PLATE</td>
<td>8400 4&quot; X 2&quot; LDW B4E</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>3</td>
<td>SILENCER</td>
<td>SR64</td>
<td>GRY</td>
<td>IVE</td>
</tr>
</tbody>
</table>

MODIFICATION
SEE DOOR SCHEDULE FOR DOOR & FRAME MODIFICATIONS

### HARDWARE GROUP NO. E-35

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AUTO FLUSH BOLT</td>
<td>FB31P</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>ND80PD RHO 14-042</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>COORDINATOR</td>
<td>COR X FL</td>
<td>628</td>
<td>IVE</td>
</tr>
<tr>
<td>2</td>
<td>SURFACE CLOSER</td>
<td>4040XP</td>
<td>689</td>
<td>LCN</td>
</tr>
</tbody>
</table>
### HARDWARE GROUP NO. E-36

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>EA FIRE EXIT HARDWARE</td>
<td>AX-98-L-F-06</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>EA RIM CYLINDER</td>
<td>20-057</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SET SEALS</td>
<td>188S</td>
<td>BLK</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>EA DOOR SWEEP</td>
<td>39A</td>
<td>AL</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>EA THRESHOLD</td>
<td>PER DETAIL</td>
<td>AL</td>
<td>ZER</td>
</tr>
</tbody>
</table>

RE-USE BALANCE OF DOOR, FRAME & HARDWARE

SEE DOOR SCHEDULE FOR DOOR & FRAME MODIFICATIONS

### HARDWARE GROUP NO. E-37

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>EA HW HINGE</td>
<td>5BB1HW 4.5 X 4.5 NRP</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>EA ELECTRIC HW HINGE</td>
<td>5BB1HW 4.5 X 4.5 TW8</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>SET CONST LATCHING BOLT</td>
<td>FB51P</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>EA DUST PROOF STRIKE</td>
<td>DP1</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>EA VANDL EU STOREROOM LOCK</td>
<td>ND96PD EU RHO N123-062</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>EA COORDINATOR</td>
<td>COR X FL</td>
<td>628</td>
<td>IVE</td>
</tr>
<tr>
<td>2</td>
<td>EA MOUNTING BRACKET</td>
<td>MB</td>
<td>689</td>
<td>IVE</td>
</tr>
<tr>
<td>2</td>
<td>EA SURFACE CLOSER</td>
<td>4040XP EDA</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>2</td>
<td>EA FLOOR STOP</td>
<td>FS441</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>SET SEALS</td>
<td>188S</td>
<td>BLK</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>EA ASTRAGAL</td>
<td>139SP</td>
<td>600</td>
<td>NGP</td>
</tr>
<tr>
<td>2</td>
<td>EA DOOR SWEEP</td>
<td>39A</td>
<td>AL</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>EA THRESHOLD</td>
<td>PER DETAIL</td>
<td>AL</td>
<td>ZER</td>
</tr>
</tbody>
</table>

CARD READER, DOOR CONTACTS & WIRING FURNISHED BY ACCESS CONTROL SUPPLIER

### HARDWARE GROUP NO. E-38

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>EA HW HINGE</td>
<td>5BB1HW 4.5 X 4.5 NRP</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>SET CONST LATCHING BOLT</td>
<td>FB51P</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>EA DUST PROOF STRIKE</td>
<td>DP1</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>EA VANDL STOREROOM LOCK</td>
<td>ND96PD RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>EA COORDINATOR</td>
<td>COR X FL</td>
<td>628</td>
<td>IVE</td>
</tr>
<tr>
<td>2</td>
<td>EA MOUNTING BRACKET</td>
<td>MB</td>
<td>689</td>
<td>IVE</td>
</tr>
<tr>
<td>2</td>
<td>EA SURFACE CLOSER</td>
<td>4040XP EDA</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>2</td>
<td>EA FLOOR STOP</td>
<td>FS441</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>QTY</td>
<td>DESCRIPTION</td>
<td>CATALOG NUMBER</td>
<td>FINISH</td>
<td>MFR</td>
</tr>
<tr>
<td>-----</td>
<td>------------------------------</td>
<td>----------------</td>
<td>--------</td>
<td>-----</td>
</tr>
<tr>
<td>1</td>
<td>SEALS</td>
<td>188S</td>
<td>BLK</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>ASTRAGAL</td>
<td>139SP</td>
<td>600</td>
<td>NGP</td>
</tr>
<tr>
<td>2</td>
<td>DOOR SWEEP</td>
<td>39A</td>
<td>AL</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td>PER DETAIL</td>
<td>AL</td>
<td>ZER</td>
</tr>
</tbody>
</table>

**HARDWARE GROUP NO. E-39**

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>ENTRANCE / OFFICE LOCK</td>
<td>ND50PD RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>FLOOR STOP</td>
<td>FS441</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>SEALS</td>
<td>188S</td>
<td>BLK</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>DOOR SWEEP</td>
<td>154A</td>
<td>AL</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td>PER DETAIL</td>
<td>AL</td>
<td>ZER</td>
</tr>
</tbody>
</table>

**HARDWARE GROUP NO. E-40**

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>VANDL CORRIDOR LOCK</td>
<td>ND97PD RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP SCUSH</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B4E</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>MOP PLATE</td>
<td>8400 4&quot; X 2&quot; LDW B4E</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>SEALS</td>
<td>188S</td>
<td>BLK</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>DOOR SWEEP</td>
<td>154A</td>
<td>AL</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td>PER DETAIL</td>
<td>AL</td>
<td>ZER</td>
</tr>
</tbody>
</table>

**HARDWARE GROUP NO. E-41**

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>VANDL STOREROOM LOCK</td>
<td>ND96PD RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP EDA</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>FLOOR STOP</td>
<td>FS441</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>SEALS</td>
<td>188S</td>
<td>BLK</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>DOOR SWEEP</td>
<td>39A</td>
<td>AL</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td>PER DETAIL</td>
<td>AL</td>
<td>ZER</td>
</tr>
</tbody>
</table>

**HARDWARE GROUP NO. E-42**

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PANIC HARDWARE</td>
<td>CD-AX-98-L-06</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>MORTISE CYLINDER</td>
<td>20-001 114 XQ11-949</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>RIM CYLINDER SET SEALS</td>
<td>188S</td>
<td>BLK</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>DOOR SWEEP</td>
<td>39A</td>
<td>AL</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td>PER DETAIL</td>
<td>AL</td>
<td>ZER</td>
</tr>
</tbody>
</table>

ActTransit D3 Reactivation  
Richmond, CA  
DOOR HARDWARE  
SECTION 08 71 00 - 20
### HARDWARE GROUP NO. E-43

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>ND80PD RHO 14-042</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>COORDINATOR</td>
<td>COR X FL</td>
<td>628</td>
<td>IVE</td>
</tr>
</tbody>
</table>

- MODIFICATION: RE-USE BALANCE OF DOOR, FRAME & HARDWARE
- SEE DOOR SCHEDULE FOR DOOR & FRAME MODIFICATIONS

### HARDWARE GROUP NO. N-01

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>CONST LATCHING BOLT</td>
<td>FB51P</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>DUST PROOF STRIKE</td>
<td>DP1</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>VANDL STOREROOM LOCK</td>
<td>ND96PD RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>COORDINATOR</td>
<td>COR X FL</td>
<td>628</td>
<td>IVE</td>
</tr>
<tr>
<td>2</td>
<td>MOUNTING BRACKET</td>
<td>MB</td>
<td>689</td>
<td>IVE</td>
</tr>
<tr>
<td>2</td>
<td>SURFACE CLOSER</td>
<td>4040XP EDA</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>2</td>
<td>FLOOR STOP/HOLDER</td>
<td>FS43</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>SEALS</td>
<td>188S</td>
<td>600</td>
<td>NGP</td>
</tr>
<tr>
<td>1</td>
<td>ASTRAGAL</td>
<td>139SP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>DOOR SWEEP</td>
<td>39A</td>
<td>AL</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td>PER DETAIL</td>
<td>AL</td>
<td>ZER</td>
</tr>
</tbody>
</table>

### HARDWARE GROUP NO. N-02

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>ELECTRIC HINGE</td>
<td>5BB1 4.5 X 4.5 TW8</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>VANDL EU</td>
<td>ND96PDEU RHO N123-062</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>LOCK GUARD</td>
<td>LG13</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP EDA</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>FLOOR STOP</td>
<td>FS441</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>SEALS</td>
<td>188S</td>
<td>600</td>
<td>NGP</td>
</tr>
<tr>
<td>1</td>
<td>DOOR SWEEP</td>
<td>39A</td>
<td>AL</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td>PER DETAIL</td>
<td>AL</td>
<td>ZER</td>
</tr>
</tbody>
</table>

### CARD READER, DOOR CONTACT & WIRING

FURNISHED BY ACCESS CONTROL SUPPLIER

ACTransit D3 Reactivation
Richmond, CA
DOOR HARDWARE
SECTION 08 71 00 - 21
### HARDWARE GROUP NO. N-03

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 EA</td>
<td>HW HINGE</td>
<td>5BB1HW 5 X 4.5 NRP</td>
<td>630</td>
<td>IV E</td>
</tr>
<tr>
<td>1 EA</td>
<td>PANIC HARDWARE</td>
<td>CD-AX-98-L-06</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>1 EA</td>
<td>MORTISE CYLINDER</td>
<td>20-001 114 XQ11-949</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1 EA</td>
<td>RIM CYLINDER</td>
<td>20-057</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1 EA</td>
<td>SURFACE CLOSER</td>
<td>4040XP EDA</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1 EA</td>
<td>FLOOR STOP</td>
<td>FS441</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1 SET</td>
<td>SEALS</td>
<td>188S</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1 EA</td>
<td>DOOR SWEEP</td>
<td>39A</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1 EA</td>
<td>THRESHOLD</td>
<td>PER DETAIL</td>
<td>626</td>
<td>IVE</td>
</tr>
</tbody>
</table>

### HARDWARE GROUP NO. N-04

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 EA</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>630</td>
<td>IV E</td>
</tr>
<tr>
<td>1 EA</td>
<td>VANDL STOREROOM</td>
<td>ND96PD RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1 EA</td>
<td>SURFACE CLOSER</td>
<td>4040XP EDA</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1 EA</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>3 EA</td>
<td>SILENCER</td>
<td>SR64</td>
<td>689</td>
<td>LCN</td>
</tr>
</tbody>
</table>

### HARDWARE GROUP NO. N-05

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 EA</td>
<td>HW HINGE</td>
<td>5BB1HW 4.5 X 4.5 NRP</td>
<td>630</td>
<td>IV E</td>
</tr>
<tr>
<td>1 EA</td>
<td>FIRE EXIT HARDWARE</td>
<td>AX-98-L-F-06</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>1 EA</td>
<td>RIM CYLINDER</td>
<td>20-057</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1 EA</td>
<td>SURFACE CLOSER</td>
<td>4040XP EDA</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1 EA</td>
<td>FLOOR STOP</td>
<td>FS441</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1 SET</td>
<td>SEALS</td>
<td>188S</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1 EA</td>
<td>DOOR SWEEP</td>
<td>39A</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>1 EA</td>
<td>THRESHOLD</td>
<td>PER DETAIL</td>
<td>626</td>
<td>IVE</td>
</tr>
</tbody>
</table>

### HARDWARE GROUP NO. N-06

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 EA</td>
<td>HW HINGE</td>
<td>5BB1HW 4.5 X 4.5 NRP</td>
<td>630</td>
<td>IV E</td>
</tr>
<tr>
<td>1 EA</td>
<td>PANIC HARDWARE</td>
<td>AX-98-L-06</td>
<td>626</td>
<td>VON</td>
</tr>
<tr>
<td>1 EA</td>
<td>RIM CYLINDER</td>
<td>20-057</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1 EA</td>
<td>SURFACE CLOSER</td>
<td>4040XP EDA</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1 EA</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>3 EA</td>
<td>SILENCER</td>
<td>SR64</td>
<td>689</td>
<td>LCN</td>
</tr>
</tbody>
</table>

### HARDWARE GROUP NO. N-07

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 EA</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>630</td>
<td>IV E</td>
</tr>
<tr>
<td>1 EA</td>
<td>STOREROOM LOCK</td>
<td>ND80PD RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1 EA</td>
<td>SURFACE CLOSER</td>
<td>4040XP</td>
<td>626</td>
<td>SCH</td>
</tr>
</tbody>
</table>

ActTransit D3 Reactivation
Richmond, CA

DOOR HARDWARE
SECTION 08 71 00 - 22
<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>EA</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
</tr>
<tr>
<td>3</td>
<td>EA</td>
<td>SILENCER</td>
<td>SR64</td>
</tr>
</tbody>
</table>

END OF SECTION
SECTION 08 80 00
GLAZING

PART 1 - GENERAL

1.01 DESCRIPTION
A. This Section describes the requirements for interior and exterior glass and glazing.
B. Related Sections:
   1. Hollow metal doors and frames are specified in Section 08 11 13.
   2. Flush wood doors are specified in Section 08 14 16.
   3. Section 10 28 13 “Toilet Accessories” for metal framed mirrors.

1.02 SUBMITTALS
A. General: Comply with Division 01.
B. Product Data: Manufacturer's technical data for each glazing material and fabricated glass product required, including installation and maintenance instructions.
C. Samples: 12-inch square samples of each type of glass indicated and specified except for clear single pane units, and 12-inch long samples of each type of sealant or gasket exposed to view.
D. Shop Drawings: Show location of exterior glass units required to be heat strengthened based on glass stress analysis calculations.
E. Glazing Schedule: Indicate glass types and thicknesses for each size opening and location. Use same designation indicated on the Drawings.
F. Qualification data for installer.
G. Preconstruction adhesion and compatibility test report.
H. Warranty.

1.03 QUALITY ASSURANCE
A. Glazing Standards: Comply with recommendations of the following manufacturer and associations except where more stringent requirements are specified:
B. Safety Glass: Where safety glass is indicated or required, provide products complying with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for category II materials. Permanently mark glazing with certification label of the SGCC. Label shall indicate manufacturer’s name, type of glass, thickness, and safety glazing standard with which glass complies.
C. Fire-Resistive Glazing Products for Door Assemblies: Products identical to those tested in accordance with ASTM E2074, labeled and listed by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
D. Fire-Resistive Glazing Products for Window Assemblies: Products identical to those tested in accordance with ASTM E2010, labeled and listed by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
E. Insulating Glass Certification Program: Provide insulating glass units permanently marked with appropriate Insulating Glass Certification Council (IGCC) certification label.

F. Glazier Qualifications: Engage an experienced glazier who has completed glazing similar in material, design, and extent to that required for this Project, with a record of successful in-service performance.

G. Source Limitations: Obtain float glass, laminated glass and insulating glass from a single source from a single manufacturer for each glass type. Obtain glazing accessories from a single source from a single manufacturer for each product and installation method.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Division 01.

B. Protect glazing materials during delivery, storage, and handling; comply with manufacturer’s directions and as required to prevent edge damage to glass, and damage to glass and glazing materials from effects of moisture, temperature changes, direct exposure to sun and from other causes.

1.05 PROJECT CONDITIONS

A. Do not proceed with glazing when ambient and substrate temperature conditions are outside the limits permitted by glazing material manufacturer or when glazing channel substrates are wet.

B. Install glazing sealants at ambient and substrate temperatures above 40-deg. F.

1.06 WARRANTY

A. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 - PRODUCTS

2.01 GLASS PRODUCTS

A. Sizes: Fabricate glass to sizes required for glazing openings indicated, with edge clearances and tolerances complying with recommendations of glass manufacturer. Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as required to comply with Project conditions.

B. Manufacture heat-treated glass by horizontal (roller hearth) process with roll wave distortion parallel with bottom edge of glass as installed.

2.02 GLASS TYPES

A. Clear Float Glass: ASTM C1036, Type I, Class 1, Quality q3, 1/4-inch thick.

B. Clear Tempered Float Glass: ASTM C1048, Condition A, Type I, Class 1, Quality q3, Kind FT; 1/4-inch thick.

C. Clear Laminated Glass: Two sheets of clear float glass laminated together with a 0.030-inch thick clear plastic interlayer; nominal thickness as indicated or as required to match existing.

D. Safety Rated Wire Glass: SAFTI/FIRST “SuperLite I-W” or approved equal.

1. Fire Rating: 20-90 minutes with hose stream.

2. Fire protective, safety rated, wired glass tested in accordance with NFPA 80, NFPA 252, NFPA 257, UL9, UL 10B and UL 10C.

3. Glazing material subject to human impact shall be certified and permanently labeled as meeting applicable requirements referenced in NFPA 80 including CPSC 16 CFR 1201, Cat. I & II.

5. Appearance: Filmed (7-mil) wired glass free of noticeable irregularities.

2.03 ELASTOMERIC GLAZING SEALANTS

A. General: Comply with recommendations of sealant and glass manufacturer's for selection of glazing sealants with performance characteristics suitable for applications indicated and conditions at time of installation.
   1. Compatibility: Select sealants with proven compatibility with other materials with which they will come into contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.
   2. Suitability: Comply with recommendations of sealant and glass manufacturers for selection of glazing sealants which have performance characteristics suitable for applications indicated and conditions at time of installation.
   3. Colors: Color of exposed sealant as selected by Architect from manufacturer's standards.

B. Silicone Glazing Sealant: One-part elastomeric silicone sealant complying with ASTM C920, Type S, Grade NS, Class 100/50, Uses NT, G, A and 0 as applicable; Dow Coming 999, General Electric "SCS 1200", Rhone-Poulenc, Inc. "Rhodorsil 3B", Tremco "Proglaze" or approved equal.

C. Structural Silicone Glazing Sealant: One-part elastomeric silicone sealant complying with ASTM C920, Type S, Grade NS, Class 40, Uses T, NT, M, G, A, and 0 as applicable; Dow Coming 795, General Electric "Silpruf" or "Gesil", Tremco, Inc. "Spectrum 2" or approved equal.

D. Glazing Sealant for Fire-Rated Glass: Metacaulk 990, DAP 1012 or approved equal, listed and approved by UL, Warnock Hersey or other approved testing agency.

2.04 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tape: Preformed, butyl-based elastomeric tape with a solids content of 100-percent, non-staining and non-migrating in contact with nonporous surfaces, with or without spacer rod as recommended by tape and glass manufacturers for application indicated, packaged in rolls with a release paper backing, complying with AAMA 800.

B. Expanded Cellular Glazing Tape: Closed-cell, polyvinyl chloride foam tape, factory coated with adhesive on both surfaces, packaged on rolls with release liner protecting adhesive, and complying with AAMA 800 for product 810.5.

C. Glazing Tape for Fire-Rated Glass: EPDM or other approved flame resistant gasket material approved by testing agency.

2.05 GLAZING GASKETS

A. Dense Elastomeric Compression Seal Gaskets: Molded or extruded neoprene, EPDM, or silicone gaskets of profile and hardness required to maintain watertight seal; complying with ASTM C864, D.S. Brown Co., Maloney, Tremco or approved equal.

B. Soft Compression Gaskets: Extruded or molded closed cell, integral-skinned neoprene, EPDM, or silicone of profile and hardness required to maintain watertight seal; complying with ASTM C509, Type II, black; D.S. Brown Co., Maloney, Tremco or approved equal.

2.06 MISCELLANEOUS GLAZING MATERIALS

A. Compatibility: Provide materials with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Type recommended by sealant or gasket manufacturer.

C. Setting Blocks: Silicone blocks, 80 to 90 Shore A durometer hardness.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place.
**E.** Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement.

**F.** Plastic Foam Joint Fillers: Preformed, compressible, resilient, nonstaining, nonextruding, nonoutgassing, strips of closed-cell plastic foam of density, size, and shape to control sealant depth and otherwise contribute to produce optimum sealant performance.

### 2.07 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

**A.** Fabricate glass and other glazing products in sizes required to glaze openings indicated, with edge and face clearances, edge and surface conditions, and bite complying with recommendations of product manufacturer and referenced glazing standard as required to comply with system performance requirements.

**B.** Clean cut or flat grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with indoor and outdoor faces.

### PART 3 - EXECUTION

#### 3.01 INSPECTION

**A.** Inspect work for compliance with manufacturing and installation tolerances, including those for size, squareness, offsets at corners; presence and functioning of weep system on framing having weeps; existence of minimum required face or edge clearances; and for effective sealing of joinery. Do not proceed with work until unsatisfactory conditions have been corrected.

#### 3.02 PREPARATION

**A.** Clean glazing channels and other framing members to receive glass. Remove coatings which are not firmly bonded to substrates. Remove lacquer from metal surfaces where elastomeric sealants are to be used.

#### 3.03 GLAZING, GENERAL

**A.** Comply with printed recommendations of glass, sealants, gaskets, and other glazing materials manufacturers.

**B.** Coordinate with framing system manufacturers for proper glazing channel dimensions to provide for necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with acceptable tolerances.

**C.** Protect glass from edge damage during handling and installation.

1. Use a rolling block in rotating glass units to prevent damage to corners. Use suction cups to shift glass units within openings; do not raise of drift glass with a pry bar. Rotate glass with flares or bevels along one horizontal edge which would occur in vicinity of setting blocks so that these are located at top of opening.

2. Remove and dispose of glass units with edge damage or other imperfections of a kind that would weaken glass when installed and impair performance and appearance.

**D.** Apply primers to joint surfaces where required for sealant adhesion.

**E.** Install setting blocks of proper size in sill rabbet, located to comply with referenced glazing standard. Set blocks in thin course of sealant.

**F.** Provide spacers inside and out, of size and spacing to preserve required face clearances for glass sizes larger than 50 united inches (length plus height), except where gaskets or glazing tapes with continuous spacer rods are used. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width, except with sealant tape use thickness slightly less than final compressed thickness of tape.

**G.** Provide edge blocking to comply with requirements of referenced glazing standard except where otherwise required by glass unit manufacturer.

**H.** Set units of glass in each series with uniformity of pattern, draw, bow and similar characteristics.
I. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

J. Square cut wedge-shaped gaskets at corners and install gaskets in manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.04 TAPE GLAZING

A. Position tapes on fixed stops so that when compressed by glass their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously but not in one continuous length. Do not stretch tapes to make them fit opening.

C. Where framing joints are vertical, cover these joints by applying tapes to heads and sills first and then to jambs. Where framing joints are horizontal, cover these joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until just before each lite is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward center of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.05 GASKET GLAZING (DRY)

A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance during installation.

B. Secure compression gaskets in place with joints located at corners to compress gaskets producing a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

C. Install gaskets so they protrude past face of glazing stops.

3.06 SEALANT GLAZING (WET)

A. Install continuous spacers between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel weep systems until sealants cure. Secure spacers in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass. Install pressurized gaskets to protrude slightly out of channel to eliminate dirt and moisture pockets.

3.07 PROTECTION AND CLEANING

A. Protect glass from breakage. Do not apply markers to surfaces of glass. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances. Remove immediately by methods recommended by glass manufacturer.

C. Remove and replace glass which is broken, chipped, cracked, abraded or damaged during construction, including natural causes, accidents and vandalism.
D. Wash glass on both faces not more than 4-days prior to date scheduled for inspection for Substantial Completion. Use methods recommended by glass manufacturers.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION
   A. This Section includes the requirements for providing wall-mounted reflective film mirrors.
   B. Related Sections:
      1. Section 10 28 13 “Toilet Accessories” for metal framed mirrors.

1.01.1 DEFINITIONS
   A. Reflective Film Mirror: consists of a rigid foam core framed by an aluminum extrusion. The frame has a raised lip around the four edges. A polyester film, aluminized on the back side, is stretched across the raised edges, and an air space is created between the back of the film and the core. The air space, 1/8", allows the film to flex under minor impact without damage.

1.03 SUBMITTALS
   A. General: Comply with Division 01 Submittal Procedures.
   B. Product Data: Manufacturer's product data and application and installation instructions.
   C. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachments to (E) wall.
   D. Warranty: Sample of special warranty.

1.04 CLOSEOUT SUBMITTALS
   A. Maintenance Data: For mirrors to include in maintenance manuals.

1.05 QUALITY ASSURANCE
   A. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.
   B. Source Limitations for Mirror Accessories: Obtain mirror accessories from single source.
   C. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

1.06 DELIVERY, STORAGE, AND HANDLING
   A. Protect mirrors according to mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.
   B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration, damage to edges, and abrasion of mirrored surfaces and applied coatings. Store indoors.

1.07 PROJECT CONDITIONS
   A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

1.08 WARRANTY
   A. Special Warranty: Manufacturer's standard form in which mirror manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal...
use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

1. Warranty Period: One year from date of substantial completion.

PART 2 - PRODUCTS

2.01 REFLECTIVE FILM MIRRORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Mirrorlite Glassless Mirror
   2. Hudson Mirror
   3. Rose Brand Glassless Mirrors
   4. Lite Glassless Mirror

2.02 MIRROR PANEL

A. Weight: 5-7 oz. per square foot.
B. Core Composition: Aluminum foil-faced isocyanurate rigid core. Aluminum foil backing has fiberglass reinforcement. Panel is UL certified with a maximum flame spread rating of 25.
C. Frame: Aluminum extrusion – nonflammable
D. Polyester film:
   1. Approximately 25 microns thick.
   2. Minimum 90% reflective. Direct reflectivity measurements are made in accordance with ASTM Spec. No. F768-82 and SAE Standard J9642 or superior.
   3. Film surface flatness is equal to or exceeds that of first surface glass mirrors.
   4. Film surface is uniform in appearance and free of optical anomalies.
   5. 1/8” air space between polyester film and rigid core.
   6. Color: standard silver

2.03 INSTALLATION PRODUCTS

A. Use one of the following three products for attaching mirror panels to wall:
   1. Double Coated Urethane Foam Tape by 3M, or approved equal. Specific tape type and thickness per mirror panel manufacturer’s recommendations.
   2. 3M Dual Lock fasteners: 250 to 250. Positioning and spacing of Dual Lock tape per mirror panel manufacturer recommendations.
   3. Aluminum angle wall brackets by mirror panel manufacturer. Slotted holes for side-to-side and vertical adjustment of mirror placement.
      a. Fasteners: fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

2.04 FABRICATION

A. Mirror Sizes: To suit project conditions, fabricate mirror panels to final size and shape. Do not cut or trim in field.
PART 3 - EXECUTION

3.01 SURFACE PREPARATION AND APPLICATION

A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.

B. Verify compatibility with and suitability of substrates, including compatibility of installation products with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.02 PREPARATION

A. Comply with installation product manufacturer’s written installation instructions for preparation of substrates.

3.03 INSTALLATION

A. Install mirrors to comply with mirror manufacturer’s written wall mounting instructions provided with product.

B. Wall brackets, if used, should be securely fastened and not overly tight to cause twisting of the mirror.

C. Wall brackets, if used, should be positioned so that fasteners to wall are hidden behind the panel.

D. If adjoining mirror panels do not align, shim panels so that both mirror surfaces are flush and even. Shim wedge shall be concealed and not visible following installation.

3.04 COMPLETION

A. Exposed surfaces shall be clean and free from scratches, dents, tool marks, stains, discoloration, fingerprints, and other defects and damage.

B. Wash exposed surface of mirrors not more than four days before the date scheduled for inspections that establish date of Substantial Completion. Wash mirrors as recommended in writing by mirror manufacturer.

C. Maintain environmental conditions that will prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.

END OF SECTION
SECTION 09 22 16
NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.01 DESCRIPTION
A. This Section describes the requirements for furnishing and installing light-gauge non-load bearing wall framing systems, including metal studs, wall furring, and backing plates.

B. Related Sections:
1. Acoustical joint sealants are specified in Section 07 92 19.
2. Metal suspension systems are specified in Section 09 22 26.23.
3. Acoustical ceiling suspension assemblies are specified in Section 09 53 00.
4. Gypsum board is specified in Section 09 29 00.
5. Acoustical insulation is specified in Section 09 81 00.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS
A. General: Where stud gauge and spacing is not indicated, engineer non-structural metal framing to comply with the following requirements.

B. Stud Systems: Select steel studs in accordance with manufacturer’s standard load tables and the following deflection criteria, based on stud depth and spacing indicated and partition height required:
3. Framed Ceilings: L/360.

C. Structural supports and blocking for light fixtures and miscellaneous wall- or ceiling-mounted items shall be designed and engineered by Contractor.

1.03 SUBMITTALS
A. General: Comply with Division 01.

B. Product Data: Manufacturer’s specifications and installation instructions for each type of metal support system, including provisions for fixture and equipment anchorage.

C. Shop Drawings: Show provision for fixture and equipment anchorage to stud systems different from typical systems or details indicated.

1.04 QUALITY ASSURANCE
A. Tolerances: Provide metal studs and furring installations that are plumb, true, straight, and rigid.

B. Welder's Qualifications: AWS D1.1 and 1.3 as applicable.

C. Fire-Test-Response Characteristics: Provide components that comply with rating requirements specified for fire-rated assemblies under UL 2079 for non-load bearing wall systems.
1. Deflection Clips and Firestop Track: Connections and/or top runner provided in fire-resistance-rated assemblies shall be certified by UL 2079 for cyclic movement requirements.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING
A. General: Comply with Division 01.

B. Deliver products in the original unopened packages, containers, or bundles with manufacturer’s label intact and legible.

C. Remove products delivered in broken, damaged, rusted or unlabeled condition from the Project site immediately.

D. Protect products from rusting and other sources of damage.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS


2.02 MATERIALS

A. Metal Studs:

1. Material: Mill-certified galvanized steel conforming to ASTM A653, G40 coating, minimum yield strength 33,000-psi.

2. Construction: Formed C-channel section conforming to ASTM C645.

3. Stud Thickness: As indicated or as required for specified deflection criteria, based on stud depth and spacing indicated and partition height required. If stud spacing is not indicated, space studs at 16-inches on center.

B. Runner Tracks:

1. Material: Mill-certified galvanized steel conforming to ASTM A653, G40 coating, minimum yield strength 33,000-psi.

2. Construction: Formed channel section conforming to ASTM C645.

3. Size: Minimum 1-inch flange width; web depth matching studs.

4. Thickness: Same as studs.

C. Vertical Deflection Connection: The Steel Network Inc. “VertiClip” or “VertiTrack”, FireTrak Corp “Shadowline”, Metal-Lite “Slotted Slip Track” or approved equal conforming to the following material properties and performance criteria:

1. Code Criteria: Meet required head of wall connection criteria as required by CBC and as indicated in UL2079 for cyclic wall movement.

2. Material Composition: ASTM A653, SS grade 50, class 1, 50-ksi minimum yield strength, 65-ksi minimum tensile strength, G-60 hot dipped galvanized coating.

3. Material Thickness: 0.036-inch.

4. Clips shall be designed for positive attachment to structure and stud web using step-bushing technology to provide frictionless vertical movement.

5. Provide clips with attached bushing and screw of the series, size, and configuration as recommended by manufacturer.

6. Top track devices pre-assembled to top track assembly in standard 12-foot lengths, with clips installed at spacing to coincide with stud spacing indicated may be used at Contractor’s option.
7. Friction-fit deep-leg track assemblies and tracks relying on steel flexure to perform are unacceptable.

D. Metal Channels: Mill-certified galvanized steel conforming to ASTM C653, G40 coating, minimum yield strength 33,000-psi.

1. Framing, Furring, and Stiffening:

<table>
<thead>
<tr>
<th>Size, Inches</th>
<th>Pounds per 1,000 Lineal Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4 cold rolled</td>
<td>300</td>
</tr>
<tr>
<td>1-1/2 cold rolled</td>
<td>475</td>
</tr>
<tr>
<td>2 cold rolled</td>
<td>590</td>
</tr>
</tbody>
</table>

2. Furring Channels: Minimum 20-gauge galvanized steel with knurled faces; hat-shaped or Z-section as required.

E. Tie Wire: No. 16-gauge, galvanized, single-strand annealed steel or No. 18-gauge, galvanized, double-strand annealed steel.

F. Screws: ASTM C1002, Type S, pan head sheet metal screws, minimum 1/2-inch length.

G. Runner Track Fasteners: Powder-actuated tempered-steel pins with corrosive resistant plating or coating, 9/64-inch diameter, minimum 1-1/8-inch penetration. The use of powder-actuated anchors is not permitted in concrete where the actual concrete strength exceeds the concrete strength at which the anchor has been tested to provide the required capacity unless the anchor capacity is verified by field testing.

H. Backing Plates: Provide backing plates as indicated.

I. Compression or Isolation Strips: Fiberglass, 1/2-inch nominal thickness, width equal to width of tracks or studs where used; density such that material will compress to one-half or less of loose thickness.

PART 3 - EXECUTION

3.01 INSPECTION AND PREPARATION

A. Verify that conditions are satisfactory for the installation of metal support systems. Do not commence the installation until unsatisfactory conditions have been corrected.

B. Coordinate installation of metal support systems with the installers of other related work. Review areas of potential interference and conflicts, and coordinate layout and support provisions for interfacing work.

3.02 GENERAL INSTALLATION REQUIREMENTS

A. Install non-load-bearing steel framing members in accordance with ASTM C754, and as specified.

B. Cutting:

   1. General: Cut framing components squarely or on angle as required to fit tightly with proper bearing against abutting members.

   2. Cutting Studs: If stud web is cut more than 50-percent, or stud flanges are cut, restore stud to original strength by wire-tying, or welding on steel reinforcement.

C. When studs extend to the underside of structural slabs, secure at top with a slip connection to accommodate slab deflection.

3.03 NON-LOAD-BEARING VERTICAL METAL FRAMING

A. Runner Tracks: Align at floor and ceiling with partition layouts. Secure to structure with specified fasteners located 2-inches from each end and spaced not to exceed 24-inches on center.

   1. Coordinate installation of continuous isolation strips or acoustical sealant at acoustical partitions with installation of top and bottom runner tracks.
2. Where partition comes to underside of profile metal deck, create an acoustic seal to fill the profile. Use either metal plate or fiberglass and acoustic sealant, as indicated.

3. Notch runner tracks as required for curved partitions.

4. Where studs extend to structure above, provide vertical deflection accommodating devices where each stud connects to structural members above.

B. Installation of Metal Studs:

1. Install studs spaced 16-inches on center unless otherwise indicated. Screw-fasten framing connections using a minimum of 2 screws for each connection.

2. At partition corners and intersections, provide a minimum of 3 studs.

3. Splice studs where required, by nesting with a minimum lap of 8-inches; fasten laps with 2 screws through each flange.

4. Unless otherwise indicated, frame door openings with double 16-gauge vertical studs securely attached to each jamb of door frame.
   a. At head, install runner track; cut flanges at ends, bend web 90-degrees and screw attach to jamb studs.
   b. Install jack studs over door opening, spaced same as full-height studs.
   c. Where control joints extend upward from door jambs, install a jack stud spaced 1/2-inch from each jamb stud. Space next full-height stud not more than 6-inches from each jamb stud.
   d. Attach jamb studs to metal door frames with metal clips, each with 2 screws into jamb stud.
   e. Attach jamb studs to wood door frames with pairs of wood screws, spaced 24-inches on center.

5. Frame openings other than door openings in the same manner as for doors, and install framing below sills of openings to match framing required above door heads.

6. Frame both sides of expansion and control joints with a separate stud; do not bridge the joint with framing components.

7. Install continuous horizontal stiffeners in partitions where recommended by stud manufacturer for partition height, stud gauge, stud spacing, number of layers of gypsum board used, and anticipated stud deflection.

8. Stiffen openings with horizontal channels. Provide one channel continuous across head of openings extending to third stud beyond on each side. Provide one channel at each frame anchor extending to third stud beyond. Wire-tie or weld horizontal channels to each stud.

C. Chase-Wall Framing:

1. Align two parallel rows of floor and ceiling runners according to partition layout.

2. Position steel studs vertically in runners with flanges in same direction, with studs on opposite sides of chase directly across from each other. Anchor to runners in accordance with manufacturer's instructions.

3. Cross brace chase studs with 12-inch wide gypsum wallboard gussets or minimum 2-1/2-inch steel studs. Attach web-to-web with screws. If chase wall studs are not opposite, brace with horizontal runners and braces.

D. Wall Furring, Direct Attachment:
1. Attach hat-shaped metal furring channels either vertically or horizontally. For furring positioned horizontally, attach a furring member not more than 4-inches from both the floor and ceiling. Secure with fasteners placed on alternate channel flanges, spaced on 16-inch centers.

2. Attach Z-shaped metal channels vertically, spaced 16-inches on center unless otherwise indicated, with fasteners spaced 24-inches on center.

3.04 BACKING PLATES

A. Install as indicated and specified for support of wall-hung cabinets, toilet partitions and accessories, and other items to be mounted on vertical surfaces.

B. Welding shall comply with AWS D1.3.

C. Paint welds with a rust-inhibitive paint.

3.05 HORIZONTAL FRAMED SURFACES

A. Joist-frame with studs of size, gauge and spacing indicated or as determined from manufacturer’s standard tables based on specified deflection criteria.

B. Provide runner channels to receive studs at ceiling and walls of same gauge as studs. Secure with mechanical fasteners at 24-inches on center maximum.

C. Secure studs to channels with screws.

D. Provide furring channels in resilient sound isolation clips as indicated.

3.06 SOUND CONTROL WORK

A. Specified requirements apply to framing for interior partitions indicated as sound partitions.

B. Isolate top and bottom runners from direct contact with structure by installing over either:

1. Continuous compression or isolation strips as specified, or

2. Two continuous 1/4-inch beads of acoustical sealant specified in Section 07 92 19 applied at quarter points of track width.

C. Studs at terminal ends of partitions abutting intersecting walls or partitions, and studs that would otherwise contact intermediate structural columns shall be similarly installed over strips or sealant.

3.07 INSTALLATION TOLERANCES

A. Variation from Plumb: Maximum 1/8-inch in 10-feet, non-cumulative.

B. Variation from Level: Maximum 1/8-inch in 10-feet, non-cumulative.

C. Variation from True Plane: Maximum 1/8-inch in 10-feet, non-cumulative.

D. Variation from True Position: Maximum 1/4-inch, non-cumulative.

E. Variation of Member from Plane: Maximum 1/8-inch, non-cumulative.

3.08 WASTE MANAGEMENT

A. Separate and recycle waste materials to the maximum extent possible.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION
A. This Section describes the requirements for furnishing and installing metal ceiling suspension systems, including suspended system for gypsum board ceilings.
B. Related Sections:
   1. Non-structural metal framing is specified in Section 09 22 16.
   2. Acoustical ceiling suspension assemblies are specified in Section 09 53 23.
   3. Gypsum board is specified in Section 09 29 00.

1.02 SUBMITTALS
A. General: Comply with Division 01.
B. Product Data: Manufacturer's specifications and installation instructions for each type of suspension system, including provisions for fixture and equipment anchorage.
   1. Include ICC-ES test reports showing proposed hanger and bracing wire fasteners are capable of supporting specified loads.

1.03 QUALITY ASSURANCE
A. Ceiling-support system shall limit deflection of finished ceilings to less than L/360.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING
A. General: Comply with Division 01.
B. Deliver products in the original unopened packages, containers, or bundles with manufacturer's label intact and legible.
C. Remove products delivered in broken, damaged, rusted, or unlabeled condition from Project site immediately.
D. Protect products from rusting and other sources of damage.

PART 2 - PRODUCTS

2.01 MATERIALS
A. Metal Channels: ASTM C645, galvanized in accordance with ASTM A653, G60 coating designation.
   1. Framing, Furring, and Stiffening:
      | Size, Inches    | Pounds per 1,000 Lineal Feet |
      |-----------------|------------------------------|
      | 3/4 cold rolled | 300                          |
      | 1-1/2 cold rolled | 475                          |
      | 2 cold rolled   | 590                          |
   2. Furring Channels: Minimum 20-gauge galvanized steel with knurled faces; hat-shaped or Z-section as required.
B. Hanger Wire: Galvanized, soft, mild annealed steel; 8-gauge, unless otherwise indicated, complying with ASTM A641.
C. Diagonal Bracing Wire: Galvanized, soft, mild annealed steel; 12-gauge, unless otherwise indicated, complying with ASTM A641.

D. Tie Wire: No. 16-gauge, galvanized, single-strand annealed steel or No. 18-gauge, galvanized, double-strand annealed steel.

E. Screws:
   1. General: ASTM C1002, corrosion resistant, for attachment to metal framing 25-gauge and lighter; ASTM C954 for attachment to metal framing 20-gauge and heavier.
   2. Thread and head designs and lengths as recommended by manufacturer for uses and materials involved.

F. Hanger and Bracing Wire Fasteners: The use of powder-actuated anchors is not permitted in concrete where the actual concrete strength exceeds the concrete strength at which the anchor has been tested to provide the required capacity unless the anchor capacity is verified by field testing.
   1. Hanger Wires: Connection device capable of carrying not less than 100-pounds.
   2. Bracing Wires: Connection device capable of carrying not less than 200-pounds or the actual design load, whichever is greater, with a safety factor of 2 without yielding.

G. Furring Channel Clips: Fabricated from galvanized wire, for attaching furring channels to cold-rolled channels.

H. Compression Stiffeners: 20-gauge channel studs, 1-1/2-inches.

**PART 3 - EXECUTION**

**3.01 SUSPENDED CEILING SUSPENSION FRAMING**

A. Space 8-gauge hanger wires 48-inches on center along carrying channels and within 6-inches of ends of carrying channels.

B. Install 1-1/2-inch cold rolled carrying channels 48-inches on center and within 6-inches of walls. At splices, interlock flanges, overlap ends 12-inches, and wire-tie with double loops of No. 16-gauge wire.

C. Install 3/4-inch cold rolled channels at right angles to carrying channels, spaced 24-inches on center and within 6-inches of walls. Provide one-inch clearance between furring channels and abutting walls and partitions. Attach to carrying channels by saddle-tying around carrying channels with one strand of No. 16 or two strands of No. 18-gauge tie wire. At splices, nest furring channels with a minimum 8-inch overlap and wire-tie each end with double loops of No. 16-gauge wire.

D. Install 4-way 45-degree diagonal bracing wires at 12'-0" x 12'-0" within 6-inches of walls. Diagonal bracing wires shall be located at the intersection of main runner and cross-furring member. Provide connection between diagonal wires and main runner so as to prevent slipping for a 200-pound approximate seismic load.

E. Install hanger and bracing wire anchors so the direction of the wire aligns as closely as possible with the direction of the forces acting on the wire.

F. Separate ceiling hanging and bracing wires at least 6-inches from unbraced ducts, pipes, and conduit.

G. Fasten wires with not less than 4 tight turns. Make all tight turns within a distance of 1-1/2-inches.

H. Install uplift stiffener for each 144-square feet of ceiling, consisting of a vertical metal stud occurring at the junction of the carrier and furring channel. Wire tie to carrier or screw to channel and secure to overhead structure.

I. At control joints, provide discontinuous lap in main runners occurring over joints. Do not bridge joints with cross furring where joints run perpendicular to furring. Where joints run parallel to furring, provide furring to support each side of joint.

J. Provide recesses and openings where indicated for lighting fixtures, registers, access panels, and other items to be installed in ceilings; provide additional furring channels where required by opening.
K. Recessed or drop-in light fixtures shall be supported directly by main runners or by supplemental framing which is supported by main runners.

L. Surface mounted fixtures shall be attached to a main runner with a positive clamping device made of material with a minimum of 14-gauge. Rotational spring catches are not acceptable.

3.02 WASTE MANAGEMENT

A. Separate and recycle waste materials to the maximum extent possible.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section includes cementitious backing boards. Extent of cementitious backing boards includes:
   1. Backing board for tiled walls and ceilings.
   2. Setting materials for installation of tile backer boards.

B. Related Sections:
   1. Elastomeric liquid waterproofing is specified in Section 07 14 16.
   2. Non-structural metal framing is specified in Section 09 22 16.
   3. Gypsum board is specified in Section 09 29 00.
   4. Tile is specified in Section 09 30 00.

1.02 SUBMITTALS

A. General: Comply with Division 01.

B. Product Data: Manufacturer's data for each type of component and system specified, including performance ratings, details of construction, materials, and installation instructions.

1.03 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Division 01.

B. Deliver materials in their original unopened packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

C. Store materials under cover and in manner to keep them dry, protected from weather, direct sunlight, surface contamination, corrosion and damage from construction traffic and other causes. Neatly stack cementitious backing board to prevent sagging; stack flat, on continuous surface, and without skids.

D. Handle cementitious backing boards to prevent damage to edges, ends or surfaces. Remove damaged or deteriorated materials from site.

1.04 PROJECT CONDITIONS

A. Cold Weather Protection: In cold weather, maintain continuous, uniform, building temperatures of not less than 45-deg F. or more than 100-deg F. for a minimum period of 48-hours prior to, during, and following cementitious backing board and tile installation.

B. Conditioning: Store cementitious backing board in spaces where it is to be installed for 48-hours prior to installation. Do not install board when it is wet.

C. Ventilation: Ventilate building spaces as required to remove excess moisture.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURER

A. United States Gypsum Company "DUROCK Brand Cement Board" or approved equal.

2.02 MATERIALS
A. Cementitious Backing Board: Aggregated portland cement board with vinyl-coated, woven glass-fiber mesh embedded in back and front surfaces.

1. Thickness: As indicated.
2. Faces: Smooth on one side, textured on other side.
3. Edges: Formed smooth edges; square cut ends.
4. Weight: 3-pounds per square foot.
5. Flexural Strength, ASTM C947:
   a. 5/8-inch Thick Board: >480-psi.
   b. 1/2-inch Thick Board: >750-psi.
8. Flame Spread, Smoke Developed: 0, 0 respectively, in accordance with ASTM E84.

B. Joint Reinforcement: Glass-fiber tape, vinyl coated, open-weave tape; 2-inches wide; pressure-sensitive.

C. Fasteners: Self-drilling screws with corrosion resistant finish.

1. At Cementitious Backing Board: Screws with flat wafer head capable of being driven flush to surface of tile backer board; 1- 1/4-inch long.
2. When cementitious backing board is installed over gypsum board base layer, screws shall be 1-5/8-inches long.

D. Water Barrier: Vapor permeable membrane, 15 lb. asphalt felt or TYVEK building paper by E.I. du Pont de Nemours & Company.

E. Setting Materials: Latex-portland cement mortar complying with ANSI A118.4.

F. Joint Compound: Setting type or Lightweight Setting Type Joint Compound.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and framing for compliance with requirements and conditions affecting work of this Section. Do not proceed with installation until piping, waterproofing, and other in-wall work has been installed and accepted by Architect and unsatisfactory conditions have been corrected.

B. Examine adjacent construction for conditions which could contribute to loss of sound attenuation.

3.02 GENERAL

A. Comply with manufacturer’s printed installation instructions applicable to products and applications indicated, except when more stringent requirements apply.

B. Before installation, cut cementitious backing backer boards to required sizes, make necessary cut-outs for penetrations, and grind or drill to provide relief at bolts and screw heads which project beyond face of substrate.
C. Control Joints: Do not install cementitious backing board continuously through building movement and control joints or where control joints are required in ceramic tile.

3.03 PARTITIONS AND CEILINGS

A. Framing: Install cementitious backing board over framing type indicated. Install blocking to support tub and other plumbing fixtures, and to receive soap dishes, grab bars, towel racks and other accessories and hardware.

B. At shower receptors, fur out studs, if necessary, so inside face of receptor is flush with exposed face of cementitious backing board.

C. Water Barrier: Install over framing prior to application of cementitious backing boards. Lap joints to shed water towards face of partition. Bottom edge shall overhang lip of tub, shower pan, or shower receptor.

D. Apply cementitious backing boards to framing with long dimension parallel to or across framing. Fit ends and edges closely but not forced together. Center end or edge joints on framing and stagger joints in adjacent rows.

E. At shower pan or shower receptor, place temporary 1/4-inch spacer strips around lip of fixture. Install cementitious backing board abutting top of spacer. Remove spacer before installing tile and fill joint with joint sealant. Joint sealants are specified in another section.

F. Fasten cementitious backing board to framing. Locate screws at least 3/8-inch from edge of board and as follows:

1. Walls - Steel Framing 20- to 14-gauge: 8-inches o.c.

3.04 JOINT TREATMENT

A. Tiled Surfaces: Apply joint reinforcing over joints and corners. Embed with mortar or adhesive used to set tile.

B. Un-Tiled Exposed or Painted Surfaces: Install cementitious backing board with smooth side exposed. Seal cementitious backing board with sealer. Apply tape over joints. Embed joint tape and treat fasteners with joint compound. Flat trowel a skim coat of joint compound over cementitious backing board to fill voids. Sand to provide a smooth surface except where a textured finish is indicated. Finish joints with at least two coats of finishing compound. Install corner beads at outside corners.

END OF SECTION
SECTION 09 29 00
GYPSUM BOARD

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing the following:

B. Related Sections:
   1. Gypsum board shaft wall assemblies are specified in Section 09 21 16.23.
   2. Non-structural metal framing is specified in Section 09 22 16.
   3. Metal suspension systems are specified in Section 09 22 26.23.
   5. Painting is specified in Section 09 91 00.

1.02 SUBMITTALS

A. General: Comply with Division 01.

B. Product Data: Manufacturer's specifications and installation instructions for each type of gypsum board and accessory required.

C. Shop Drawings: Furnish layout drawing showing proposed location of control joints.

D. Samples: 12-inch long samples of each type of trim.

1.03 QUALITY ASSURANCE

A. Provide products manufactured in North America only.

B. Gypsum board work shall comply with ASTM C840 and California Building Code (CBC) Section 2508 unless otherwise indicated or specified.

C. Installation and finishing of gypsum board shall comply with GA-216. Installation of fire-rated gypsum board shall comply with their listing descriptions indicated on the Drawings.

D. Fire-Resistance Ratings: Where gypsum board systems with fire-resistance ratings are indicated, provide materials and installations identical with those of applicable assemblies tested in accordance with ASTM E119 by fire testing laboratories acceptable to authorities having jurisdiction.

   1. Provide fire-resistance-rated assemblies identical to those indicated by reference to GA File No's. in GA-600 "Fire Resistance Design Manual" or to design designations in UL "Fire Resistance Directory" or in listing of other testing and agencies acceptable to authorities having jurisdiction.

E. Allowable Tolerances:

   1. Gypsum board surfaces shall have no measurable variation in any 2-foot direction and a maximum variation of 1/8-inch in 10-feet when a straightedge is laid on the surface in any direction. Specified tolerances apply to both plumbness of walls and levelness of ceilings.

   2. Shim work as required to comply with specified tolerances.

   3. Do not exceed 1/16-inch offset between planes of abutting sheets at edges or ends.
1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Division 01.

B. Delivery:
   1. Deliver materials to the Project site in original package containers or bundles with manufacturer’s labels intact and legible.
   2. Deliver fire-rated materials bearing the testing agency’s label and classification identification.

C. Storage:
   1. Store gypsum board in accordance with GA-238 and manufacturer’s recommendations.
   2. Store materials indoors in a dry area, under cover, and stacked flat off the floor.
   3. Stack gypsum boards so that long lengths are not over short lengths.

D. Handle gypsum board to avoid damaging face and edges of sheets.

E. Protect metal corner beads and trim from being bent or damaged.

1.05 PROJECT CONDITIONS

A. Establish and maintain environmental conditions for application and finishing gypsum board to comply with ASTM C840 and with gypsum board manufacturer’s recommendations.

B. Minimum Room Temperatures: For non-adhesive attachment of gypsum board to framing, maintain not less than 40-deg. F. For adhesive attachment and finishing of gypsum board, maintain not less than 50-deg. F. for 48-hours prior to application and continuously thereafter until drying is complete.

C. Ventilate building spaces to remove water not required for drying joint treatment materials. Avoid drafts during dry, hot weather to prevent materials from drying too rapidly.

D. Provide for continuous ventilation during installation, using as close to 100-percent outside air as possible.

E. Protect workers and HVAC system from gypsum dust.

F. Remove and replace all gypsum board products that are exposed to water and display mold and mildew. Removal shall occur as soon as possible after exposure to water.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

A. United States Gypsum, CertainTeed Gypsum, Inc., Georgia Pacific, National Gypsum Company or approved equal.

2.02 GYPSUM BOARD

A. Regular Gypsum Board: United States Gypsum “SHEETROCK SW”, CertainTeed Gypsum, Inc. “ProRoc” or approved equal with tapered rounded edge to minimize ridging or beading and other joint imperfections.
   1. ASTM C1396, regular type.
   2. Thickness: 5/8-inch unless otherwise indicated.

B. Fire-Rated Gypsum Board: United States Gypsum “SHEETROCK SW Type X”, CertainTeed Gypsum, Inc. “ProRoc Type X” or approved equal with tapered rounded edge to minimize ridging or beading and other joint imperfections.
   1. ASTM C1396, Type X fire-resistant type.


C. Regular Mold- and Moisture-Resistant Gypsum Board: United States Gypsum “SHEETROCK Mold Tough”, CertainTeed Gypsum, Inc. “ProRoc Moisture and Mold Resistant with M2TECH” or approved equal noncombustible, moisture- and mold-resistant gypsum core encased in moisture- and mold-resistant, 100-percent recycled face and back papers. Panels shall have a tapered long edge.

1. ASTM C1396, regular type.
2. Thickness: 5/8-inch unless otherwise indicated.
3. Mold Resistance: Panel score of 10 when tested in accordance with ASTM D3273.

D. Fire Rated Mold- and Moisture-Resistant Gypsum Board: United States Gypsum “SHEETROCK Mold Tough Type X”, CertainTeed Gypsum, Inc. “ProRoc Moisture and Mold Resistant with M2TECH Type X” or approved equal noncombustible, moisture- and mold-resistant gypsum core encased in moisture- and mold-resistant, 100-percent recycled face and back papers. Panels shall have a tapered long edge.

1. ASTM C1396, Type X fire-resistant type.
3. Mold Resistance: Panel Score of 10 when tested in accordance with ASTM D3273.

2.03 GYPSUM BOARD ACCESSORIES

A. Screws: ASTM C954 or ASTM C1002.

1. Use Type S screws for gypsum board attachment to light steel framing.
2. Use Type S-12 screws for gypsum board attachment to 20-gauge and heavier steel framing.
3. Use Type G screws for gypsum board attachment to gypsum board.
4. Use Type W screws for gypsum board attachment to wood framing.

B. Metal Trim: Galvanized steel, 26-gauge minimum; profiles and dimensions indicated.

2. Casing Beads: United States Gypsum, ClarkDietrich Building Systems Metal J-Trim #400 or approved equal.
3. Control Joints: United States Gypsum, ClarkDietrich #093 Zinc Control Joint (ZNCJ) or approved equal roll-formed zinc with perforated flanges, 1-3/4-inch wide with 1/4-inch wide center channel with removable tape strip over channel.

C. Reveals: Extruded aluminum alloy 6063-T5, profiles indicated, finish as selected by the Architect.


1. Drying-type (ready mixed): United States Gypsum “SHEETROCK” all-purpose joint compound or approved equal.
2. Setting-type (chemically hardening): United States Gypsum “SHEETROCK” setting-type joint compound or approved equal.

3. Low-Dust Emission Type: United States Gypsum “SHEETROCK” Plus 3 ready-mixed lightweight all purpose joint compound with dust control or approved equal.

E. Reinforcing Joint Tape: ASTM C475, 2-inch nominal width.

F. Acoustical Sheet Sealant Pad: Harry A. Lowry & Associates, 3M or approved equal.

G. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.


PART 3 - EXECUTION

3.01 INSPECTION

A. Verify that conditions are satisfactory for the installation of gypsum board and accessories.

1. Check framing for accurate spacing, alignment, plumbness, and levelness. Verify that both new and existing framing members will result in gypsum board surfaces complying with specified tolerances.

2. Verify spacing of installed framing does not exceed maximum allowable for thickness of board to be used.

3. Verify door frames are set for thickness of board to be used.

4. Repair protrusions of framing, twisted framing members, or unaligned members before installation of gypsum board commences.

B. Do not commence the installation until unsatisfactory conditions have been corrected.

3.02 APPLICATION OF GYPSUM BOARD

A. Apply materials in conformance with ASTM C840, the manufacturer's instructions, and as indicated.

B. When gypsum board is to be applied to both walls and ceilings, apply to ceilings first.

C. For partitions, apply full height sheets with long dimension parallel to framing members with abutting edges over supports. Where ceiling heights exceed 10'-0" and where required by fire resistive ratings, apply sheets with long dimension perpendicular to framing members. For ceilings, apply sheets with long dimension either perpendicular or parallel to framing members to result in fewest joints. For fire-rated assemblies, apply gypsum board in accordance with CBC Chapter 7.

D. Use sheets of maximum lengths to minimize end joints.

E. Neatly fit and stagger end joints.

F. Locate joints on different studs at opposite sides of partition.

G. Cut and fit neatly around outlets and switches. Back-to-back wall penetrations shall be at least two stud spaces apart for acoustic isolation.

H. Double-Layer Application:

1. Apply base layer with long dimension perpendicular to and centered on framing; apply face layer parallel to framing. Apply base layer parallel to framing where required by fire-resistive ratings.

2. Stagger sheets of each layer so that joints of each layer are 16-inches apart.
I. Isolation of Gypsum Board from Other Construction:

1. Provide perimeter relief where gypsum board abuts structural decks, ceilings, vertical structural elements, or window sections.
2. Finish gypsum board edge with corner bead.
3. Seal space between casing bead and structure with continuous sealant bead.
4. Seal around electrical boxes and conduit and pipe penetrations.
5. Seal at base of gypsum board sheets.

J. Acoustic Control Requirements for Sound Walls:

1. Leave a 1/8- to 1/4-inch space between gypsum board and adjacent construction to provide a space for acoustical sealant.
2. Seal airtight with acoustical sealant material specified in Section 07 92 19.
3. Seal penetrations through walls, or cuts in one face of walls, with a full bead of sealant at perimeter; this includes provisions for electrical outlet and switch boxes, pipes, ducts, and similar items.
4. Seal electrical boxes at the back with specified sheet sealant pad. Where wires enter the boxes, seal the openings airtight around the wires and knockout openings.
5. Install mild steel sleeves where required, fiberglass packing between sleeve or framing, service and cover plates. Seal on both sides to render airtight.

K. Installation of Fasteners:

1. Do not locate fasteners less than 3/8-inch from edges or ends of sheets. Do not locate fasteners less than one-inch from edges or ends in horizontal applications.
2. Fire-Rated Partitions: Install fasteners in accordance with the more restrictive of either CBC Chapter 7 or the Underwriters' Laboratories assemblies as denoted on partition schedule.
4. Fire-Rated Ceilings: Install fasteners in accordance with CBC Chapter 7.
5. Non-Fire-Rated Ceilings: Install fasteners spaced not more than 12-inches on center.
6. Install screws using powered screw guns with adjustable screw-depth control head. Drive shank perpendicular to gypsum board surface. Do not hammer screws.
7. Set fastener heads slightly below surface of gypsum board, but do not break or strip paper face around fastener.
8. Stagger fasteners opposite each other on adjacent ends and edges.
9. Omit fasteners at edges where metal edge trim will be installed.

L. Installation of Accessories:

1. Install corner trim at vertical and horizontal external corners and angles, and edge trim at junctions of gypsum board and other materials and at exposed edges.
2. Control Joints:
a. Ceilings: Maximum area for ceilings with perimeter relief shall be 2,500-sq. ft.; maximum area for ceilings without perimeter relief shall be 900-sq. ft. Do not exceed 50-feet between control joints in ceilings with perimeter relief; 30-feet between control joints in ceilings without perimeter relief. At fire-rated ceilings, provide 5/8-inch thick Type X gypsum back block behind control joint.

b. Control joint locations shall occur only where indicated on reviewed layout drawings.

3.03 TAPING AND FINISHING

A. Finish Levels: Provide levels of gypsum board finish for locations as follows, in accordance with Gypsum Association GA 214 “Recommended Specification: Levels of Gypsum Board Finish”.

1. Level 0: In areas of temporary construction, no taping or accessories are required.

2. Level 1: Ceiling plenum areas and concealed areas. Provide higher level of finish as required to comply with fire-resistance ratings and acoustical ratings.

3. Level 2: Gypsum board substrate at tile, except remove tool marks and ridges.

4. Level 3: Not used.

5. Level 4: Gypsum board surfaces, except where another finish level is specified.

6. Level 5: Not used.

B. Interior Gypsum Board Finishing:

1. Taping (Level 1):
   a. Use taping or all purpose compound.
   b. Butter taping compound into inside corners and joints.
   c. Center tape over joints and press down into fresh compound.
   d. Remove excess compound. Tape joints of gypsum board above suspended ceilings.

2. First Coat (Level 2):
   a. Use taping or all-purpose drying-type compound or setting-type joint compound.
   b. Immediately after bedding tape, apply skim coat of compound over body of tape and allow to dry completely in accordance with manufacturer’s instructions.
   c. Apply first coat of compound over flanges of trim and accessories, and over exposed fastener heads and finish level with board surface.

3. Second Coat (Level 3):
   a. Use all purpose or topping drying type joint compound.
   b. After first coat treatments is dried, apply second coat of compound over tape and trim, feathering compound 2-inches beyond edge of first coat.

4. Third Coat (Level 4):
   a. Use all purpose or topping drying type joint compound.
   b. After second coat has dried, sand surface lightly and apply thin finish coat to joints, fasteners and trim, feathering compound 2-inches beyond edge of second coat.
c. Allow third coat to dry. Apply additional compound, and touch-up and sand, to provide surface free of visual defects, tool marks, and ridges, ready for application of finish.

C. Cut edges and openings around pipes and fixtures shall be caulked flush with sanitary sealant as specified in Section 07 92 00.

D. In the completed installation, gypsum board shall have plumb and straight surfaces with no waves or buckles. Joints, fastener heads, and trim flanges shall be invisible after finishing. Surfaces shall be uniformly smooth and ready for painting or other decoration.

E. Primer/Surfacer: Complete gypsum board surface to Level 4 before applying primer-surfacer. Machine-apply with airless sprayer in conformance with manufacturer’s instructions to a wet film thickness of 15- to 20-mils. Allow to dry overnight before painting.

3.04 PROTECTION OF FINISHED WORK

A. Maintain temperature and humidity conditions as required to protect the installation.

B. Protect completed gypsum board from damage or deterioration until final acceptance of the work.

3.05 WASTE MANAGEMENT

A. Separate clean waste gypsum products from contaminants for recycling. Do not include wood, plastic, metal, asphalt impregnated gypsum board or any gypsum board coated with glass fiber vinyl, decorative paper, paint or other finish. Place in designated area and protect from moisture and contamination. Protect scraps and pulverized material from moisture and contamination.

B. Clean, unpainted waste gypsum products may be recycled by:
   1. Returning to gypsum board manufacturer in lieu of landfill.
   2. Hauling to alternative use manufacturer in lieu of landfill.

C. Separate metal waste and place in designated areas for recycling or reuse.

END OF SECTION
SECTION 09 30 00
TILE

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing the following:
   1. Wall tile.
   2. Floor tile.

B. Related Sections:
   1. Elastomeric liquid waterproofing is specified in Section 07 14 16.
   2. Joint sealants are specified in Section 07 92 00.
   3. Cementitious backing board is specified in Section 09 28 13.

1.02 SUBMITTALS

A. General: Comply with Division 01.

B. Product Data: Furnish manufacturer's product data for each specified product.

C. Shop Drawings: Show tile patterns and locations and widths of expansion, contraction, and isolation joints in tile substrates and finished tile surfaces.

D. Samples for Verification: Furnish samples of the following items. Where products involve color and texture variations, furnish sets showing full range of variations expected.
   1. Each type and composition of tile for each color and texture required, at least 12-inches square, mounted on plywood or hardboard backing and grouted.
   2. Full-size units of each type of trim and accessory for each color required.
   3. Metal edge or divider strips in 6-inch lengths.

1.03 QUALITY ASSURANCE

A. Single-Source Responsibility for Tile: Obtain each color, grade, finish, type, and variety of tile from a single source with resources to provide products of consistent quality in appearance without delaying progress of the work.

B. Single-Source Responsibility for Setting and Grouting Materials: Obtain ingredients of a uniform quality from one manufacturer for each cementitious and admixture component and from one source or producer for each aggregate.

C. Installer's Qualifications: A minimum of 3-years experience installing ceramic tile of the types specified, and a minimum of 5 installations of a magnitude similar to or larger than the work of this Section.

D. Floor tile shall have a minimum dynamic coefficient of friction (DCOF) of 0.42 determined in accordance with ANSI 137.1-2012.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Division 01.

B. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with ANSI A137.1 for labeling sealed tile packages.
C. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

1.05 PROJECT CONDITIONS

A. Maintain environmental conditions and protect work during and after installation to comply with referenced standards and manufacturer's printed recommendations.

B. Maintain temperatures at 50-deg. F. or more in tiled areas during installation and for 7-days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

PART 2 - PRODUCTS

2.01 TILE MATERIALS

A. Tile: Manufacturer, Pattern and Color: As indicated in the Finish Legend, or approved equal.

1. Manufacturer representative contacts (for reference):
   a. Daltile: Ralph Messchaert – T: 916.798.8035, ralph.messchaert@daltile.com
   b. Roca Tile: Paul Bell – T: 916.708.1927, paulb@nsdgallery.com

B. Trim Units: Provide trim units to match adjoining flat tile.

1. Size: Coordinate with sizes and coursing of adjoining flat tile.

2. Shapes:
   b. Wainscot Cap for Thin-Set Tile: Surface bullnose.
   c. External Corners for Thin-Set Tile: Surface bullnose.
   d. Internal Corners: Field-butted square corners.

D. Accessories for Glazed Wall Tile: Provide one soap holder for each shower. Coordinate type required with installation method of wall tile.

2.02 SETTING MATERIALS

A. Portland Cement: ASTM C150, Type I.

B. Sand: ASTM C144.

C. Hydrated Lime: ASTM C206 or C207, Type S.

D. Water: Clean, clear, potable.

E. Cleavage Membrane: Asphalt felt, ASTM D226, Type I (No. 15) or 4-mil thick polyethylene sheeting.

F. Reinforcing:

1. Floors: Galvanized welded wire fabric, 2-inches x 2-inches - W0.3 x W0.3 (16 ASW gage or 0.0625-inch diameter).

G. Mortar:


Mortar shall be approved for use in thin-setting ceramic tile over elastomeric liquid waterproofing specified in Section 07 14 16.

2.03 GROUTING MATERIALS

A. Commercial Portland Cement Grout: ANSI A118.6, color as selected by the Architect.

B. Dry-Set Grout: ANSI A118.6, color as selected by the Architect.

C. Latex-Portland Cement Grout: ANSI A118.6, color as selected by the Architect.

D. Chemical-Resistant Epoxy Grout: ANSI A118.3, color as selected by the Architect.

E. Grout Schedule:
   1. Wall Tile: Commercial portland cement, dry-set, or latex-portland cement.
   2. Floor Tile: Commercial portland cement, sand-portland cement, dry-set, latex-portland cement or epoxy.
   3. Toilet Room and Shower Floors: Epoxy.

2.04 MISCELLANEOUS MATERIALS

A. Metal Edge Strips: Zinc alloy or stainless steel terrazzo strips, 1/8-inch wide at top edge with integral provision for anchorage to mortar bed or substrate.

B. Sealer: As recommended by tile and grout manufacturers.

C. Curing Cover: 40-pound kraft membrane.

D. Elastomeric Sealant: As specified in Section 07 92 00.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine substrates and areas where tile will be installed, with installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
   1. Verify that substrates for setting tile are firm, dry, clean, and free from oil or waxy films and curing compounds.
   2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.

3.02 PREPARATION

A. Blending: For tile exhibiting color variations within the range selected, verify that tile has been blended in factory and packaged accordingly so that tile units taken from one package show the same range in colors as those taken from other packages and match approved samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.03 INSTALLATION, GENERAL

A. General: Install tile materials in accordance with tile manufacturer’s instructions and recommendations. Provide additional tile setting materials, including but not limited to crack isolation membrane, where recommended by tile manufacturer.

B. ANSI Tile Installation Standard: Comply with referenced parts of ANSI 108 series of tile installation standards.

D. Extend tile work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions except as otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

E. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so that plates, collars or covers overlap tile.

F. Jointing Pattern: Unless otherwise indicated, lay tile in grid pattern. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so that extent of each sheet is not apparent in finished work.

G. Lay out tile wainscots to next full tile beyond dimensions indicated.

H. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints during installation of setting materials, mortar beds, and tile. Do not saw cut joints after installation of tiles.

1. Locate joints in tile surfaces directly above joints in concrete substrates.

2. Prepare joints and apply sealants as specified in Section 07 92 00.

3.04 TILE INSTALLATION METHODS

A. Interior Floors:

1. Toilet Rooms: Mortar-set in accordance with ANSI A108.1 using TCNA Method F111 for slabs on grade or F112 for suspended slabs, modified to include waterproofing under tile. Waterproofing is specified in Section 07 14 16.

B. Interior Walls:

1. Thin-set over Cementitious Backing Board: Install over cementitious backing board in accordance with ANSI A108.5 using TCNA Method W244.

C. Showers:

1. Walls: Thin-set over cementitious backing board in accordance with ANSI A108.5 using TCNA Method W244 and B415, modified to include waterproofing under tile. Waterproofing is specified in Section 07 14 16.

2. Floors: Mortar-set in accordance with ANSI A108.1 using TCNA Method B415, modified to include waterproofing under tile. Waterproofing is specified in Section 07 14 16.

D. Expansion Joints: Comply with TCA Method EJ171. Proposed joint locations shall be approved by the Architect.

1. Interior: Provide expansion joints at 24- to 36-feet on center in both directions, over cold joints and saw-cut control joints, and where tile abuts restraining surfaces. Joint spacing for tile exposed to direct sunlight or moisture shall be 12-to 16-feet on center. Joint width for paver tile shall be minimum 1/4-inch wide; ceramic mosaic tile and glazed wall tile shall be minimum 1/8-inch.

2. Sealant Materials: As specified in Section 07 92 00.

3.05 CLEANING

A. Upon completion of placement and grouting, clean tile surfaces so they are free of foreign matter.

1. Remove latex-portland cement grout residue from tile as soon as possible.

2. Do not use acid or acid cleaners to clean tile.
B. Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work.

3.06 CURING

A. Damp cure tile installations, including portland cement grouts, for a minimum of 72-hours.
   1. Cover with clean non-staining kraft paper.
   2. Do not use polyethylene sheets directly over tile on horizontal surfaces.

3.07 PROTECTION

A. Provide final protection and maintain conditions in a manner acceptable to manufacturer and installer that ensures tile is without damage or deterioration at time of Substantial Completion.
   1. When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.
   2. Prohibit foot and wheel traffic from tiled floors for at least 7-days after grouting is completed.

B. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

C. Apply sealer to portland cement grout installations in accordance with sealer manufacturer’s recommendations. Apply to small test area and obtain Architect’s approval before proceeding with application over large areas.

3.08 WASTE MANAGEMENT

A. Separate waste in accordance with the Waste Management Plan and place in designated areas in the following categories for recycling:
   1. 1/2 tiles and larger, set aside for reuse by Owner, non-profit organizations such as Habitat for Humanity, etc.
   2. Broken tile and cut offs smaller than ½ tile, excess mortar and grout, crush for use as mosaic, sub-base or fill.
   3. Separate metal waste and place in designated areas for recycling or reuse.
   4. Separate cardboard waste and place in designated areas for recycling.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION
A. This Section describes the requirements for the materials and installation of acoustical ceiling panels.
B. Related Sections:
   1. Acoustical ceiling suspension assemblies are specified in Section 09 53 23.

1.02 SUBMITTALS
A. General: Comply with Division 01.
B. Product Data: Manufacturer's descriptive and technical data and illustrations. Include MSDS data sheets.
C. Material Samples: Duplicate sets of full-size panels for each type and size of acoustical unit required.
D. Warranty.

1.03 WARRANTY
A. Warrant acoustical ceiling panels to be free from visible sag and against mold, mildew and bacteria for a period of 30-years from Date of Substantial Completion. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 - PRODUCTS

2.01 ACOUSTICAL CEILING PANELS
A. As indicated in the Finish Legend.
   Note: Indication of a specific manufacturer, product, pattern, and/or color is provided to convey design intent and is not intended to restrict the use of comparable products sourced from other manufacturers. The architect shall determine if proposed substitutions are equivalent and meet the design intent.

PART 3 - EXECUTION

3.01 AMBIENT CONDITIONS
A. Building shall have been entirely enclosed and heated not less than 10-days before start of suspended-ceiling work.
B. Before installation, acoustical units shall have been stored within the spaces where they are to be used for not less than 3-days, and with cartons opened and stripped sufficiently to permit units to stabilize to ambient conditions.
C. Remove and replace all acoustical panel ceiling products that are exposed to water and display mold and mildew. Removal shall occur as soon as possible after exposure to water.

3.02 INSTALLATION
A. Install acoustical panels in suspended grid system in accordance with manufacturer's instructions.
B. Field-cut edges of tegular edge acoustical panels shall be routed to match the edge profile of uncut panels so that panels lay in grid system flush with adjacent un-cut panels and edges of cut panels match the appearance of uncut panels.
C. Touch-up edges to match factory cut panels.

3.03 COMPLETION
A. Acoustical panels shall rest uniformly on their supporting members and shall be flat and free from twist and warp.

B. Exposed surfaces of acoustical units shall be clean and free from scratches, dents, tool marks, stains, discoloration, fingerprints, and other defects and damage.

3.04 WASTE MANAGEMENT

A. Separate waste and place in designated areas in the following categories for recycling:

1. 1/2 panels and larger, set aside for reuse by Owner, non-profit organizations such as Habitat for Humanity, etc.

2. Place scrap panels in designated areas for recycling or reuse.

3. Separate cardboard waste and place in designated areas for recycling.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for the materials and installation of acoustical suspension systems for acoustical panels.

B. Work under this Section includes furnishing and installing safety hanger wires for mechanical and electrical equipment to extent specified. Connecting safety wires to such equipment is not included.

C. Related Sections:
   1. Metal suspension systems are specified in Section 09 22 26.23.
   2. Acoustical panel ceilings are specified in Section 09 51 13.
   3. Heating, ventilating and air conditioning work is specified in Division 23.
   4. Electrical work is specified in Division 26.

1.02 SUBMITTALS

A. General: Comply with Division 01.

B. Shop Drawings:
   1. Indicate ceiling-system layouts and general and atypical conditions and details.
   2. Include details of bracing, special features and joints, perimeters, relationship to adjacent construction, and anchorage and connections to structures.

C. Product Data: Manufacturer's descriptive and technical data and illustrations, marked to identify product materials, types, and variations.

D. Material Samples: Duplicate sets of 10-inch-long pieces of grid system and perimeter trim members with one end as factory fabricated, and connection and fastening accessories and devices.

1.03 QUALITY ASSURANCE

A. Installer's Qualifications: Regularly providing installation of assemblies of the types required.

B. Suspension systems shall be designed, fabricated, and installed to meet requirements of ASTM C635 and ASCE 7 Section 13.5.6 for Seismic Zones D, E & F.

PART 2 - PRODUCTS

2.01 EXPOSED WIDE FACE GRID SYSTEM

A. Approved Manufacturers: Armstrong "Prelude XL HRC", USG, Inc. "Donn DX / DXL HRC" or approved equal.

B. Material: Hot dipped galvanized steel made from USA produced recycled steel.

C. Main Runners: 15/16-inch flange, 1-11/16-inch high, double web construction.

D. Cross Runners: 15/16-inch flange, double web construction.

E. Wall Angle, Reveals, and Miscellaneous Trim: Roll-formed from electrogalvanized steel strip to profiles indicated.

E. Finish: Factory-applied white low gloss enamel.
F. Structural Classification: Heavy duty meeting the requirements of ASTM C635.

G. Provide manufacturer’s seismic clips for grid system connections to 7/8-inch wall angle.

H. Recycled Content:
   1. Total Content: 66-percent.
   2. Total Post-Consumer Content: 56-percent.

2.02 SUSPENSION MATERIALS AND FASTENINGS

A. General: Comply with requirements of ASTM C635.

B. Wire:
   1. General: ASTM A641, galvanized steel with class 1 coating, soft annealed; factory pre-straightened units.

C. Wire Connections to Overhead Structures: The use of powder-actuated anchors is not permitted in concrete where the actual concrete strength exceeds the concrete strength at which the anchor has been tested to provide the required capacity unless the anchor capacity is verified by field testing.
   1. Hanger Wires: Connection device capable of carrying not less than 100-pounds.
   2. Bracing Wires: Connection device capable of carrying not less than 200-pounds or the actual design load, whichever is greater, with a safety factor of 2 without yielding.

D. Fastenings for Accessories:
   1. Bolts or screws of adequate size, in types appropriate for conditions and materials involved, made of corrosion-resistant materials or coated as approved.
   2. Concealed only, unless otherwise indicated or approved.

E. Compression Stiffeners: Minimum 20-gauge metal stud with 7/8-inch flange up to 4-feet in length; minimum 25-gauge metal stud with 1-5/8-inch flange and lips up to 8-feet in length. Provide structural calculations for compression stiffeners greater than 8-feet in length.

PART 3 - EXECUTION

3.01 INSTALLATION REQUIREMENTS

A. Installations shall be in accordance with manufacturers’ instructions and reviewed shop drawings, ASTM C635 and ASCE 7 Section 13.5.6.

B. Anchor hanger and bracing wire anchors so that the direction of the wire aligns as closely as possible with the direction of the forces acting on the wire. Hanger wires shall not be more than 1 (horizontal) in 6 (vertical) out of plumb.

C. Provide 12-gauge hanger wires at the ends of all main and cross runners within 8-inches from the support or within 1/4 of the length of the end tee, whichever is least, for the perimeter of the ceiling area.

D. Provide trapeze or other supplementary support members at obstructions to main hanger spacing. Provide additional hangers, struts or braces as required at all ceiling breaks, soffits or discontinuous areas. Hanger wires more than 1 in 6 out of plumb shall have counter-sloping wires.
E. Ceiling grid members shall be attached to not more than 2 adjacent walls in accordance with ASCE 7, Section 13.5.6.2(b). Ceiling grid members shall be at least 3/8-inch and not more than 3/4-inch free of other walls. If walls run diagonally to ceiling grid system runners, one end of main and cross runners shall be free, and a minimum of 3/4-inch clear of wall.

F. The width of the perimeter supporting closure angle shall be not less than 7/8-inch.

G. At the perimeter of the ceiling area where main or cross runners are not connected to the adjacent wall, provide interconnection between the runners at the free end to prevent lateral spreading. A metal strut or a No. 16 gauge wire with a positive mechanical connection to the runner may be used. Where the perpendicular distance from the wall to the first parallel runner is 12-inches or less, this interlock is not required.

H. Expansion joints shall be provided in the ceiling at intersections of corridors and at junctions of corridors with lobbies or other areas.

I. Provide lateral-force bracing assemblies consisting of a compression strut and four 12-gauge splayed bracing wires oriented 90-degrees from each other at the following spaces:
   1. Place sets of bracing wires spaced not more than 12-feet by 12-feet on center.
   2. Provide bracing wires at locations not more than 1/2 the specified spacing from each perimeter wall and at the edge of vertical ceiling offsets.
   3. The slope of these wires shall not exceed 45-degrees from the plane of the ceiling and shall be taut without causing the ceiling to lift. Splices in bracing wires are not permitted.
   4. Compression struts shall not be more than 1 (horizontal) in 6 (vertical) out of plumb.

J. Fasten hanger wires with not less than 3 tight turns; fasten bracing wires with not less than 4 tight turns. Make tight turns within a distance of 1-1/2-inches.

K. Provide seismic separation joints for ceiling areas greater than 2,500-square feet.

L. Testing of Concrete Anchors:
   1. When drilled-in concrete anchors or shot-in anchors are used in reinforced concrete for hanger wires, 1 out of 10 shall be field tested for 200-pounds of tension.
   2. When drilled-in concrete anchors are used for bracing wires, 1 out of 2 shall be field tested for 440-pounds in tension. Shot-in anchors in concrete are not permitted for bracing wires.

M. Support of Light Fixtures and Air Terminals: Comply with ASTM C635.
   1. Ceiling suspension systems that support light fixtures, air-ventilation grilles or partitions shall have a classification of heavy-duty.
   2. Recessed or drop-in light fixtures and grilles shall be supported directly from the fixture housing to the structure above with a minimum of two 12-gauge wires located at diagonally opposite corners. Fixture support wires may be slightly loose to allow the fixture to seat in the grid system.
   3. Fixture shall not be supported from main runners or cross runners if the weight of the fixtures causes the total dead load to exceed the deflection capability of the ceiling suspension system.

N. Installation Tolerances:
   1. Bottom surface plane of each assembly shall be within plus or minus 1/8-inch of ceiling-height level required.
   2. Bottom surface plane of each assembly shall be level and true to plane within 1/8-inch in 12-feet.

3.02 PERIMETER TRIM

A. Provide in longest lengths available and combinations of lengths to minimize number of joints required.
B. Do not use pieces shorter than 48-inches.
C. Miter joints at corners.
D. Install to neatly close with adjoining vertical surfaces.

3.03 RE-USE OF EXISTING CEILING HANGER AND BRACING WIRES
A. The gauge and spacing of the existing wires shall comply with the requirements specified in this Section.
B. Existing ceiling hanger wires shall be capable of carrying not less than 200-pounds.
C. Existing bracing wires shall be capable of carrying not less than 440-pounds.

3.04 COMPLETION
A. Adjust hangers as required. Addition of kinks or bends in hanger are not acceptable; take up in ties only.
B. When complete, grid members of each assembly shall be mutually parallel/square, accurately aligned, with joints neatly formed and closely fitted and aligned flush; each assembly shall be securely anchored and braced to structure to prevent movement.
C. Exposed surfaces of grids shall be clean and free from scratches, dents, tool marks, stains, discoloration, fingerprints, and other defects and damage.

3.05 WASTE MANAGEMENT
A. Separate and recycle waste materials to the maximum extent possible.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION

A. The work of this Section includes the following:

1. Retaining and paying for an independent Testing Laboratory to perform moisture vapor emission, in-concrete relative humidity and alkalinity-pH testing on new concrete slabs to receive applied flooring materials.

2. Applying a vapor emission control system treatment when testing reveals vapor emission or alkalinity levels exceeding specified maximums at no cost to the Owner. Include mechanical preparation, control system, primers and cement topcoat products as specified.

B. Related Sections:

1. Cast-in-place concrete is specified in Section 03 30 00.
2. Resilient sheet flooring is specified in Section 09 65 16.
3. Resilient tile flooring is specified in Section 09 65 19.
4. Tile carpeting is specified in Section 09 68 13.

1.02 SUBMITTALS

A. General: Comply with Division 01.

B. Product Data: Furnish product data on treatment materials proposed for use, ASTM laboratory test reports, and application instructions.

C. Test Diagram: Prepare moisture, humidity and pH report of each test area. Include name of company performing the test; types of testing instruments used; floor plan of building with each test location identified; starting date, time, and beginning weight; estimate of building temperature; stopping date, time, and ending weight; pH levels; and computed pounds of emission, including equations.

D. Warranty.

1.03 QUALITY ASSURANCE

A. Installer: Manufacturer's trained personnel or factory-trained authorized installer. Installer shall have a minimum of 5-years documented experience in the installation of concrete vapor emission control systems.

B. Manufacturer: Minimum 5-years experience producing two-component water-based control systems.

1.04 PROJECT CONDITIONS

A. Maintain temperature range of 55-deg. F. and 85-deg. F. for 72-hours prior to, during, and after application of vapor control sealer.

1.05 WARRANTY

A. Warranty failure of finish flooring system due to concrete water vapor emission to the installed system for a period of 15-years from date of Substantial Completion. Include replacement of finish flooring material, and re-application of adhesive, vapor emission control system. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 - PRODUCTS
2.01 APPROVED MANUFACTURERS


B. Humidity Testing Equipment: American Moisture Test “AMT Moisture / Relative Humidity Meter” or approved equal.

C. Alkalinity Testing Equipment: American Moisture Test “AMT Concrete Digital Alkalinity-pH Meter” or approved equal.

2.02 MATERIALS

A. Vapor Control Sealer: Two-component waterborne polymer designed to penetrate concrete slabs and seal cracks, joints, and slab imperfections. The resins allow the polymers to saturate porous concrete and embed a dense, high compressive film strength within the concrete to restrict water vapor emission, alkalinity migration and 100-percent relative humidity transfer.

1. Water Vapor Transmission Rate, ASTM E96:
   a. Grains/sq. ft./hour: 0.6.
   b. Pounds/1000-sq. ft./24-hrs: 2.0.

2. Water Vapor Permeance, ASTM E96: 1.4-perm (inch-pound).


5. In-Concrete Relative Humidity, ASTM F2170: Tolerant to 100-percent RH.

6. Alkalinity pH, ASTM F710: Resistant to 14pH.


B. Vapor Emission Testing Equipment: Manufacturer’s standard.

C. Humidity Testing Equipment: Manufacturer’s standard sleeves, RH probes, sleeve caps and humidity meter.

D. Alkalinity Testing Equipment: Meter shall be capable of wide range 1-15 pH measurements per ASTM F170.

PART 3 - EXECUTION

3.01 VAPOR EMISSION TESTING

A. Perform pre-installation testing of the concrete slab by a calcium chloride test prior to the application of specified water vapor emission control system treatment. Testing shall be performed by a qualified testing personnel and Testing Laboratory.

B. Perform three tests for the first 1,000-sq. ft. of flooring and one additional test for each additional 1,000-sq. ft. of flooring. Conduct around the perimeters of the room, center of room and where moisture may be evident.

1. Moisture: Perform ASTM F1869 anhydrous calcium chloride testing on clean concrete slabs; free of curing, sealing, adhesive residue, water and surface contaminates in a area 20-inches by 20-inches 24-hours before test kits are installed.
2. **Alkalinity**: Perform ASTM F710 alkalinity testing during retrieval of moisture tests, directly inside dome area by placing several drops of manufacturer provided solution to concrete surface. Wait 60-seconds and apply digital LCD pH meter. Record results to the nearest hundredth on final test report.

3. **Temperature, Humidity and Surface Thermometer**: Document temperature, humidity and surface temperature at installation and retrieval of moisture kits on final testing report. Note dew point temperature for control barrier installations.

C. Tests shall determine the change in weight of moisture-absorbing anhydrous calcium chloride and the results shall represent the amount of moisture transmitting out of the concrete slab area. The value shall be expressed in pounds and shall be equivalent to the weight of the water that is emitted from a 1,000-sq. ft. concrete slab area in a 24-hour period of time.

D. Unless more restrictive emission levels are required by finish flooring manufacturer, if calcium chloride testing reveals water vapor emission levels greater than 3-pounds per 1,000-sq. ft. for resilient flooring and elastomeric flooring and 5-pounds per 1,000-sq. ft. for adhesively-applied carpet, apply sealer in accordance with manufacturer's instructions. Alkalinity readings shall not exceed 9.0 pH for adhesive applied flooring.

### 3.02 HUMIDITY TESTING

A. Where applied floor coverings have published relative humidity tolerances, perform humidity testing of concrete slabs in accordance with ASTM F2170.

B. Test results shall be expressed in percent and whether or not the concrete is acceptable to receive floor coverings, coatings, toppings or vapor control sealers.

C. Concrete floors to be tested shall be at service temperature and interior room space above the floor slab shall be at service temperature and service humidity for at least 48-hours.

D. Test at a rate of three tests for areas up to 1,000-sq. ft. and one more test for each additional 1,000-sq. ft. of floor area.

E. Select test sites away from windows, protected from direct sunlight and 4-feet from exterior walls.

F. Drill a 2-inch deep hole using an SDS hammer drill with a 5/8-inch bit. Blow the hole free of debris using compressed air and a vacuum. Insert the pre-measured sleeve in the hole and secure. Insert the RH probe, install sleeve cap and allow to remain for 72-hours. Allow holes to reach equilibrium for 72-hours. Remove the sleeve cap and connect the meter cable to the probe. Allow the probe to re-acclimate for 30-minutes.

G. Mark all test numbers and locations directly on the concrete surface. When readings are required at a later date, apply the sleeve cap and return to test as required.

H. Unless more restrictive humidity levels are required by finish flooring manufacturer, do not install flooring when humidity levels are greater than 75-percent RH.

### 3.03 ALKALINITY TESTING

A. Perform alkalinity testing using pH testing meter in accordance with manufacturer’s instructions.

B. Perform testing at a rate of three tests for the first 1,000-square feet of flooring and one additional test for each 1,000-square feet of flooring thereafter.

C. Alkalinity readings above 9.0 pH are considered excessive and require remediation prior to installing flooring materials.

### 3.04 APPLICATION OF VAPOR EMISSION CONTROL SYSTEM

A. **Surface Preparation:**

1. Concrete shall cure for 48-hours and be structurally sound, clean, free of dust, grease, oil, existing coatings, paint marks, carbonated layers and other potential contaminants.
2. Concrete shall be heavily profiled in accordance with the International Concrete Surface Repair Institute to a Concrete Surface Profile (CSP) #4.

3. Profile edges, joints and cracks clean with a diamond crack chasing blade, removing fill.

4. Acid etching, sanding discs or grinding surfaces are not acceptable.

5. Vacuum entire surface with an industrial unit. Do not use clean sweep agents.

B. Mixing: Mix in accordance with manufacturer’s instructions.

C. Application:
   1. Pre-dampen concrete with clean water using an airless sprayer.
   2. Allow surface to dry for 20-minutes and broom areas that puddle.
   3. Pour product on concrete and scrub into surface with a nylon broom.
   4. While wearing spike shoes re-apply product after 40-minutes.
   5. Spread evenly over entire surface following rates recommended by manufacturer based on slab vapor emission levels. Apply multiple coats if required by slab vapor emission levels.

D. Crack and Joint Treatment: Cracks and joints less than 1/8-inch wide may be sealed during application. Re-seal cracks that remain exposed after application with additional product for greater crack bridging in accordance with manufacturer’s instructions.

E. Cement Patching/Leveling:
   1. Allow material to cure for a minimum of 12- to 24-hours before using a cement product to smooth uneven floor transitions. Cement shall be a minimum thickness of 1/8-inch to allow proper adhesive transfer.
   2. Apply a non-porous primer to secure cement products.

END OF SECTION
SECTION 09 65 13
RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section includes the following:

1. Resilient wall base.
2. Resilient flooring accessories.
3. Resilient carpet accessories.

B. Related Sections:

1. Resilient sheet flooring is specified in Section 09 65 16.
2. Resilient tile flooring is specified in Section 09 65 19.
3. Tile carpeting is specified in Section 09 68 13.

1.02 SUBMITTALS

A. General: Comply with Division 01.

B. Product Data: Submit for each type of product specified.

C. Samples: Samples for verification purposes in manufacturer's standard sizes, but not less than 12-inches long, of each different color and pattern of product specified.

1.03 QUALITY ASSURANCE

A. Fire Performance Characteristics: Provide products with the following fire performance characteristics as determined by testing products per ASTM test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Critical Radiant Flux: 0.45-watts per sq. cm or more per ASTM E648.
2. Smoke Density: Less than 450 per ASTM E662.

B. All materials shall comply with the requirements of Air Quality Management District (AQMD) Rule 1168 governing the emission of Volatile Organic Compounds.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Division 01.

B. Deliver products to Project site in original manufacturer's unopened cartons and containers, each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.

C. Store products in dry spaces protected from the weather with ambient temperatures maintained between 50- and 90-deg. F.

D. Move products into spaces where they will be installed at least 48-hours in advance of installation.

1.05 PROJECT CONDITIONS

A. Maintain a minimum temperature of 70-deg. F. in spaces to receive products specified in this Section for at least 48-hours prior to installation, during installation, and for not less than 48-hours after installation. After this period, maintain a temperature of not less than 55-deg. F.
B. Do not install products until they are at the same temperature as that of the space where they are to be installed.

C. Close spaces to traffic during installation of products specified in this Section.

D. Provide for continuous ventilation during installation using as close to 100-percent outside air as possible.

1.06 SEQUENCING AND SCHEDULING

A. Sequence installing products specified in this Section with other construction to minimize possibility of damage and soiling during remainder of construction period.

PART 2 - PRODUCTS

2.01 RESILIENT WALL BASE

A. Resilient Wall Base: As indicated in the Finish Legend.

B. Note: Indication of a specific manufacturer, product, pattern, and/or color is provided to convey design intent and is not intended to restrict the use of comparable products sourced from other manufacturers. The architect shall determine if proposed substitutions are equivalent and meet the design intent.

2.02 RESILIENT ACCESSORIES

A. Provide resilient cap for cove vinyl sheet flooring, carpet edge for glue down applications, reducer strip for resilient flooring, and tile/carpet transition strips.

B. Profile and Dimensions: As indicated.

C. Color: As selected by the Architect from manufacturer's standards.

2.03 INSTALLATION ACCESSORIES

A. Concrete Slab Primer: Non-staining type as recommended by flooring manufacturer.

B. Trowelable Underlayments and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by flooring manufacturer for applications indicated.

C. Adhesives: Provide VOC-compliant type and brands of solvent free water-resistant adhesive as recommended by manufacturer of resilient wall base and accessories for conditions of installation.

PART 3 - EXECUTION

3.01 PREPARATION

A. Comply with manufacturer's installation specifications for preparing substrates indicated to receive products indicated.

B. Use trowelable leveling and patching compounds per manufacturers directions to fill cracks, holes, and depressions in substrates.

C. Broom or vacuum clean substrates to be covered immediately before installing products specified in this Section. Following cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust.

3.02 INSTALLATION

A. Install products specified in this Section using methods indicated according to manufacturer's installation directions.

B. Apply resilient wall base to walls, columns, pilasters, casework, and other permanent fixtures in rooms and areas where base is required. Install wall base in lengths as long as practicable. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

1. Install inside and exterior corners before installing straight pieces.
C. Place resilient accessories so they are butted to adjacent materials of type indicated and bond to substrates with adhesive. Install reducer strips at edges of flooring that otherwise would be exposed.

3.03 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing installation:

1. Remove visible adhesive and other surface blemishes using cleaner recommended by manufacturers of resilient product involved.

2. Damp-mop resilient accessories to remove black marks and soil.

B. Clean products specified in this Section not more than 4 days prior to dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean products using method recommended by manufacturer.

3.04 WASTE MANAGEMENT

A. Close and seal tightly all partly used adhesive containers and store protected in well ventilated fire-safe area at moderate temperatures.

B. Place used adhesive tubes and containers in areas designated for hazardous materials.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION
A. This Section includes resilient sheet floor coverings over existing resilient tile flooring.

B. Related Sections:
1. Resilient base and accessories are specified in Section 09 65 13.
2. Resilient tile flooring is specified in Section 09 65 19.

1.02 SUBMITTALS
A. General: Comply with Division 01.

B. Product Data: Submit for each type of product specified.

C. Shop Drawings: Show location of seams and edge strips. Indicate location of columns, doorways, enclosing partitions, built-in cabinets, and locations where cutouts are required in flooring.

D. Samples: For verification purposes in form of 6-inch by 9-inch sections of each different color and pattern of resilient sheet floor covering product specified, showing full range of variations expected in these characteristics.

E. Maintenance data for resilient sheet floor coverings.

F. Warranty.

1.03 QUALITY ASSURANCE
A. Fire Performance Characteristics: Provide resilient sheet floor coverings with the following fire performance characteristics as determined by testing products per ASTM test method indicated below by Underwriters Laboratories, Inc. (UL) or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Critical Radiant Flux: 0.45-watts per sq. cm or more per NFPA 253 (ASTM E648).

2. Smoke Density: Less than 450 per NFPA 258 (ASTM E662).

1.04 REGULATORY REQUIREMENTS
A. Slip Resistant Surfaces: Conform to the more restrictive provisions of Title III of the Americans with Disabilities Act or California Building Code (CBC).

1. Resilient flooring shall have a coefficient of friction of at least 0.6 per ASTM D2047.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING
A. General: Comply with Division 01.

B. Deliver resilient sheet floor coverings and installation accessories to Project site in original manufacturer's unopened cartons and containers, each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.

C. Store flooring materials in dry spaces protected from the weather with ambient temperatures maintained between 50- and 90-deg. F.

D. Move resilient sheet floor coverings and installation accessories into spaces where they will be installed at least 48-hours in advance of installation.
1.06  PROJECT CONDITIONS

A. Maintain a minimum temperature of 70-deg F. in spaces to receive resilient sheet floor coverings for at least 48-hours prior to installation, during installation, and for not less than 48-hours after installation. After this period, maintain a temperature of not less than 55-deg F. and not more than 95-deg F. unless otherwise acceptable to the floor covering manufacturer.

B. Do not install resilient sheet floor coverings until they are at the same temperature as the space where they are to be installed.

C. Close spaces to traffic while installing resilient sheet floor covering.

D. Provide for continuous ventilation during installation using as close to 100-percent outside air as possible.

1.07  SEQUENCING AND SCHEDULING

A. Install resilient sheet floor coverings and accessories after other finishing operations, including painting, have been completed.

1.08  WARRANTY

A. Warrant resilient sheet flooring to be free from defects in materials and workmanship for a period of 5-years from the Date of Substantial Completion. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 - PRODUCTS

2.01  RESILIENT SHEET COVERINGS

A. Manufacturer, Pattern and Color: As indicated in the Finish Legend.

B. Note: Indication of a specific manufacturer, product, pattern, and/or color is provided to convey design intent and is not intended to restrict the use of comparable products sourced from other manufacturers. The architect shall determine if proposed substitutions are equivalent and meet the design intent.

2.02  INSTALLATION ACCESSORIES

A. Concrete Slab Primer: Non-staining type as recommended by flooring manufacturer.

B. Trowelable Underlayments and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by floor covering manufacturer for applications indicated.

C. Adhesives: Provide VOC-compliant type and brands of solvent free water-resistant adhesive as recommended by manufacturer of resilient flooring for conditions of installation.

D. Seam Sealer: Formulation provided or approved by floor covering manufacturer for specified products.

PART 3 - EXECUTION

3.01  EXAMINATION

A. Verify that existing resilient tile flooring is acceptable to receive new resilient sheet flooring.

1. Existing flooring shall be dry and free of materials whose presence would interfere with bonding of adhesive.

2. Existing flooring shall be free of cracks, ridges, depressions, scale, and foreign deposits of any kind.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02  PREPARATION
A. Comply with manufacturer's installation specifications to prepare substrates indicated to receive resilient sheet floor coverings.

B. Use trowelable leveling and patching compounds per floor covering manufacturer's direction to fill cracks, holes, and depressions in substrates.

C. Remove coatings and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush. Exercise care in grinding existing floor tile that may contain asbestos.

D. Broom or vacuum clean substrates to be covered by resilient sheet floor coverings immediately before installation. Following cleaning, examine substrates to determine if there is visually any evidence of moisture or dust.

E. Apply primer, if recommended by flooring manufacturer, prior to application of adhesive. Apply according to manufacturer's directions.

3.03 INSTALLATION

A. Comply with resilient sheet floor covering manufacturer's installation instructions and other requirements indicated that are applicable to each type of floor covering installation included in Project.

B. Lay out resilient sheet floor coverings to comply with the following requirements:

1. Maintain uniformity of resilient sheet floor covering direction.

2. Arrange for a minimum number of seams and place them in inconspicuous and low traffic areas, but in no case less than 6-inches away from parallel joints in flooring substrates.

3. Match edges of resilient floor coverings for color shading and pattern at seams.

4. Avoid cross seams.

C. Scribe, cut, and fit resilient sheet floor coverings to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture, including cabinets, pipes, outlets, edgings, thresholds, and nosings.

D. Extend resilient sheet floor coverings into toe spaces, door reveals, closets, and similar openings.

E. Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other nonpermanent marking device.

F. Adhere resilient sheet floor coverings to flooring substrates by method approved by floor covering manufacturer.

1. Produce completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections.

2. Comply with floor covering manufacturer's directions including those for trowel notching, adhesive mixing, and adhesive open and working times.

G. Chemically bond seams in sheet vinyl floor coverings where this seaming method is indicated. Prepare seams and apply seam sealers to produce tightly fitted seams without gaps or overlaps.

H. Hand roll resilient sheet floor coverings in both directions from center out to embed floor coverings in adhesive and eliminate trapped air. At walls, door casings, and other locations where access by roller is impractical, press floor coverings firmly in place with flat-bladed instrument.

3.04 CLEANING AND PROTECTION
A. Perform the following operations immediately after installing resilient sheet floor coverings:

1. Remove visible adhesive and other surface blemishes using cleaner recommended by floor covering manufacturers.

2. Sweep or vacuum floor thoroughly.

3. Do not wash floor until after period recommended by floor covering manufacturer.

4. Damp-mop floor to remove black marks and soil.

B. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods indicated or recommended by floor covering manufacturer.

1. Cover resilient sheet floor coverings with undyed, untreated building paper until inspection for Acceptance of work.

2. Do not move heavy and sharp objects directly over resilient sheet floor coverings. Place plywood or hardboard panels over floor coverings and under objects while they are being moved. Slide or roll objects over panels without moving panels.

C. Clean resilient sheet flooring not more than 4-days prior to dates scheduled for inspections intended to establish date of Acceptance of Work in each area of Project. Clean resilient sheet floor coverings by method recommended by manufacturer.

3.05 WASTE MANAGEMENT

A. Separate waste and place in the following categories for re-use:

1. Sheet materials larger than 2-sq. ft.

B. Linoleum and cork, if used, are biodegradable and may be shredded and composted.

C. Close and seal tightly all partly used adhesive containers and store protected in well-ventilated fire-safe area at moderate temperatures.

D. Place used adhesive tubes and containers in areas designated for hazardous materials.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION
   A. This Section includes resilient tile flooring.
   B. Related Sections:
      1. Water vapor emission and humidity testing and control systems are specified in Section 09 61 43.
      2. Resilient base and accessories are specified in Section 09 65 13.
      3. Resilient sheet flooring is specified in Section 09 65 16.

1.02 SUBMITTALS
   A. General: Comply with Division 01.
   B. Product Data: Submit for each type of product specified. Include certification by tile manufacturer that products supplied for tile installation comply with local regulations controlling use of volatile organic compounds (VOC's).
   C. Samples: For verification purposes in full-size tiles of each different color and pattern of resilient floor tile specified, showing full range of variations expected in these characteristics.
   D. Maintenance data for resilient floor tile, to include in Operating and Maintenance Manual.
   E. MSDS data sheets for adhesive.

1.03 QUALITY ASSURANCE
   A. Single-Source Responsibility for Floor Tile: Obtain each type, color, and pattern of tile from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the work.
   B. Fire Performance Characteristics: Provide resilient floor tile with the following fire performance characteristics as determined by testing products per ASTM test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
      1. Critical Radiant Flux: 0.45-watts per sq. cm or more per ASTM E648.
      2. Smoke Density: Less than 450 per ASTM E662.
   C. All materials shall comply with the requirements of Air Quality Management District (AQMD) Rule 1168 governing the emission of Volatile Organic Compounds.

1.04 REGULATORY REQUIREMENTS
   A. Slip Resistant Surfaces: Conform to the more restrictive provisions of Title III of the Americans with Disabilities Act or with California Building Code (CBC).
      1. Resilient flooring shall have a coefficient of friction of at least 0.6 per ASTM D2047.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING
   A. General: Comply with Division 01.
   B. Deliver tiles and installation accessories to Project site in original manufacturer's unopened cartons and containers each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.
C. Store flooring materials in dry spaces protected from the weather with ambient temperatures maintained between 50-deg. F. and 90-deg. F.

D. Store tiles on flat surfaces. Move tiles and installation accessories into spaces where they will be installed at least 48-hours in advance of installation.

1.06 PROJECT CONDITIONS

A. Maintain a minimum temperature of 70-deg. F. in spaces to receive tiles for at least 48-hours prior to installation, during installation, and for not less than 48-hours after installation. After this period, maintain a temperature of not less than 55-deg. F.

B. Do not install tiles until they are at the same temperature as the space where they are to be installed.

C. Close spaces to traffic during tile installation.

D. Provide for continuous ventilation during installation using as close to 100-percent outside air as possible.

1.07 SEQUENCING AND SCHEDULING

A. Install tiles and accessories after other finishing operations, including painting, have been completed.

B. Do not install tiles over concrete slabs until the slabs have cured and are sufficiently dry to bond with adhesive as determined by tile manufacturer's recommended bond and moisture test.

PART 2 - PRODUCTS

2.01 RESILIENT TILE FLOORING

A. Manufacturer, Pattern and Color: As indicated in the Finish Legend.

B. Note: Indication of a specific manufacturer, product, pattern, and/or color is provided to convey design intent and is not intended to restrict the use of comparable products sourced from other manufacturers. The architect shall determine if proposed substitutions are equivalent and meet the design intent.

2.02 INSTALLATION ACCESSORIES

A. Concrete Slab Primer: Non-staining type as recommended by flooring manufacturer.

B. Trowelable Underlayments and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by tile manufacturer for applications indicated.

C. Adhesives: Provide VOC-compliant type and brands of solvent free water-resistant adhesive as recommended by manufacturer of resilient wall base and accessories for conditions of installation.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas where installation of tiles will occur, with Installer present, to verify that substrates and conditions are satisfactory for tile installation and comply with tile manufacturer's requirements and those specified in this Section.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials whose presence would interfere with bonding of adhesive. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by tile manufacturer.

2. Finishes of subfloors comply with tolerances and other requirements specified in Section 03 30 00 for slabs receiving resilient flooring.

3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits of any kind.
3.02 PREPARATION

A. General: Comply with manufacturer’s installation specifications to prepare substrates indicated to receive tile.

B. Use trowelable leveling and patching compounds per tile manufacturer's directions to fill cracks, holes, and depressions in substrates.

C. Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush.

D. Broom or vacuum clean substrates to be covered by tiles immediately before tile installation. Following cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust.

E. Apply concrete slab primer, if recommended by flooring manufacturer, prior to applying adhesive. Apply according to manufacturer's directions.

F. Test concrete slabs to receive resilient tile flooring for moisture and humidity levels as specified in Section 09 61 43.

3.03 INSTALLATION

A. General: Comply with tile manufacturer's installation directions and other requirements indicated that are applicable to each type of tile installation included in Project.

B. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths at perimeter that equal less than one-half of a tile. Install tiles square with room axis, unless otherwise indicated.

C. Match tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged, if so numbered. Cut tiles neatly around all fixtures. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles with grain running in one direction unless otherwise indicated or directed by the Architect.

D. Scribe, cut, and fit tiles to butt tightly to vertical surfaces, permanent fixtures, built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings.

E. Extend tiles into toe spaces, door reveals, closets, and similar openings.

F. Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other nonpermanent marking device.

G. Adhere tiles to flooring substrates without producing open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections in completed tile installation.

H. Use full spread of adhesive applied to substrate in compliance with tile manufacturer's directions including those for trowel notching, adhesive mixing, and adhesive open and working times.

I. Hand roll tiles where required by tile manufacturer.

3.04 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing tile installation:

C. Do not proceed with installation until unsatisfactory conditions have been corrected.
1. Remove visible adhesive and other surface blemishes using cleaner recommended by tile manufacturers.

2. Sweep or vacuum floor thoroughly.

3. Do not wash floor until after time period recommended by resilient floor tile manufacturer.

4. Damp-mop tile to remove black marks and soil.

B. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended by tile manufacturer.

1. Cover tiles with undyed, untreated building paper until inspection for Acceptance of Work.

2. Do not move heavy and sharp objects directly over tiles. Place plywood or hardboard panels over tiles and under objects while they are being moved. Slide or roll objects over panels without moving panels.

C. Clean tiles not more than 4-days prior to dates scheduled for final acceptance. Clean tiles using method recommended by manufacturer.

3.05 WASTE MANAGEMENT

A. Separate waste and place in the following categories:

1. Full size tiles for reuse or to be recycled by flooring manufacturer.

2. Cut tile scraps to be recycled by flooring manufacturer.

B. Linoleum and cork, if used, are biodegradable and may be shredded and composted.

C. Close and seal tightly all partly used adhesive containers and store protected in well-ventilated fire-safe area at moderate temperatures.

D. Place used adhesive tubes and containers in areas designated for hazardous materials.

END OF SECTION
SECTION 09 68 13

TILE CARPETING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing tile carpeting.

B. Related Sections:
   1. Water vapor emission and humidity testing and control systems are specified in Section 09 61 43.
   2. Resilient base and accessories are specified in Section 09 65 13.

1.02 SUBMITTALS

A. General: Comply with Division 01.

B. Product Data: Include the following:
   1. Reports documenting the results of tests by a NVLAP approved laboratory for electrostatic propensity and flooring radiant panel test.
   2. Catalog data and product physical characteristics.
   3. Manufacturer’s printed installation instructions, surface preparation, seaming techniques, recommended adhesives and other installation accessories.
   4. Statement verifying environmental requirements.
   5. Maintenance instructions including recommended cleaning equipment and materials, spot removal information, and cleaning methods.

C. Samples:
   1. For verification purposes, two full size tiles of each color and pattern selected.
   2. 12-inch long sample of carpet accessories.

D. Layout Drawings: Show layout of each area to be covered for approval of pattern, and any pertinent installation details.

E. Warranty.

1.03 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Carpet tiles shall be approved by applicable jurisdictions.

B. Fire Hazard Classification: Class I floor finish. Minimum critical flux limit of 0.45-watts/square centimeter when tested in accordance with NFPA 253.

C. Static electricity generation of installed carpet shall not exceed 3.5 KV at 70-deg. F and 20-percent R.H. for life of carpet tile.
D. Installer’s Qualifications: Installer shall be approved by carpet tile manufacturer, and shall have regularly been providing installations of the types required for no less than five years.

E. Visually perceptible deviations in color at sides and end seams shall not be acceptable.

F. Indoor Air Quality: Carpet tile shall meet or exceed the minimum standards contained in the Carpet and Rug Industry (CRI) Institute consumer information label.

G. Comply with CRI – Carpet and Rug Institute Indoor Air Quality Green Label Testing Program.
   1. All carpet tile products shall comply with the VOC limit established by the Carpet and Rug Institute (CRI) Green Label Indoor Air Quality Test Program.

H. Carpet tiles shall be “Cradle to Cradle” (C2C) certified.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. General: Comply with Division 01.

B. Deliver and store packaged materials in original containers labels intact until time for use, with seals unbroken and store rolls in a flat position. Protect from damage, dirt, stains and moisture.

C. Do not store carpet tile near products that can off gas harmful substances.

1.05 PROJECT CONDITIONS

A. Sequencing Schedule: Do not install carpet tiles until building is entirely closed in, wet work and painting is completed, and heating system is in operation.

B. Use adhesives in strict compliance with manufacturer’s recommendations, and ventilate area with maximum outside air for a minimum of 48-hours after installation.

C. Test substrates to ensure that no dusting will occur through installed carpet tile. Apply sealer on porous concrete surfaces where required to prevent dusting.

1.06 INDOOR AIR QUALITY

A. Pre-ventilate carpet tile in well ventilated, uninhabited space for a few days prior to installation.

B. Provide maximum ventilation during installation.

C. Isolate area of installation from remainder of building.

D. Clean new carpet tile thoroughly with a high-efficiency particulate air (HEPA) filtration vacuum.

1.07 WARRANTY

A. Warrant the carpet tile to be free of defects for a period of 5-years from date of Substantial Completion. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 - PRODUCTS

2.01 CARPET TILE

A. Carpet Tile: Manufacturer, pattern and color as indicated in the Finish Legend.
Note: Indication of a specific manufacturer, product, pattern, and/or color is provided to convey design intent and is not intended to restrict the use of comparable products sourced from other manufacturers. The architect shall determine if proposed substitutions are equivalent and meet the design intent.

2.02 ACCESSORIES

A. Carpet Adhesive: VOC-compliant acrylic emulsion, solvent-free, meeting or exceeding CRI “Green Label” requirements, as recommended by carpet tile manufacturer.

B. Crack Filler: Latex base type.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas to receive carpet tiles and verify that surfaces are suitable for installation.

B. Test concrete floors for moisture with suitable moisture meter. Moisture and humidity levels shall not exceed adhesive manufacturer's recommendations, as specified in Section 09 61 43.

C. Do not begin installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Subfloor:
   1. Prior to installation, repair minor floor irregularities and thoroughly clean floor, leaving no dirt or grit.
   2. Fill cracks exceeding 1/16-inch in width with crack filler and sand smooth.
   3. Confirm compatibility of adhesive with sealers or curing agents on concrete floors.

3.03 INSTALLATION

A. Apply carpet tiles in strict accordance with manufacturer's instructions.


C. Cement carpet tiles directly to floor. Remove excess cement with approved solvent.

D. Cut evenly along walls, cut and fit evenly around projections, comers, pipes, electrical outlets, floor air or heating elements, and trim strips.

E. Securely fasten carpet edging strips to floor wherever carpet tiles meet different floor material and no threshold or other divider is noted.

F. Extend carpet tile materials under all open-bottomed and raised-bottom obstructions, and under removable flanges of obstructions. Extend carpet tiles into closets and alcoves of rooms indicated to receive carpeting, unless another material is specifically identified to be used in that space. Carpet tile shall be installed under all movable furniture and equipment.

G. Finish installation shall be free from visual defects.

H. The Owner may review carpet tile scraps and retain any he chooses. Remove remainder of scraps from site.
I. Leave carpet base and walls clean and free from stains, blemishes and other foreign material. Remove loose threads and vacuum clean.

J. Installation shall not receive furniture or heavy traffic for 48-hours after installation.

3.04 CLEAN UP

A. After completion of the carpet tile installation, remove all waste and excess materials, tools and equipment. The complete installation shall be thoroughly vacuumed, using an upright, commercial grade, beater type cleaner, and left in a clean condition. Provide all necessary temporary protection required.

3.05 WASTE MANAGEMENT

A. All scraps of unused material shall be reclaimed and recycled by the carpet tile manufacturer. Include a detailed confirmation of the material received by the manufacturer and documentation that these materials have been recycled into new flooring materials. No incineration of reclaimed materials is acceptable.

B. Provide owner with instructions for the return of carpet product to manufacturer at end of product’s life cycle for recycling. Include manufacturer’s written information for carpet recycling program.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION
A. This Section includes the requirements for furnishing and installing vinyl wall covering.

1.03 SUBMITTALS
A. General: Comply with Division 01 Submittal Procedures.
B. Product Data: Manufacturer's product data and application and installation instructions. Data shall include substantiation of VOC limitation of products in accordance with the California Green Building Standards “CalGreen” 2013.
C. Shop Drawings: Show layout and location of installation.

1.04 ENVIRONMENTAL QUALITY ASSURANCE
A. Vinyl and coatings and adhesives shall not exceed the VOC limits established in California Air Resources Board Architectural Coatings Suggested Control Measure.

1.05 JOB CONDITIONS
A. Provide packaging and any other means necessary to prevent damage or deterioration during shipment, handling, and storage.
B. Maintain protective coverings in place and in good repair until removal is necessary.
C. Maintain storage spaces and products in dry condition within temperature extremes recommended by manufacturer.
D. Follow special instructions of manufacturer.

PART 2 - PRODUCTS

2.01 Flexible Vinyl Wall Covering with Decorative Mural
A. Material: Commercial Grade Low VOC Vinyl Wall Covering, tested per CA-1350 Air Quality Standards
B. Color: Ultra-white vinyl face
C. Weight: 13 Type II, 20 oz. per lineal yd.
D. Surface Texture: Smooth Texture – Slight Sheen
E. Material Backing: Polyester non-woven (smooth)
F. Size: 52” panel widths
G. Pattern: “Aspens, Ashley National Forest, UT Mural” by Murals Your Way, or approved equal.
H. Ink: Manufacturer’s standard UV protected ink with 20-year indoor fade resistance.

2.02 MISCELLANEOUS MATERIALS
A. Primer: VOC compliant heavy-duty primer with mold and mildew inhibitors, as recommended by manufacturer for installation conditions.

B. Adhesive: Per manufacturer's recommendation. Verify VOC limit compliance.

PART 3 - EXECUTION

3.01 PREPARATION

A. Ensure surfaces are clean, smooth, dry and free of all contaminants.

B. Protect adjacent surfaces/areas from damage during installation.

C. Remove any existing loose paint and wall coverings.

D. Nail heads, nicks, gouges, and other surface imperfections shall be filled, sanded smooth and sealed.

C. Prepare wall surface with primer at least 72 hours prior to installation of wall covering.

3.02 APPLICATION

A. Install wall covering panels in accordance with manufacturer's instructions.

B. Install wall covering promptly within 24 hours of removing and unrolling from packaging.

C. Apply undiluted adhesive uniformly to entire back side of panel using the wall covering manufacturer's recommended methods.

D. Ensure a firm bond of wall covering to the wall surface, and prevent separation at seams. Do not crease the panel material.

E. Ensure that panels are aligned and matched properly so that the mural image is continuous across all panels.

F. Follow manufacturer's instructions to prevent air bubbles from forming between the wall surface and wall covering.

3.03 COMPLETION

A. Exposed surfaces shall be clean and free from scratches, dents, tool marks, stains, discoloration, fingerprints, and other defects and damage.

END OF SECTION
SECTION 09 81 00
ACOUSTIC INSULATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing acoustic insulation.

B. Related Sections:

1. Thermal insulation is specified in Section 07 21 00.
2. Roof board insulation is specified in Section 07 22 16.
3. Firestopping insulation is specified in Section 07 84 00.
4. Acoustical joint sealants are specified in Section 07 92 19.

1.02 SUBMITTALS

A. General: As specified in Division 01.

B. Product Data: Manufacturer's specifications for each type of insulation required.

1.03 QUALITY ASSURANCE

A. Fire Ratings: Comply with fire-resistance and flammability ratings specified.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Division 01.

B. Protect insulation from physical damage and from becoming wet or soiled. Comply with manufacturer's recommendations for handling, storage and protection during installation.

1.05 INDOOR AIR QUALITY

A. Protect ducts and HVAC system from loose insulation particulates.

B. Provide temporary ventilation of building areas where building insulation is being installed.

PART 2 - PRODUCTS

2.01 ACOUSTIC INSULATION

A. Formaldehyde-Free Unfaced Glass Fiber Blanket/Batt Acoustical Insulation: Acoustical insulation produced by combining glass fibers with formaldehyde-free thermosetting resins to comply with ASTM C665, Type I.

1. Surface Burning Characteristics: Maximum flame spread and smoke developed values of 25 and 50 when tested in accordance with ASTM E84.

2. Approved Manufacturers: Johns Manville "Formaldehyde-Free Sound Control Fiber Glass Batts", Owens Corning "QuietZone Acoustic Batts" or approved equal.

3. Thickness: 3-inches unless otherwise indicated.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with manufacturer's instructions for installation conditions.
B. Do not install insulation until building is sufficiently enclosed or protected against absorption of moisture by the insulation, and do not install insulation unless supporting framing and construction is in a thoroughly dry condition.

C. Install snugly between framing members with ends snugly fitted between units and against adjacent construction.

D. Carefully cut and fit insulation around pipes, conduit, and other obstructions and penetrations.

E. Where door and window frames occur in framing, cut additional strips of insulation and hand-pack as required to fill voids in and around such frames.

3.02 PROTECTION

A. Protect installed insulation from harmful exposures and from physical damage.

3.03 WASTE MANAGEMENT

A. Plan and coordinate the insulation work to minimize the generation of offcuts and waste. Remove insulation scraps to the maximum extent feasible.

B. Separate and recycle waste materials to the maximum extent possible.

END OF SECTION
SECTION 09 91 00
PAINTING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for painting and finishing of interior and exterior exposed items and surfaces.

   1. Surface preparation, priming and coats of paint specified are in addition to shop-priming and surface treatments specified in other Sections.

   2. Work includes painting exposed pipes and ducts, hangers, exposed steel and iron, and primed metal surfaces of Mechanical and Electrical equipment, and general sheet metal work, except as otherwise indicated or specified.

   3. Work includes painting hardware specified as primed (USP or 600).

   4. Work includes sanding shop-primed surfaces and applying specified primer and finish coats.

   5. "Paint" means coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

B. Surfaces Not to Be Painted:

   1. Pre-finished items, including but not limited to acoustic materials, casework, and finished mechanical and electrical equipment, including light fixtures, switchgear and distribution cabinets.

   2. Concealed surfaces such as walls or ceilings in concealed areas and inaccessible areas, furred areas, pipe spaces, and duct shafts.

   3. Finished metal surfaces such as anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials, exterior aluminum entrances, storefronts, and windows.

   4. Moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sensing devices, motor and fan shafts.

C. Following categories of work are included under other Sections:

   1. Shop priming ferrous metal items including structural steel, metal fabrications, hollow metal work and similar items. The work of this Section includes sanding and applying specified primer on all shop-primed surfaces exposed to view in the completed work.

   2. Shop priming of fabricated components such as architectural woodwork, wood casework and shop-fabricated or factory-built mechanical and electrical equipment or accessories.

   3. Piping identification is specified in Division 22.

D. Do not paint over code-required labels, equipment identification, performance rating, name, or nomenclature plates.

1.02 SUBMITTALS

A. General: Comply with Division 01.

B. Certification: Furnish certification by the paint manufacturer that products supplied comply with local regulations controlling the use of volatile organic compounds (VOCs).

C. Samples: Furnish samples of each color and material to be applied, with texture to simulate actual conditions, on representative samples of the actual substrate.
1. Provide stepped samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing samples for review. Resubmit until required sheen, color, and texture is achieved.

2. Furnish samples on the following substrates for review of color and texture only:
   
a. Painted Wood: Two 12-inch square samples of each color and material on hardboard.

D. Product Data: Specified paint systems are those of Benjamin Moore, Dunn Edwards, Frazee, Kelly Moore, Sherwin Williams and Vista. If other paint manufacturers are proposed and accepted by the Architect, furnish product comparison charts showing that proposed paint systems are equal to the specified materials in number of coats, type of paint, and sheen.

1.03 QUALITY ASSURANCE

A. Applicators Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent.

B. Single Source Responsibility: Provide primers and other undercoat paint produced by same manufacturer as finish coats. Use thinners approved by paint manufacturer, and use within recommended limits.

C. Coordination of Work: Review other Sections in which prime paints are to be provided to ensure compatibility of coatings system for various substrates. Upon request, furnish information or characteristics of finish materials to be used.

D. Requirements of Regulatory Agencies: Comply with applicable rules and regulations of governing agencies for air quality control.

1. Comply with current applicable regulations of the local air quality district, California Air Resources Board (CARB) and the Environmental Protection Agency (EPA).

2. Regulatory changes may affect the formulation, availability, or use of specified coatings. Confirm availability of coatings to be used prior to start of painting.

E. Field Samples: On interior and exterior wall surfaces provide full-coat finish samples on at least 100-sq. ft. of surface, as directed, until required sheen, color and texture is obtained; simulate finished lighting conditions for review of in-place work. Approved samples will be used as a standard for the Project.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Division 01.

B. Deliver materials to job site in original, new and unopened packages and containers bearing manufacturer's name, batch number, color, and directions.

C. Store materials in tightly covered containers. Maintain containers in a clean condition, free of foreign materials and residue.

D. Keep storage area neat and orderly. Remove oily rags and waste daily. Ensure that workers and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of paints.

1.05 JOB CONDITIONS

A. Apply water-base paints when temperature of surfaces to be painted and surrounding air temperatures are between 50-deg. F. and 90-deg. F., unless otherwise permitted by paint manufacturer's printed instructions.

B. Apply solvent-thinned paints only when temperature of surfaces to be painted and surrounding air temperatures are between 45-deg. F. and 90-deg. F., unless otherwise permitted by paint manufacturer's printed instructions.

C. Do not apply paint in rain, fog or mist, when relative humidity exceeds 85-percent, or when temperature is less than 5-deg. F. above dew point, or to damp or wet surfaces, unless otherwise permitted by paint manufacturer's printed instructions.
D. Provide adequate ventilation during interior painting using as close to 100-percent outside air as possible.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

A. Benjamin Moore, Dunn Edwards, COMEX/Frazee, Kelly Moore, Sherwin Williams, Vista or approved equal.

2.02 MATERIALS

A. Material Compatibility: Provide block fillers, primers, finish coat materials, and related materials that are compatible with one another and the substrates indicated under conditions of service and application.

B. Material Quality: Provide best quality grade of coatings as regularly manufactured by acceptable paint materials manufacturers. Materials not displaying manufacturer's identification as a standard, best-grade product will not be acceptable. Each product within any one paint system shall be from the same manufacturer.

2.03 COLORS

A. Paint colors are indicated in the Finish Legend. Colors not scheduled shall match color samples approved by Architect.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions under which painting is to be applied. Surfaces receiving paint shall be thoroughly dry before paint is applied.

   1. Provide barrier coats over incompatible primers or remove and re-prime as required. Notify Architect prior to applying barrier coats.

   2. Clean surfaces before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning.

   3. Start of painting will be construed as the applicator's acceptance of surfaces and conditions within a particular area.

3.02 PROTECTION

A. Protection: Protect work of other Sections against damage by painting and finishing work. Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.

   1. Provide "Wet Paint" signs as required to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.

   2. Remove or protect hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted, or provide surface-applied protection prior to surface preparation and painting. Following completion of painting, reinstall removed items.

   3. At completion of work of other Sections, touch-up and restore damaged or defaced painted surfaces.

3.03 SURFACE PREPARATION

A. Concrete and Masonry:

   1. Prepare surfaces to be painted by removing surface contaminants.

      a. Remove efflorescence with stiff bristle brush, wire brushing, wiping, sandblasting or acid washing and rinsing. Allow to dry.

      b. Remove chalk, dust, dirt, asphalt, tar or excessive mortar by scraping or wire brushing.
c. Remove rust, grease or oil by solvent cleaning or sandblasting.

d. Treat concrete surfaces which are highly glazed or where traces of form release agents are present with a preparation of one-part concentrated muriatic acid, 4-parts water and one-part detergent or as recommended by parting compound manufacturer. Remove acid with water. Allow to dry.

e. Remove stains on concrete resulting from weathering or corroded metals, with a solution of 2-oz. sodium methasilicate in one-gallon water. Wet stained areas with water before application of solution. Allow to dry.

B. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.

1. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dry.

2. Prime, stain, or seal wood to be painted immediately upon delivery. Prime edges, ends, faces, undersides, and backsides of wood, including cabinets, counters, cases, and paneling.

3. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately upon delivery.

C. Ferrous Metal: 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 recommendations of The Society for Protective Coatings (SSPC).

1. Blast surfaces clean as recommended by the paint system manufacturer and according to requirements of SSPC specification SSPC-SP 10.

2. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.

3. Sand shop-applied prime coats to a smooth surface, ready to receive specified primer and finish coats.

D. Galvanized Metals:

1. Clean galvanized metal with an appropriate metal prep and passivator remover.

2. Perform the following test to ensure passivator removal:

   a. With a 5-percent copper sulfate solution, place a swab or droplets on the prepared area. If the copper sulfate causes the galvanized coating to blacken, passivator has been removed and the surface is ready for paint application.

   b. If the copper sulfate has no effect on the galvanized coating, continue with metal prep solution or use a scotch pad to abrade it, being careful not to remove the galvanizing.

3. Document the process and successful passivator removal with photographs.

E. Gypsum Board: Clean surfaces of dust, dirt, grease, oil and other foreign matter and dust clean.

F. Existing Surfaces to be Repainted: Thoroughly clean and de-gloss surfaces to be repainted by sanding or other means prior to painting. Patched and bare areas shall be shop-primed with same alkyd primer as specified for new work.

3.04 MATERIALS PREPARATION

A. Mix and prepare painting materials in accordance with manufacturer’s directions.

B. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.
C. Stir materials before application to produce a mixture of uniform density, and stir as required during application. Do not stir surface film into material. Remove film and strain material before using.

D. Use thinners approved by paint manufacturer and only within recommended limits.

E. Tinting: Tint each undercoat a lighter shade to facilitate identification of each coat where multiple coats of the 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.

3.05 APPLICATION

A. General: Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Provide finish coats compatible with prime coats.

2. The number of coats required is the same regardless of the application method. Do not apply following coats until the previous coat has cured as recommended by the manufacturer. Sand between applications where required to produce a smooth even surface.

3. Apply additional coats when undercoats, stains or other conditions show through final coat, until paint film is of uniform finish, color and appearance. Edges, corners, crevices, welds, and exposed fasteners shall receive a dry film thickness equivalent to that of flat surfaces.

4. Paint surfaces behind movable equipment and furniture.

5. Paint surfaces behind permanently-fixed equipment or furniture with prime coat before final installation of equipment.

6. Paint visible surfaces of ducts where visible through registers or grilles with a flat, non- specular black paint.

7. Paint back sides of access panels, and removable or hinged covers to match exposed surfaces.

8. Finish doors on top, bottom and side edges same as faces. Where openings into rooms have different finishes, finish door edges as directed by the Architect.

9. Omit primer on metal surfaces that have been shop-primed and touch-up painted, unless otherwise indicated.

B. Scheduling Painting: Apply first-coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation.

1. Allow sufficient time between successive coatings to permit proper drying.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's instructions.

1. Brushes: Use brushes best suited for the material applied.

2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.

3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.

D. Minimum Coating Thickness: Apply materials at not less than manufacturer's recommended spreading rate.

E. Mechanical and Electrical Work: Painting mechanical and electrical work is limited to items exposed in mechanical equipment rooms and in occupied spaces. Finish to match adjoining wall or ceiling surfaces.
1. Mechanical items to be painted include, but are not limited to, piping, hangers, and supports; heat exchangers; tanks; ductwork; insulation; supports; motors and mechanical equipment; air grilles and diffusers; and accessory items.

2. Electrical items to be painted include, but are not limited to conduit and fittings, panels, and switchgear.

F. Block Filler: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores completely filled flush, free of pinholes. Provide multiple coats if required.

G. Prime Coats: Before applying finish coats, apply a prime coat. Re-coat primed and sealed surfaces where there is evidence of suction spots or unsealed areas to assure a finish coat with no burn-through or other defects.

H. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness and other surface imperfections will not be acceptable.

I. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.

3.06 FIELD QUALITY CONTROL

A. The Owner reserves the right to invoke the following test procedure at any time and as often as the Owner deems necessary during painting.

1. The Owner will engage the services of an independent testing agency to sample the paint material being used. Samples of material delivered to the Project will be taken, identified, sealed, and certified in the presence of the Contractor.

2. The testing laboratory will perform appropriate tests for material analysis, abrasion resistance, reflectivity, flexibility, washability, absorption, accelerated weathering, dry opacity, accelerated yellowness, recoating, skinning, color retention, alkali and mildew resistance, and application to specified mil thickness.

3. If test results show material being used does not comply with specified requirements, the Contractor may be directed to stop painting, remove non-complying paint, pay for testing, repaint surfaces coated with rejected material, and remove rejected material from previously painted surfaces if, upon repainting with specified paint, the two coatings are incompatible.

3.07 CLEANING

A. Clean-Up: During progress of work, remove discarded paint materials, rubbish, cans and rags at end of each work day.

B. Upon completion of painting work, clean window glass and other paint-spattered surfaces. Remove spattered paint by washing and scraping; do not scratch or damage finished surfaces.

3.08 EXTERIOR PAINT SCHEDULE

<table>
<thead>
<tr>
<th>BENJAMIN MOORE</th>
<th>DUNN-EDWARDS</th>
<th>FRAZEE/COMEX</th>
<th>KELLY-MOORE</th>
<th>SHERWIN WILLIAMS</th>
<th>VISTA</th>
<th>MPI CATEGORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Ferrous Metal, 100% Acrylic Semigloss</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First Coat</td>
<td>Acrylic Metal Primer M04</td>
<td>Bloc-Rust BRPR00</td>
<td>561 Acrylic Metal Primer</td>
<td>5725 DTM Acrylic Primer/Finish</td>
<td>ProCryl B66-310 Acrylic Primer</td>
<td>9600 Protec Metal Primer</td>
</tr>
<tr>
<td>Second Coat</td>
<td>Aura Exterior Semi-Gloss #632</td>
<td>EVSH50 Evershield SG</td>
<td>124 Miro Glide SG</td>
<td>1250 Acry-Shield</td>
<td>A-100 A8 Seligmigl</td>
<td>7500 Acriglo Semi Gloss</td>
</tr>
<tr>
<td>Third Coat</td>
<td>Aura Exterior Semi-Gloss #632</td>
<td>EVSH50 Evershield SG</td>
<td>124 Miro Glide SG</td>
<td>1250 Acry-Shield</td>
<td>A-100 A8 Seligmigl</td>
<td>7500 Acriglo Semi Gloss</td>
</tr>
<tr>
<td>B. Galvanized and Zinc Alloy Metal, 100% Acrylic Semigloss</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretreatment</td>
<td>Etch</td>
<td>ME-01 Etch</td>
<td>Jasco Prep N’ Prime</td>
<td>Jasco Prep N’ Prime</td>
<td>B711Y1 DTM Wash Primer</td>
<td>Jasco Prep N’ Prime</td>
</tr>
<tr>
<td>First Coat</td>
<td>Fresh Start Acrylic Primer</td>
<td>Ultragrip Premium</td>
<td>561 Acrylic Metal Primer</td>
<td>5725 DTM Acrylic</td>
<td>ProCryl B66-310 Prime</td>
<td>4800 Metal Pro Primer</td>
</tr>
</tbody>
</table>
### C. Plaster, 100% Acrylic Flat

<table>
<thead>
<tr>
<th>First Coat</th>
<th>Second and Third Coats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aura Exterior Semi-Gloss #636</td>
<td>Aura Exterior Flat 629</td>
</tr>
<tr>
<td>EVSH10 Evershield Flat</td>
<td>EVSH10 Evershield Flat</td>
</tr>
<tr>
<td>124 Miro Glide SG</td>
<td>124 Miro Glide SG</td>
</tr>
<tr>
<td>1250 Acry-Shield</td>
<td>1250 Acry-Shield</td>
</tr>
<tr>
<td>A-100 A8 Semigloss</td>
<td>A-100 A6 Flat</td>
</tr>
<tr>
<td>7500 Acriglo Semi Gloss</td>
<td>2800 Acriglo</td>
</tr>
<tr>
<td>11</td>
<td>10</td>
</tr>
</tbody>
</table>

### D. Concrete, 100% Acrylic Flat

<table>
<thead>
<tr>
<th>First Coat</th>
<th>Second and Third Coats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh Start Acrylic Primer N023</td>
<td>Aura Exterior Flat 629</td>
</tr>
<tr>
<td>ESPRO00 Eff-Stop Primer</td>
<td>EVSH10 Evershield Flat</td>
</tr>
<tr>
<td>266 Epotit Primer</td>
<td>203 Duratec</td>
</tr>
<tr>
<td>247 Acry-Shield</td>
<td>1240 Acry-Shield</td>
</tr>
<tr>
<td>A24W300 Luxon Primer</td>
<td>A-100 A6 Flat</td>
</tr>
<tr>
<td>2800 Acriglo</td>
<td>2800 Acriglo</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
</tr>
</tbody>
</table>

### E. Concrete Block, 100% Acrylic Flat

<table>
<thead>
<tr>
<th>First Coat</th>
<th>Second and Third Coats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latex Block Filler 244</td>
<td>Aura Exterior Flat 629</td>
</tr>
<tr>
<td>SBSL00 Smooth Block Fil</td>
<td>EVSH10 Evershield Flat</td>
</tr>
<tr>
<td>262 Acrylic Block Filler</td>
<td>203 Duratec</td>
</tr>
<tr>
<td>521 Color Shield</td>
<td>1240 Acry-Shield</td>
</tr>
<tr>
<td>B25W25 Prep Rite Block Filler</td>
<td>A-100 A6 Flat</td>
</tr>
<tr>
<td>040 Acrylic Block Filler</td>
<td>2800 Acriglo</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
</tr>
</tbody>
</table>

### 3.09 INTERIOR PAINT SCHEDULE

<table>
<thead>
<tr>
<th>BENJAMIN MOORE</th>
<th>DUNN-EDWARDS</th>
<th>FRAZEE/COMEX</th>
<th>KELLY-MOORE</th>
<th>SHERWIN WILLIAMS</th>
<th>VISTA</th>
<th>MPI CATEGORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Wood, 100% Acrylic Low Odor/Zero VOC Semigloss</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First Coat</td>
<td>Eco Spec WB Primer N372</td>
<td>UGS000 Ultragrip Select</td>
<td>C153 UltraTech</td>
<td>973 Acry-Plex</td>
<td>ProMar 200 Zero B28-200 Primer</td>
<td>5001 V-Pro Primer</td>
</tr>
</tbody>
</table>

| B. Concrete and Plaster, Acrylic Low Odor/Zero VOC Flat |
| First Coat | Eco Spec Latex Primer Sealer N372 | Ultra-Grip Select UGS000 | C153 UltraTech | 971 Acry-Plex | ProMar 200 Zero B28-2600 Primer | 5001 V-Pro Primer | 50 |
| Second and Third Coats | Eco Spec Latex Flat 373 | SZR010 Sparta-Zero Flat | C171 UltraTech Zero | 1005 KM Professional Zero Flat | ProMar 200 Zero B30xw2600 Flat | 5100 V-Pro Flat | 143 |

| C. Concrete and Plaster, 100% Acrylic Low Odor/Zero VOC Low Sheen/Eggshell |
| First Coat | Eco Spec Latex Primer Sealer N372 | Ultra-Grip Select UGS000 | C153 UltraTech | 971 Acry-Plex | ProMar 200 Zero B28x2600 Primer | 5001 V-Pro Primer | 50 |

| D. Concrete and Plaster, 100% Acrylic Low Odor/Zero VOC Semigloss |
| First Coat | Eco Spec Latex Primer Sealer N372 | SBSL00 Smooth Block Fil | C153 UltraTech | 973 Acry-Plex | ProMar 200 Zero B28-2600 Primer | 5001 V-Pro Primer | 50 |

| E. Concrete Block, Acrylic Low Odor/Zero VOC Flat |
| First Coat | PPG 6-15 Masonry Block Filler | SBSL00 Smooth Block Fil | C102 UltraTech Acrylic Block Filler | 521 Color Shield | B25W25 Prep Rite Block Filler | 040 Acrylic Block Filler | 4 |
3.10 WASTE MANAGEMENT

A. Set aside extra paint for future color matches, or reuse by Owner. Habitat for Humanity, etc. Where paint recycling is available, collect all waste paint by type and provide for delivery to recycling or collection facility.

B. Close and seal tightly all partly used paint and finish containers and store protected in well-ventilated fire-safe area at moderate temperatures.
C. Place empty containers of solvent based paints in areas designated for hazardous materials.

D. Do not dispose of paints or solvents by pouring on the ground. Place in designated containers for proper disposal.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION
   A. This Section describes the requirements for furnishing and installing epoxy coatings at shop and pit area floors.
   B. Related Sections:
      1. Painting is specified in Section 09 91 00.
      2. Elastomeric coatings are specified in Section 09 97 23.

1.02 SUBMITTALS
   A. General: Comply with Division 01.
   B. Samples:
      1. Manufacturer's standard color samples for initial color selections.
      2. Minimum 12-inch square samples of epoxy coating material for verification of initial selections, showing applied thickness, texture and color.
   C. Product Data: Furnish complete description of each coating proposed describing its composition and limitations. Include information on VOC emission levels.

1.03 QUALITY ASSURANCE
   A. Applicator: Epoxy coating materials shall be installed by an applicator approved and endorsed by the materials manufacturer.
   B. Requirements of Regulatory Agencies: Comply with applicable rules and regulations of governing agencies for air quality control.
   C. Pre-Installation Conference: Just prior to application of coating, meet at the Project site with the representative of the coating manufacturer, installer, Contractor, and other parties affected by the application. Review methods and procedures including, but not limited to, substrate conditions, drains, penetrations, construction scheduling and availability of materials, inspection, testing, and certification procedures.

1.04 JOB CONDITIONS
   A. Proceed with work only after substrate construction and penetrating work have been completed.
   B. Proceed with installation when conditions will permit work to proceed in accordance with manufacturer's recommendations.
   C. Maintain temperature between 55-deg. F and 100-deg. F before and during application. Surfaces shall be dry and at least 5-deg. above dew point. Maintain curing temperature for 7-days.
   D. Maintain relative humidity below 85-percent. Provide forced-air ventilation as recommended by coating manufacturer.
   E. Do not permit smoking, open flame, or spark producing equipment in areas of application.

1.05 PRODUCT DELIVERY AND STORAGE
   A. General: Comply with Division 01.
   B. Deliver materials in unopened containers with manufacturer's name and product designation clearly indicated.
C. Store materials in strict accordance with manufacturer's recommendations.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURER

A. Crossfield Products “Dex-O-Tex Flex-Shield” or approved equal.

2.02 MATERIALS

A. Epoxy Coating: Troweled flexibilized urethane epoxy specialty flooring.
   1. Color: As selected by the Architect from manufacturer’s standard colors.
   2. Physical Properties:
      b. Tensile Modulus: 17,150-psi.
      c. Tensile Elongation: 96-percent.
      d. Tear Strength: 120-lb/in.
      e. Bond Strength, ACI #403: 400-psi.
      f. Surface Hardness, ASTM D2240: 55 Shore D.
      g. Chemical Resistance, ASTM D1308:
         - Gasoline: No Effect
         - Kerosene: No Effect
         - Skydrol: No Effect
         - Isopropyl Alcohol: No Effect
         - Toluene: No Effect
         - Hydrogen Peroxide: Slight Stain
         - Hydrochloric Acid (25%): No Effect

B. Finish Coat: Aliphatic poly-urea as recommended for specific Project requirements.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine the areas and conditions where the epoxy coating system is to be installed and notify the Architect of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

B. Evaluate level of moisture in the substrate in compliance with ASTM F1869 or ASTM F2170 and as specified in Section 09 61 43.

3.02 PREPARATION

A. Perform preparation and cleaning procedures according with SSPC-SP 13 and flooring manufacturer’s instructions. Provide clean, dry and neutral substrate for application.

B. Concrete Surfaces: Shot-blast or power scarify as required to obtain optimum bond of flooring to concrete. Remove sufficient material to provide a sound surface free of laitance, glaze, oil, and other penetrating contaminants. Repair damaged and deteriorated concrete to acceptable condition. Leave surface free of dust, dirt, laitance, and efflorescence.
Materials: Mix resin hardener and aggregate when required, and prepare materials according to flooring system manufacturer’s instructions.

3.03 APPLICATION

A. General: Apply each component of the flooring system according to the manufacturer’s instructions to produce a uniform monolithic flooring surface of the required thickness.

B. Bond Coat: Apply bond coat over the prepared substrate at the manufacturer’s recommended spreading rate.

C. Body Coat: Over primer, trowel apply flexibilized urethane epoxy mix at nominal 5/64-inch thickness. Broadcast appropriate aggregates into the wet base coat to an even and uniform surface profile.

D. Finish Coat: Apply top coat finish coating over the cured and prepared body coat. Apply finish coat in two successive applications. Provide a uniform even final finish.
   1. Final finish coat shall be color and skid retardant profile as approved by the Architect.
   2. Finished floor shall be 1/8-inch thick, uniform in color and free of trowel marks.

E. Cove Base: Apply cove base mix to wall surfaces at locations indicated to form cove base height of 4-inches unless otherwise indicated. Follow the manufacturer’s printed instructions and details including taping, mixing, priming, troweling, sanding, and top-coating of cove base.

3.04 CURING

A. Cure the flooring in accordance with the manufacturer’s directions. Close the application area for a minimum of 24-hours.

3.05 CLEANUP AND PROTECTION

A. Remove spilled and splattered materials immediately as work progresses.

B. Protect the installation as required to ensure that the work will be without damage or deterioration at the time of final acceptance and after completion of other construction work.

3.06 REPAIRS

A. Where imperfections, discontinuities or surface defects are present, mask areas, mechanically abrade and apply additional spot finish coat as required. Patched areas shall be indistinguishable from adjacent surfaces after curing.

B. If coating defect involves significant void or holiday, or if film has been damaged to the substrate, mask of affected area and spot abrasive blast. Apply successive coats as specified for original coating. Patched areas shall be indistinguishable from adjacent surfaces after curing.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section includes the requirements for surface refinishing of tile for vertical and horizontal surfaces.

1.01.1 REFINISHING CONTRACTOR REQUIREMENTS

A. Contractor company must have a proven track record and substantiated performance from commercial and institutional facilities that have used their refinishing process and must present references from said institutions upon request.

B. All refinishing of tile vertical and horizontal surfaces will utilize a surface refinishing process that creates a membrane over the surface and penetrates porous surfaces, i.e. grout and binds its components together.

C. The process must not include the use of hydrofluoric acids to etch the surface and potentially expose contaminants to the air.

D. All technicians must have completed a certified training and safety program specific to the surface refinishing system being used.

E. The refinishing company must be able to provide the architect with choices of colors, finishes, and textures.

1.01.2 DEFINITIONS

A. Surface Refinishing: the restoration of an existing vertical or horizontal surfaces, consisting of porcelain, tile, fiberglass, cultured marble, laminate, acrylic, terrazzo or concrete block, to like new. May also be referred to as surface restoration or re-glazing.

B. Clear coat: An application of an abrasive, water and chemical resistant urethane to create a watertight seal over the color finish.

1.03 SUBMITTALS

A. General: Comply with Division 01 Submittal Procedures.

B. Product Data: Manufacturer's product data and application and installation instructions. Data shall include substantiation of VOC limitation of products in accordance with the California Green Building Standards “CalGreen” 2013.

C. Shop Drawings: confirm layout and location of installation.

D. Mock-up: A sample of what the finished product will look like to be provided by the refinishing company and approved by the architect.

E. Pre-Installation Conference: Just prior to application of surface refinishing system, meet at the project site with the representative of the system manufacturer, installer, contractor, and other parties affected by the application. Review methods and procedures including, but not limited to, substrate conditions, penetrations, construction scheduling, and availability of materials, inspection, testing, and certification procedures.

F. Manufacturer’s 1-year warranty against peeling or failure of adhesion.

1.04 ENVIRONMENTAL QUALITY ASSURANCE

A. Comply with applicable rules and regulations of governing agencies for air quality control.
1.05 JOB CONDITIONS
   A. Proceed with work only after substrate preparation and penetrating work have been completed.
   B. Proceed with installation when conditions will permit work to proceed in accordance with manufacturer’s recommendations.
   C. Maintain temperature and humidity conditions in accordance with the manufacturer’s requirements for application of the product.
   D. Do not permit smoking, open flame, or spark producing equipment in areas of application.

PART 2 - PRODUCTS
2.01 SECTION INCLUDES
   A. Cleaners
   B. Bonding Agent
   C. Sealing Epoxy
   D. Primers
   E. Decorative Topcoat System
   F. Clear Coats

2.02 CLEANERS
   A. Surface must be cleaned using a two-step process to physically and chemically remove soap film, scale, mineral deposits, oils, grease, and organic compounds. The two-step cleaners must create a neutral PH surface, which is critical to the bonding process.

2.03 BONDING AGENT
   A. A bonding agent, i.e. Miracle Method’s MM-4 or approved equal (no known equal), specifically engineered to work on glazed ceramic tile is required. The bonding agent should have an epoxy component that will ensure adhesion, or “bonding” on any hard surface, particularly glazed surfaces. Etching acids, such as hydrofluoric acid are not an acceptable substitute for a proven bonding agent.

2.04 SEALING EPOXY
   A. A sealing epoxy, i.e. Miracle Method’s “Mira Seal” or approved equal (no known equal), that will provide a secure membrane is required. Must be suitable for wet environments.

2.05 PRIMERS
   A. A two-component, fast dry, high build polyamide epoxy primer, tinted as needed to achieve desired color, is required with a 4-5 mil wet and 3.5 mil dry thickness when applied.

2.06 DECORATIVE TOPCOAT SYSTEM
   A. Miracle Method’s “Natural Accents”, or approved equal (no known equal). Multicolor topcoat system containing modified polymer particles suspended within a modified Terpolymer water phase composite. The product should be ready-to-spray using HVLP spray equipment. Adjustments to viscosity may be made with water, not to exceed 5% of total volume

2.07 CLEAR COATS
   A. The required solvent-based, multi-component, satin finish urethane clear coat is critical to the durability of the final product. It must meet the following requirements:
PART 3 - EXECUTION

3.01 SURFACE PREPARATION AND APPLICATION

A. Protect adjacent surfaces/areas from damage during application.

B. Mask adjacent surfaces to protect from overspray.

C. Remove old caulk.

D. Set up UL approved exhaust fan and tubing (min 2000 cubic feet per minute) to vent odor and overspray safely out of the area.

E. Wear protective clothing and use a fresh air respirator.

F. Use two-step cleaning process to remove all mineral deposits, soap scum, dirt, and oils from the existing surface. Use cleaners that ensure the necessary neutral PH level for proper adhesion of the finish coats.

G. Fill and repair any holes, cracks, or chips in the tile surface that can be felt with a fingernail, including, but not limited to, holes left from removal of toilet room accessories and fixtures.

H. Do not use etching acids or any form of hydrofluoric acid.

I. Apply bonding agent to ensure adhesion of new coating on tile surface. The bonding agent consists of two components to create a chemical bond between the old surface and the new finish. Bonding agent will dry in less than two minutes after application.

J. Apply two coats of appropriately tinted primer over the bonding-agent bonded surface.

K. Spray on 4-6 mils of acrylic enamel in 3-4 coats using a High Volume Low Pressure (HVLP) fine finish spray rig. Finish should be uniform in appearance and gloss without any runs, drips, rough spots, or orange peel. Color to match architect’s selected finish.

L. Allow coating to cure per manufacturer’s recommendations, and hi-speed buff and polish finish as necessary to remove any dust bumps or imperfections. Finish should be smooth to the touch.

M. Remove masking paper and clean the jobsite.

N. Re-caulk as needed with mold-resistant silicone caulking.

3.02 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the coating’s manufacturer. Minimum 60 degrees (f).

B. Follow coating manufacturer’s recommended procedure for masking, cleaning, ventilation, use of product, repairs, and application of primer and topcoats.

C. Provide a lighting level of at least 80 ft. candles measured mid-height at substrate surface.

D. Water and electricity must be available on site.

3.03 SAFETY
A. Installer will conform to all safety guidelines and parameters required by the architect or contractor and must provide architect or contractor with MSDS sheets and a copy of its respiratory safety program upon request.

B. Technicians are required to wear gloves, safety goggles, and use the respirator equipment as outlined in the manufacturer's safety manual during the refinishing process.

C. Technicians may be required to adhere to additional safety standards as dictated by the general contractor.

3.04 COMPLETION

A. Exposed surfaces shall be clean and free from scratches, dents, tool marks, stains, discoloration, fingerprints, and other defects and damage.

END OF SECTION
SECTION 09 96 69
ELECTROSTATIC PAINTING

PART 1 - GENERAL

1.01 DESCRIPTION
A. This Section describes the requirements for electrostatic painting of existing metal lockers.
B. Related Sections:
   1. Painting is specified in Section 09 91 00.

1.02 SUBMITTALS
A. General: Comply with Division 01.
B. Product Data: Manufacturer's technical information including paint label analysis and application instructions for each material proposed for use.
C. Furnish two 12-inch square samples of each color, sheen and finish texture to simulate actual conditions. Samples will be reviewed by the Owner's Representative for color and finish only.

1.03 QUALITY ASSURANCE
A. Work shall be done by painters experience in electrostatic painting.
B. Spraying equipment shall be first quality and made especially for electrostatic painting.
C. Paints and painting materials shall be produced by the same manufacturer.

1.04 PROJECT CONDITIONS
A. Comply with manufacturer's recommendations for environmental conditions under which coatings can be applied.
B. Take necessary safety precautions for proper ventilation, respirators, and eye shields.

PART 2 - PRODUCTS

2.01 MATERIALS
A. Approved Manufacturer: Dunn Edwards.
B. After surface preparation wash lockers in "Metal-Prep" to remove all oils, grease, waxes, etc.

   Wash: Metal-Prep
   Primer: #IP520 Red Oxide
   Finish: Ultrashield #IP630 2 part polyurethane, finish coat thickness 1.5-mils.

PART 3 - EXECUTION

3.01 PREPARATION
A. Examine surfaces and conditions under which electrostatic painting is to be applied. The starting of work shall be construed as acceptance of the surfaces and conditions.
B. Prior to surface preparation, remove all hardware.

C. Remove existing finish as required to ensure proper adhesion of new finish. Remove rust and repair voids, nicks, cracks, dents and holes with a suitable patching material and finish flush to adjacent surfaces. Feather edges around all areas. All surfaces shall be sanded to a smooth finish.

3.02 SPRAY PAINTING

A. Spray painting shall be done off the site. Prior to any touch-up work, consult with the Owner's Representative to determine any conditions or limitations which the Owner may have regarding spray painting. Obtain written approval from the Owner.

3.03 FINISH

A. All surfaces, both exposed and in place non-exposed surfaces shall receive electrostatic paint finish.

B. Number of Coats: Primer and 1 finish coat.

C. Colors: As selected by the Architect.

END OF SECTION
SECTION 09 97 23
ELASTOMERIC COATINGS

PART 1 - GENERAL

1.01 DESCRIPTION
A. This Section includes two-component elastomeric polyuria lining system on walls and ceiling of the Chassis Wash area.

1.02 SUBMITTALS
A. General: Comply with Division 01.
B. Product data for coatings, primer, and accessories. Include material safety data sheets (MSDSs) and certifications showing compliance with specified standards.
C. Manufacturer’s color chart for selections by Architect.
D. Manufacturer’s instructions for installation and maintenance.
E. Warranty.

1.03 QUALITY ASSURANCE
A. Installer qualifications: 5-years’ successful experience applying waterproofing and acceptable to manufacturer for installing their products.

1.04 FIELD SAMPLE
A. Apply elastomeric coating to cast-in-place concrete substrate where directed by the Architect to demonstrate performance and appearance.
   1. Minimum size: As directed by the Architect.
   2. Conduct tests in accordance with ASTM D4541 to verify adhesion of installed primer and top coat to prepared substrate. Test at least 3 specimens and report results to Architect.
   3. Accepted sample may remain as part of work and will be used as basis for acceptance of remaining sealant work. Unacceptable samples shall be removed.
B. Do not proceed with application of elastomeric coating until test panel has been successfully tested and approved.

1.05 PRE-INSTALLATION CONFERENCE
A. Convene a pre-installation conference at the site prior to applying elastomeric coatings.
B. Require attendance of entities directly concerned with wall substrate and elastomeric coating.
C. Review:
   1. Schedule for applying elastomeric coatings.
   2. Environmental regulations.
4. Protection of surrounding surfaces.
5. Approved field sample will be used as a measure of acceptance.
6. Weather conditions forecast.
7. Other items related to successful execution of work.

1.06 PRODUCT HANDLING

A. General: Comply with Division 01.
B. Deliver products in manufacturer’s original containers clearly labeled with product identification, date of manufacture, and shelf life.
C. Store materials in clean, cool, dry area at temperatures between 34- and 90-degrees F.
D. Do not use elastomeric coating and primer after manufacturer’s stated shelf life.

1.07 PROJECT CONDITIONS

A. Do not install elastomeric coating during inclement weather, strong winds, or when such conditions are expected. Allow wet surfaces to dry.
B. Do not apply when temperature is expected to fall below 40-degrees F. or humidity is expected to exceed 90-percent within next 24-hours.

1.08 WARRANTY

A. Warrant silicone elastomeric coating materials to be free from defects in materials and workmanship for a period of 10-years from date of Substantial Completion. This warranty is in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

A. Rhino Linings “Rhine Extreme 21-50” or approved equal.

2.02 MATERIALS

A. Elastomeric Coating: Two-component, rapid curing, elastomeric pure polyurea lining system designed to be sprayed with high pressure plural component spray equipment. Color as selected by the Architect.

1. Hardness (Shore D), ASTM D2240: 50 +/- 5.
5. Water Absorption – 24 hours, ASTM D570: Not more than 1.5 percent.
PART 3 - EXECUTION

3.01 SURFACE PREPARATION

A. Surfaces shall be clean, dry, sound, and free of frost and contamination, such as mildew, dirt, grease, oils, salts, efflorescence and other contamination that may affect adhesion.

B. Coordinate installation with adjacent work to ensure proper sequence of construction. Protect adjacent areas and landscaping from contact due to mixing, handling, and installation.

3.02 MIXING

A. Mix products in accordance with manufacturer's instructions.

3.03 APPLICATION

A. Apply primer to prepared substrate in accordance with manufacturer's instructions.

3.04 PROTECTION

A. Provide protection of installed materials from water infiltration into or behind.

B. Protect applied materials from dust, dirt, precipitation, freezing and continuous high humidity until they are fully cured.

END OF SECTION
SECTION 10 11 00

VISUAL DISPLAY SURFACES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing the following types of visual display surfaces:

1. Porcelain enamel markerboards
2. Enclosed Cork Boards

1.02 SUBMITTALS

A. General: Comply with Division 01 Submittal Procedures.
B. Product Data: Manufacturer's technical data and installation instructions for each material and component part, including data substantiating that materials comply with specified requirements.
C. Shop Drawings: Include sections of typical trim members and dimensioned elevations. Show anchors, grounds, reinforcement, accessories, layout and installation details.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

B. Enclosed Cork Board: Norwood Commercial Furniture, Ghent, Claridge Products and Equipment, or approved equal.

2.02 MARKERBOARDS

A. Porcelain Enamel Markerboards: Provide balanced, high-pressure-laminated porcelain enamel markerboards of 3-ply construction consisting of face sheet, core material, and backing.

1. Face Sheet: 24-gauge enameling grade steel, exposed face coated with primer, ground coat, and color cover; concealed face coated with primer and ground coat. Cover coat shall be manufacturer's special writing surface with gloss finish intended for use with liquid felt-tipped markers.
2. Core: 3/8-inch thick particleboard or 1/4-inch thick tempered hardboard.
3. Backing Sheet: 0.015-inch thick aluminum sheet.

B. Metal Trim and Accessories: Minimum 0.062-inch thick aluminum. Provide straight, single-length units wherever possible. Miter corners to a neat, hairline closure.

1. Field-Applied Trim: Manufacturer's standard snap-on trim, with no visible screws or exposed joints.
2. Chalktray: Manufacturer's standard continuous solid extrusion-type with ribbed section and smoothly curved exposed ends.

C. Finish aluminum trim and accessories with clear anodized finish.
C. Furnish each markerboard with 12 assorted color markers and a felt eraser.

2.03 ENCLOSED CORK BOARD

A. Frame: 96" x 48" frame with (3) lockable door panels.
   1. Swing-open door panels consist of a wood or metal frame with shatter resistant clear acrylic lenses.
   2. Door panels shall include locking hardware provided by the cork board manufacturer.
   3. Frame color/material to be selected by architect from manufacturer’s standard finish options.
   4. Frame shall be of a type designed for wall-mounted installation with mounting holes located at the rear of the display.

B. Back: Plywood with self-healing tackable surface of ¼" cork.

2.04 FABRICATION

A. Porcelain Enamel Markerboards: Laminate facing sheet and backing sheet to core material under pressure with flexible, waterproof adhesive.

B. Provide factory-assembled units unless otherwise acceptable to the Architect.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Deliver factory-built units completely assembled in one piece without joints.

B. Install units as indicated and in accordance with manufacturer’s instructions. Maintain perimeter lines straight, plumb, and level. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories required for installation.

3.02 ADJUST AND CLEAN

A. Verify that accessories required for each unit have been properly installed and that operating units function properly.

B. Clean units in accordance with manufacturer’s instructions.

END OF SECTION
SECTION 10 14 00
SIGNAGE

PART 1 - GENERAL

1.01 DESCRIPTION
A. This Section describes the requirements for furnishing and installing the following types of signs:
   1. Internally illuminated dimensional letters and numbers.
   2. Accessibility entrance signs.
   3. Parking stall accessibility symbols and signs.
   4. Unauthorized vehicle signs.
   5. Toilet room entry signs.
   6. Room identification signs.
   7. Tactile exit signs.
   8. International symbol of accessibility.

B. Related Sections:
   1. Electrical is specified in Division 26.

1.02 SUBMITTALS
A. General: Comply with Division 01.
B. Product Data: Manufacturer's construction details relative to materials, dimensions of individual components, profiles, and finishes for each type of sign required.
C. Shop Drawings: Furnish shop drawings for fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show anchors, grounds, reinforcement, accessories, layout, and installation details.
   1. Furnish message list for each sign required, including large scale details of wording and layout of lettering.
   2. For signs supported by or anchored to permanent construction, furnish setting drawings, templates, and directions for installation of anchor bolts and other anchors.
   3. Furnish full-size spacing templates for individually mounted dimensional letters and numbers.
D. Samples: Furnish samples of each exposed material, including letters and other graphics, showing finish, color, and qualities of fabrication and design.

1.03 QUALITY ASSURANCE
A. Comply with California Building Code (CBC) Section 11B-703.

PART 2 - PRODUCTS
2.01 MATERIALS AND FABRICATION
A. Acrylic Sheet: Transparent, clear, semi-matte or non-glare, thickness specified.
B. Aluminum Sheet: Alloy and temper recommended by the aluminum producer or finisher for the type of use and finish indicated and specified.

C. Aluminum Extrusions: Alloy and temper recommended by the aluminum producer or finisher for the type of use and finish indicated and specified.

D. Stainless Steel Plate, Sheet, and Strip: Provide stainless steel plate, sheet, or strip, AISI Type 302, complying with ASTM A167.

E. Fasteners: Use concealed fasteners fabricated from metals that are not corrosive to the sign material and mounting surface.

F. Colored Coatings for Acrylic Plastic Sheet: Use colored coatings, including inks and paints for copy and background colors that are recommended by acrylic manufacturer for optimum adherence to acrylic surface and are non-fading for the application intended.

G. Interior Signage:
   1. Signs shall be sign manufacturer’s standard one piece photopolymer sign face with tactile Braille and letters or acrylic sign face with applied tactile lettering and Braille, at manufacturer’s option, and shall be interior rated.
   2. Sign materials and fabrication shall comply with applicable CBC and ADA signage requirements.
   3. Sign Finish: Eggshell, matte, or non-glare as selected by the Architect.
   4. Copy: 5/8-inch minimum, 2-inch maximum as recommended by sign manufacturer for required copy, raised minimum 1/32-inch.
   5. Letters: San Serif, style as indicated or as selected by the Architect.
   6. Braille: Contracted Grade 2 Braille complying with CBC Section 1117B.5.6.
   7. Mounting: Tamper-resistant mechanical fasteners.

2.02 SIGN SUMMARY

A. Cutout Letters and Numbers:
   1. Cut letters and numbers from aluminum plate material with translucent acrylic illuminated lens. Product precisely cut characters with square cut, smooth edges.
   2. Finish: As selected by the Architect.
   3. Provide uniform internal LED illumination and photo-sensor switch.

B. Entrance Signs:
   1. All building entrances that are accessible to and useable by physically disabled persons shall be identified with at least one standard accessibility symbol sign and with additional directional signs as required, to be visible to persons along approaching pedestrian ways.
   2. Comply with CBC Section 11B-216.6.

C. Parking Stall Accessibility Symbols and Signs:
   1. Each parking space reserved for the handicapped shall have a surface identification outlining a profile view of a wheelchair with occupant in white on blue background, 36-inches high x 36-inches wide.
      a. Comply with CBC Section 11B-502.6.
2. Provide a reflectorized sign permanently posted immediately adjacent to and visible from each parking stall or space reserved for the handicapped, consisting of a profile view of a wheelchair with occupant in white on blue background. Size shall be minimum 70-square inches, mounted not more than 80-inches from the bottom of the sign to the parking space grade.

   a. Spaces complying with van accessible requirements shall have shall an additional sign stating "Van-Accessible" mounted below the symbol of accessibility.

   b. Comply with requirements specified in CBC Section 11B-502.6.

D. Unauthorized Vehicle Sign:

1. Post the following sign in a conspicuous place at each entrance to the off-street parking area, not less than 17-inches x 22-inches in size with lettering not less than 1-inch in height, which clearly states: "Unauthorized vehicles parked in designated accessible spaces not displaying distinguishing placards or license plates issued for persons with disabilities may be towed away at Owner's expense. Towed vehicles may be reclaimed at __________________ or by telephoning _________________."

2. Blank spaces shall be filled in with appropriate information as directed by the Architect.

3. Comply with requirements specified in CBC Section 11B-502.8.

E. Toilet Room Entry Signs:

1. Provide geometric symbols as follows. Material and colors as indicated or as selected by the Architect.

   a. Men: 12-inch equilateral triangle with international symbol for men.

   b. Women: 12-inch diameter circle with international symbol for women.

   c. Unisex: 12-inch diameter circle with 12-inch equilateral triangle.

   d. Comply with CBC Section 11B-703.7.2.6 and ADA Article 4.30.

2. Provide sign with raised letters and Braille on the wall adjacent to the latch outside the door. Where there is no wall space on the latch side and at double leaf doors, provide sign on nearest adjacent wall. Comply with CBC Section 11B-703.4.2.

3. Center geometric symbols on door and signs on wall at a height of 60-inches above finished floor.

F. Room Identification Signs:

1. Provide one sign adjacent to latch side of doors or on the nearest adjacent wall where indicated. Signs shall identify room name as directed by the Architect.

2. Provide signs with raised upper case letters with Grade 2 Braille. Comply with ADA Article 4.30.

3. Mount signs 60-inches above finish floor to centerline of sign.

4. Comply with CBC Section 11B-703.4.2.

G. Tactile Exit Signs: Provide tactile exit signs complying with CBC Section 1117B.5.1.1, at the locations listed in CBC Section 1011.3.

H. International Symbol of Accessibility:

1. Design: As indicated in CBC Section 11B-703.7.2.1.

2. Color: White figure on a blue background. Blue color equal to Color No. 15090 in Federal Standard 595B.

PART 3 - EXECUTION
3.01 INSTALLATION

A. Locate where indicated and as required by applicable codes and secure with specified fasteners.

B. Install level, plumb and at height indicated or required, with surfaces free from distortion or other appearance defects.

C. Dimensional Letters and Numbers: Mount letters and numbers using standard fastening methods recommended by manufacturer. Provide template to establish letter spacing and to locate holes for fasteners.

   1. Mount letters with backs in contact with wall surface or projected from the wall surface as indicated.

3.02 CLEANING AND PROTECTION

A. At completion of installation, clean soiled surfaces in accordance with manufacturer’s instructions. Protect units from damage until final acceptance.

END OF SECTION
PART 1 – GENERAL

1.01 DESCRIPTION
A. This Section describes the requirements for furnishing and installing phenolic toilet compartments and urinal screens.
B. Related Sections:
   1. Metal fabrications are specified in Section 05 50 00.
   2. Toilet accessories are specified in Section 10 28 13.

1.02 SUBMITTALS
A. General: Comply with Division 01.
B. Product Data: Submit manufacturer's descriptive and technical data and illustrations, annotated to clearly indicate specific product types, variations, features, and materials involved. Include manufacturer's printed installation instructions.
C. Shop Drawings: Submit Shop Drawings showing fabrication and erection of assemblies, to extent not fully described by manufacturer's data sheets. Show anchorage, accessory items and finishes. Include location drawings for bolt hole locations in supporting members for attachment of compartments and screens.
D. Color Charts: Submit color charts illustrating manufacturer's full-range of finish colors for Architect's selection.
E. Samples:
   1. Submit 4-inch by 4-inch samples of phenolic panel material showing selected colors and finished edges.
   2. Submit one sample of each of type of hardware and fastener.
F. Maintenance Data: Furnish manufacturer's printed instructions and recommendations for the maintenance and care of compartments and screens to the Owner.
G. Warranty.

1.03 QUALITY ASSURANCE
A. Source Limitations: Provide phenolic toilet compartments and urinal screens from one source and one manufacturer. All components shall be the products of a single manufacturer.
B. Specified Manufacturer: Products of Bobrick Washroom Equipment, Inc. are specified to set a standard of quality. Equivalent systems of other manufacturers may be acceptable, if in the judgment of the Architect, they meet the intent of the specification in terms of design, function, materials and quality of workmanship. Other manufacturers may be proposed for consideration by adhering to procedures set forth in Contract Documents.
C. Regulatory Requirements:
1. Materials and installation shall be in compliance with requirements of the applicable building code and other regulations.

2. Fire-Resistance Characteristics: When tested in accordance with ASTM E84 Flame Spread Index shall be not more than 20 and Smoke Developed Index shall be not more than 95.

### 1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

**A. General:** Comply with Division 01.

**B. Deliver products in manufacturer's original unopened protective packaging.**

**C. Store materials in original protective packaging to prevent soiling, physical damage, and wetting.**

**D. Handle so as to prevent damage to finished surfaces.**

**E. Comply with manufacturer's additional requirements.**

### 1.05 WARRANTY

**A. Furnish to Owner manufacturer’s written warranty against delamination, corrosion, breakage, and defects in factory workmanship in panels, doors, and stiles and against defects in materials and factory workmanship in hardware.**

**B. Warranty Periods:**

1. **Panels, Doors, and Stiles:** Ten (10) years from date of Substantial Completion.

2. **Hardware:** One (1) year from date of Substantial Completion.

### PART 2 – PRODUCTS

#### 2.01 APPROVED MANUFACTURERS

**A. Toilet Compartments:** Bobrick "Duraline Series 1182.67" overhead braced as specified, or approved equal.

**B. Urinal Screens:** Bobrick "Duraline Series 1185" wall-hung as specified, or approved equal.

#### 2.02 MATERIALS AND COMPONENTS

**A. Stiles (pilasters), doors, and panels shall be solidly-fused plastic laminate with matte finish melamine surfaces, colored face sheets, black phenolic-resin core, and black edges. Stiles and doors shall be 3/4-inch thick and divider panels shall be 1/2-inch thick.**

**B. Attachment Devices:** 3/8-inch minimum diameter threaded steel rods, leveling devices, and other hardware as required. Leveling devices shall be corrosion resistant chromate-treated, double zinc-plated steel not less than 3/16-inch thick, concealed by a one-piece 4-inch high, 22-gauge AISI Type 304 satin finish stainless steel shoes.

**C. Door Hardware:**

1. **General:** Manufacturer’s standard institutional heavy-duty, vandal-resistant types, constructed from AISI Type 304 satin finish stainless steel.

2. **Door Latch:** 14-gauge sliding type requiring less than a 5-pound force to operate, with nylon track, rubber bumper door stop, and 8-gauge keeper. Twisting type latch operation not acceptable. Latch shall be operable from the outside without special tools or knowledge for emergency access.
3. Hinges: 16-gauge, continuous, self-closing, piano type.


5. Coat Hook: Type that projects no more than 1-1/8 inches from face of door. Furnish one in each toilet compartment.

E. Panel and Stile Mounting Brackets:
   1. Material: 18-gauge AISI Type 304 satin finish stainless steel.
   2. Types:
      b. For Securing Panels and Stiles to Walls: Integrally-formed angle brackets, continuous full-height of panels.

F. Headrail: Extruded anodized aluminum with satin finish. Enclosed construction with sloping top. Face has raised grip-resistant edge.

G. Threaded Inserts: Provide manufacturer's standard concealed threaded inserts for hardware attachment at stiles, doors, and panels. Inserts shall be capable of withstanding 1000 pounds direct pull.

H. Fasteners: Stainless steel, pin-head Torx screws.

I. Anchors: Corrosion-resistant, types and sizes suitable to Project conditions, as recommended in writing by the manufacturer.

PART 3 – EXECUTION

3.01 INSPECTION
   A. Verify that conditions are satisfactory for the installation of phenolic toilet compartments and urinal screens. If unsatisfactory conditions exist
   B. Do not begin installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION
   A. Install phenolic toilet compartments, urinal screens, hardware, fittings, and accessories in compliance with the manufacturer's printed instructions, accepted Shop Drawings, and as specified.
   B. Provide fasteners suitable for attaching to adjacent construction.
   C. Conceal evidence of drilling in finished work.

3.03 ADJUSTMENT AND CLEANING
   A. Adjust brackets to provide uniform clearances not exceeding the following:

B. Adjust stile shoes to fit flush with adjacent surface.
C. Adjust hardware for proper operation.
D. Set hinges on in-swinging doors to hold doors open approximately 15 degrees from closed position when unlatched, and hinges on out-swinging doors to return doors to fully closed position.
E. After completion of installation, clean and polish compartments, hardware, fittings, and accessories, and touchup minor scratches to match finish.

3.04 COMPLETION

A. When complete, each toilet and shower compartment and urinal screen assembly shall be set square, plumb and level, accurately aligned, and securely anchored to supporting Work to prevent movement.
B. Doors shall remain plumb in all positions of swing, and doors and hardware shall operate smoothly, quietly, and free from binding.
C. Exposed surfaces shall be clean and free from scratches, dents, tool marks, stains, discoloration, and other defects and damage.

3.05 PROTECTION

A. Protect toilet compartments and urinal screens from damage and deterioration until time of completion and acceptance by the Owner.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing the following:
   1. Standard-duty wire mesh partitions.

B. Related Sections:
   1. Door hardware is specified in Section 08 71 00.

1.02 SUBMITTALS

A. General: Comply with Division 01.

B. Product Data: Manufacturer's specifications, technical data and installation instructions.

C. Samples: Samples of wire mesh and frame members, with manufacturer's standard finish.

D. Shop Drawings: Include plans, elevations, and large scale details showing anchorage and accessory items. Furnish location template drawings for items supported or anchored to permanent construction.

E. Setting Drawings: For anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete.

1.03 QUALITY ASSURANCE

A. Manufacturer: Provide wire mesh partitions as complete units produced by a single manufacturer, including mounting accessories, fittings, and fastenings.

B. Source Limitations: Obtain wire mesh items from single source from single manufacturer.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. General: Comply with Division 01.

B. Deliver wire mesh items with cardboard protectors on perimeters of panels and doors and with posts wrapped to provide protection during transit and Project site storage. Use vented plastic.

C. Deliver keys to Owner by registered main or overnight package service.

1.05 PROJECT CONDITIONS

A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, where possible, to ensure proper fitting of work.

1.06 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Door Locks: Equal to 5-percent of amount installed for each type, but no fewer than three locks.
PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS


2.02 STANDARD DUTY MESH PARTITIONS

A. Mesh: 10-gauge crimped steel wire woven into 1-1/2-inch mesh, securely clinched to frame members.

B. Frames: Provide cutouts for pipes, ducts, beams, and other items shown or required for partition installation. Finish edges of cut-outs to provide a neat, protective edge.

1. Vertical Members: 1-1/4-inch x 5/8-inch cold-rolled steel C-Section channels with 1/4-inch bolt holes approximately 18-inches on center.

2. Horizontal Members: 1-inch x 1/2-inch x 1/8-inch cold-rolled steel channels, mortised and tenoned to vertical members.

3. Horizontal Reinforcing Members: 1-inch x 1/2-inch x 1/8-inch cold-rolled steel channel with wire woven through, or two 1-inch x 1/2-inch channels bolted or riveted to each side of mesh, and secured to vertical members. Provide number of horizontal reinforcing members to suit panel height as recommended by partition manufacturer.

C. Stiffening Bars: For free-standing partitions over 12'-0" high, provide flat bar stiffener posts between abutting panel frames. Size as recommended by partition manufacturer for partition height.

D. Top Capping Bars: 2-1/4-inch x 1-inch cold-rolled steel channels, secured to top framing channel with 1/4-inch "U" bolts spaced not more than 28-inches o.c.

E. Corner Posts: 1-1/4-inch x 1-1/4-inch x 1/8-inch angles with floor shoe and 1/4-inch bolt holes to align with bolt holes in vertical frame members.

F. Line Posts: Where partition runs exceed 20-feet without intersection or connection to overhead framing, furnish 3-inch x 4.1-pound channel line posts with 5-inch x 18-inch x 1/4-inch base plates located at recommended intervals to ensure partition rigidity and stability.

G. Intersection Posts: Wherever three- or four-way intersections occur, use 1-1/4-inch x 1-1/4-inch tubular steel post with floor shoe and 1/4-inch bolt holes aligned for bolting to adjacent panels.

H. Floor Shoes: Cast metal, sized to suit vertical framing and to provide approximately 3-inch clear space between finished floor and bottom horizontal frame members. Provide with leveling adjustments.

2.03 DOORS

A. Sliding Door: Door frame of 1-1/2-inch x 3/4-inch x 1/8-inch channel with 1-1/2-inch x 1/8-inch flat bar cover plate on 4 sides. Provide door with two, 4-wheel roller bearing carriers, box track, bottom guide channel and bronze mortise type cylinder lock operated by key outside and recessed knob inside. Align bottom of door with bottom of adjacent panels. Cylinders are included with product. Keying is specified in Section 08 71 00.

2.04 FABRICATION

A. Provide bolts, hardware, and accessories for complete installation.

B. Finish: Manufacturer's standard shop-applied enamel finish, color as selected by Architect.
PART 3 - EXECUTION

3.01 INSTALLATION

A. Erect partitions plumb, rigid, properly aligned, and securely fastened in place, complying with drawings and manufacturer's recommendations.

B. Provide additional field bracing as indicated or required for rigid, secure installation.

3.02 ADJUST AND CLEAN

A. Adjust moving components for smooth operation without binding.

B. Touch-up damaged finish after completion of installation using field-applied paint to match color of shop-applied finish.

END OF SECTION
SECTION 10 28 13
TOILET ACCESSORIES

PART 1 - GENERAL

1.01 DESCRIPTION
A. This Section describes the requirements for furnishing and installing toilet accessories.
B. Related Sections:
   1. Joint sealants are specified in Section 07 92 00.
   2. Glazing is specified in Section 08 80 00.
   3. Non-structural metal framing is specified in Section 09 22 16.
   4. Gypsum board is specified in Section 09 29 00.
   5. Tile is specified in Section 09 30 00.
   6. Phenolic toilet compartments are specified in Section 10 21 13.20.

1.02 SUBMITTALS
A. General: Comply with Division 01.
B. Product Data: Manufacturer's product data and installation instructions for each toilet accessory.
C. Setting Drawings: Furnish setting drawings, templates, instructions, and directions for installation of anchorage devices and cut-out requirements in other work.

1.03 QUALITY ASSURANCE
A. Manufacturer: Accessories shall be products of a single manufacturer for the entire Project unless otherwise accepted by the Architect.
B. Toilet tissue dispensers shall be continuous flow type. Dispensers that control delivery are not acceptable.
C. Toilet accessories shall not have manufacturer's name and/or logo exposed to view when installed.

1.04 REGULATORY REQUIREMENTS
A. Accessibility: Conform to the more restrictive provisions of the American with Disabilities Act or CBC.

1.05 PROJECT CONDITIONS
A. Coordinate accessory locations, installation, and sequencing with other work to avoid interference and to assure proper installation, operation, adjustment, cleaning, and servicing.
B. Ensure wall studs and backing plates are installed as required.

1.06 PROJECT WARRANTY
A. Furnish manufacturer's written 5-year warranty against silver spoilage of mirrors, agreeing to replace any mirrors that develop visible defects within warranty period. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL
A. Stainless Steel: AISI 18-8 Type 304, with No. 4 finish.
B. Mirror Glass: Clear tempered float glass with silvering, electro-plated copper coating, and protective coating.
C. Fasteners: Concealed screws, bolts, and other devices of same material as accessory unit or of galvanized steel where concealed. Exposed face fasteners are not acceptable.
D. Keys: Unless otherwise directed by the Owner, provide universal keys for access to toilet accessory units requiring internal access for servicing. Provide a minimum of six keys.

2.02 TOILET ACCESSORY ITEMS
A. GB-1, 2, 3: American Specialties, Inc. 3800 Series or approved equal, configurations indicated.
B. CR-1: American Specialties, Inc. includes 1200-SHU, 1214, and 1200-V or approved equals.
C. CS-1: American Specialties, Inc. 9013 or approved equal.
D. FS-1: American Specialties, Inc. 8206-L and –R or approved equal.
E. HD-1: American Specialties, Inc. 0197 Satin Stainless Steel or approved equal.
F. MD-1: American Specialties, Inc. 0720-Z or approved equal.
G. MI-1, 2, 3: American Specialties, Inc. 0600 or approved equal.
H. MP-1: American Specialties, Inc. 8425 or approved equal.
I. NV-1: American Specialties, Inc. 204684 or approved equal.
J. NV-2: American Specialties, Inc. 204684-9 or approved equal.
K. PT-1: American Specialties, Inc. 20469 or approved equal.
L. PT-2: American Specialties, Inc. 8522 or approved equal.
M. SC-1: American Specialties, Inc. 0477-SM or approved equal.
N. SD-1: American Specialties, Inc. 20365 or approved equal.
O. TP-1: American Specialties, Inc. 0484-R or approved equal.
P. TP-2: American Specialties, Inc. 0482-R or approved equal.
Q. TP-3: American Specialties, Inc. 20030 or approved equal.
R. WB-1: Rubbermaid S-9970GR or approved equal.

PART 3 - EXECUTION
3.01 INSPECTION
A. Check wall openings for correct dimensions, plumbness of blocking or frames, and other preparation that would affect installation of accessories.
B. Check areas to receive surface mounted units for conditions that would affect quality and execution of work.
C. Verify spacing of plumbing fixtures and toilet partitions that affect installation of accessories.

3.02 INSTALLATION
A. Install toilet accessory units in accordance with manufacturer's instructions, using tamper-proof fasteners. Finish of exposed fasteners shall match accessory item secured. Install units plumb and level, firmly anchored in locations
and at heights indicated.

B. Secure mirrors to walls in concealed, tamper-proof manner with special hangers, toggle bolts, or screws. Set units plumb, level, and square at locations indicated, in accordance with manufacturer's instructions for type of substrate involved.

C. Fit flanges of accessories snug to wall surfaces. Install sanitary sealant in gaps between 90-degree return flanges and finish wall surface after installation.

D. Finish edges of accessories with sealant to avoid water penetration.

3.03 ADJUSTING AND CLEANING

A. Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.

B. Clean and polish exposed surfaces of accessories in accordance with manufacturer's recommendations after removing temporary labels and protective coatings.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION
A. This Section describes the requirements for furnishing and installing emergency key access systems for Fire Department access.
B. Related Sections:
   1. Gate operators are specified in Section 32 21 12.73.

1.02 SUBMITTALS
A. General: Comply with Division 01.
B. Product Data: Manufacturer's descriptive and technical data and installation details.

1.03 QUALITY ASSURANCE
A. Coordinate ordering lock boxes with City of Richmond Fire Department.

PART 2 - PRODUCTS

2.01 EMERGENCY KEY ACCESS SYSTEMS
A. Approved Manufacturer: Knox Company Model 3201 or approved equal.
   1. Construction: Heavy-duty, high security.
   2. Door: 1/2-inch solid steel.
   3. Size: 7-inches high x 7-inches wide.
   5. Color: As selected by Architect from manufacturer's standards.
B. Key Control Switch: Knox #3502 or approved equal. Provide in lock box at automatic gates.
C. Emergency Padlocks: Knox #3772 or approved equal.
D. Emergency Responder Gate Access Radio Receiver: Click2Enter-I.V4 or approved equal.
E. Fastenings: Non-ferrous, type to suit installation conditions.

PART 3 - EXECUTION

3.01 INSTALLATION
A. Install emergency key access system components at locations indicated in accordance with manufacturer's instructions.
B. Securely fasten in place with sides plumb and level.
C. Exposed surfaces shall be free from scratches, tool marks, and other damage and defects.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing the following:

1. Fire extinguishers.

2. Fire extinguisher cabinets.

1.02 SUBMITTALS

A. General: Comply with Division 01.

B. Product Data: Furnish for each type of product specified. For fire extinguisher cabinets, include rough-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type and materials, trim style, door construction, panel style, and materials.

C. Samples: Furnish samples of each type of metal finish required, prepared on metal of same thickness and allow to be used in the final work. Where finishes involve normal color and texture variation, include sample sets showing full range of variations expected.

1.03 QUALITY ASSURANCE

A. Obtain fire extinguishers and cabinets from one source from a single manufacturer.

B. UL-Listed Products: Provide fire extinguishers which are UL-listed and bear UL "Listing Mark" for type, rating, and classification of extinguisher specified.

C. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.

1.04 COORDINATION

A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers are accommodated.

B. Coordinate sizes and locations of fire protection cabinets with wall depths.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cold-Rolled Steel: ASTM A1008, Commercial Steel (CS), Type B.

B. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 1/4-inch thick, Class 1 (clear).

2.02 FIRE EXTINGUISHERS

A. General: Provide fire extinguishers for each extinguisher cabinet and other locations indicated. Comply with requirements of governing authorities. Fire extinguishers shall be full charged and tagged in accordance with requirements of the authority having jurisdiction.

B. Multi-Purpose Dry Chemical Type: UL-rated 2A:10BC, 5-lb. nominal capacity, in enameled steel container.
2.03 FIRE EXTINGUISHER CABINETS


B. Tub: Heavy-gauge, white baked enamel.

1. Where fire extinguisher cabinets are installed in fire-rated partitions, provide cabinet walls fabricated from 0.0428-inch thick, cold-rolled steel sheet lined with minimum 5/8-inch thick fire-barrier material. Provide factory-drilled mounting holes.

C. Cabinet Type:

1. Concrete and Concrete Masonry Walls: Surface-mounted.


D. Trim Style: Exposed trim, either square-edge or rolled-edge as standard with manufacturer for cabinet type and depth.

E. Door and Trim Material: Manufacturer's standard enameled steel.

F. Door Glazing: Clear tempered float glass.

G. Door Style: Match existing.

H. Door Hardware: Manufacturer's standard door operating hardware for cabinet type, trim style, and door material and style specified. Provide door pull, exposed or concealed, and friction latch. Provide concealed or continuous type hinge permitting door to open 180-deg.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install items in locations and at mounting heights indicated, or if not indicated, at heights to comply with applicable regulations of governing authorities.

B. Prepare recesses in walls for fire extinguisher cabinets as required by type and size of cabinet and style of trim in compliance with manufacturer's instructions.

C. Securely fasten fire extinguisher cabinets to structure, square and plumb, to comply with manufacturer's instructions.

END OF SECTION
SECTION 10 81 13

BIRD CONTROL DEVICES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing the following types of bird control:

1. Bird netting.

1.02 SUBMITTALS

A. General: Comply with Division 01.

B. Product Data: Furnish descriptive information from the manufacturer including samples, catalogue, installation instructions and drawings, and other descriptive material.

C. Shop Drawings: Show methods of attaching bird netting to supporting construction.

D. Samples: Furnish samples of each type of proposed bird control materials, including fasteners.

1.03 QUALITY ASSURANCE

A. Single Source Responsibility: Furnish products from one manufacturer for entire Project.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS


2.02 MATERIALS

A. Bird Netting:

1. Material: Black, high density polyethylene, UV, flame and rot resistant.

2. Construction: Seamless knotted netting. 6 monofilaments, each 12/1000-inch thick with UV stabilizers. Monofilaments twisted together to produce a twine with a breaking strain in excess of 20 Kg.

3. Mesh Size: 3/4-inch square steam set knots.

B. Hardware: Provide stainless steel screw eyes, expanding net bolts, eye bolts and nuts, hooks, clips, hog rings, tumbuckles, ferrules and other hardware as recommended by manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine the installation area, and note any detrimental or hazardous work conditions.

B. Do not proceed with installation until conditions are corrected.

3.02 INSTALLATION
A. Install products in accordance with the manufacturer's installation instructions.

3.03 INSPECTION

A. Visually inspect bird control systems for any signs of poor installation, including loose screws, bolts, fasteners, wires or un-removed debris.

B. Immediately correct and repair as necessary.

END OF SECTION
# SECTION 11 11 00

**VEHICLE SERVICE EQUIPMENT**

## PART 1 - GENERAL

The General Provisions of the Contract, including General and Special Conditions and the requirements of Division 1, apply to the Work in this Section.

### 1.01 WORK INCLUDED

A. Equipment items as listed below by Equipment Identifier:

<table>
<thead>
<tr>
<th>Equipment Identifier</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2153</td>
<td>Compressor, air, base mounted, 10 HP (Ref. Part 2.01)</td>
</tr>
<tr>
<td>2188</td>
<td>Compressor, screw, rotary, 30 HP (Ref. Part 2.02)</td>
</tr>
<tr>
<td>2189</td>
<td>Compressor, screw, rotary, 50 HP (Ref. Part 2.03)</td>
</tr>
<tr>
<td>2228</td>
<td>Dryer, air, refrigerated, 100 CFM (Ref. Part 2.04)</td>
</tr>
<tr>
<td>2235</td>
<td>Dryer, air, refrigerated, 360 CFM (Ref. Part 2.05)</td>
</tr>
<tr>
<td>6290</td>
<td>Breathable air filter (Ref. Part 2.06)</td>
</tr>
<tr>
<td>7510</td>
<td>Pump, air piston (CG), with hoist (Ref. Part 2.07)</td>
</tr>
<tr>
<td>7520</td>
<td>Pump, air piston, 10:1 ratio (ATF, EO) (Ref. Part 2.08)</td>
</tr>
<tr>
<td>7530</td>
<td>Pump, diaphragm, mixing (EC) (Ref. Part 2.09)</td>
</tr>
<tr>
<td>7540</td>
<td>Pump, diaphragm, used fluid evacuation (UO) (Ref. Part 2.10)</td>
</tr>
<tr>
<td>7541</td>
<td>Pump, diaphragm, used fluid evacuation (UC) (Ref. Part 2.11)</td>
</tr>
<tr>
<td>7600</td>
<td>Pump, submersible, 3/4 HP (DEF) (Ref. Part 2.12)</td>
</tr>
<tr>
<td>7700</td>
<td>Reel banks, general (Ref. Part 2.13)</td>
</tr>
<tr>
<td>7710</td>
<td>Reel bank (CA) (Ref. Part 2.14)</td>
</tr>
<tr>
<td>7711</td>
<td>Reel bank (CA2) (Ref. Part 2.14)</td>
</tr>
<tr>
<td>7712</td>
<td>Reel bank (CW) (Ref. Part 2.15)</td>
</tr>
<tr>
<td>7720</td>
<td>Reel bank (CA, W) (Ref. Part 2.17)</td>
</tr>
<tr>
<td>7730</td>
<td>Reel bank (CA, CG, GO) (Ref. Part 2.18)</td>
</tr>
<tr>
<td>7750</td>
<td>Reel bank (ATF, CA, EC, EO, W) (Ref. Part 2.19)</td>
</tr>
<tr>
<td>7751</td>
<td>Reel bank (ATF, CG, EC, EO, GO) (Ref. Part 2.20)</td>
</tr>
<tr>
<td>7760</td>
<td>Reel bank (ATF, CA, CW, DEF, EO, EC) (Ref. Part 2.21)</td>
</tr>
<tr>
<td>7838</td>
<td>Tank, triple wall, polyethylene, 1,000 gallon (DEF) (Ref. Part 2.22)</td>
</tr>
<tr>
<td>7970</td>
<td>Tank, double wall, cube, 500 gallon (ATF, EC) (Ref. Part 2.23)</td>
</tr>
</tbody>
</table>
24.  7996  Drain pan, used oil, rolling (Ref. Part 2.24)
25.  7997  Drain pan, used coolant, rolling (Ref. Part 2.23)
26.  7998  Receiver, used coolant, 25 gallon (Ref. Part 2.24)
27.  7999  Receiver, used oil, 25 gallon (Ref. Part 2.25)

B.  Roughing-in installation of equipment, and final connection of utilities, with labor, services, and incidentals necessary for complete and operational equipment installation.

1.02  RELATED SECTIONS
A.  Section 40 12 13 - Breathable Air Systems

1.03  REFERENCES
A.  ASME Code for Unfired Pressure Vessels

1.04  QUALITY ASSURANCE
A.  Manufacturer’s Representative:
   1.  Installation:  Provide a qualified manufacturer’s representative at site to supervise work related to equipment installation, check out, and start up.
   2.  Training:  Provide a qualified manufacturer’s representative to provide training to Owner’s maintenance personnel in operation and maintenance of specified equipment.

1.05  BUY AMERICA COMPLIANCE
A.  The Contractor shall comply with the applicable Buy America requirements set forth in 49 U.S.C. 5323(j) and the applicable regulations in 49 C.F.R. Part 661, as amended.  If the Contractor procures any capital items with Federal funds, it is the Contractor’s responsibility to obtain the Buy America certification required under such regulations.
B.  Reference Division 1 for Buy America compliance.

1.06  SUBMITTALS
A.  Product Data:
   1.  Submit Product Data in accordance with Division 1 - General Requirements of these specifications.
   2.  Restrict submitted material to pertinent data.  For instance, do not include manufacturer’s complete catalog when pertinent information is contained on a single page.

B.  Operations and Maintenance Manual:
   1.  Submit Operations and Maintenance Manuals in accordance with Division 1- General Requirements of these specifications.
   2.  Provide complete parts, operating, and maintenance manual covering equipment at time of installation.
   3.  Description of system and components.
   4.  Schematic diagrams of electrical, plumbing, and compressed air system.
5. Manufacturer’s printed operating instructions.

6. Printed listing of periodic preventive maintenance items and recommended frequency to validate warranties. Failure to provide maintenance information will indicate that preventive maintenance is not a condition for validation of warranties.

C. Shop Drawings: Submit Shop Drawings in accordance with Division 1 - General Requirements of these specifications.

D. Include certified data for each unit and accessory system indicating the following:
   1. Air compressor performance curves at summer design condition
   2. Intercooler performance at summer design condition
   3. Air dryer performance at 38 degrees F, dew point at 175 PSIG
   4. Indicate components, assembly, dimensions, weights and loadings, required clearances, location and size of field connections, intake air filter outline, blow-off silencer outline, main motor drive data, aftercoolers, control panel, and electrical pneumatic schematics.

1.07 PRODUCT SUBSTITUTIONS
A. Follow requirements specified in Division 1 - General Requirements.

B. Additional costs resulting from substitution of products other than those specified, by model number, including drawing changes and construction, will be at the expense of the Contractor.

C. Substitution Approval: Prior to delivery or installation, submittals for each equipment item by Equipment Identifier shall be provided in accordance with Division 1 - General Requirements. Acceptance will be based on the technical requirements herein as determined by Owner and Architect.

1.08 WARRANTY
A. Warrant work specified herein for one year from substantial completion against defects in materials, functions, and workmanship.

B. Warranty shall include materials and labor necessary to correct defects.

C. Defects shall include, but not be limited to noisy, rough or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish. Defects shall not include damage due to neglect, misuse, or situations resulting from non-performance of a manufacturer’s recommended preventive maintenance schedule.

1.09 PRODUCT DELIVERY, STORAGE, AND HANDLING
A. Deliver equipment in manufacturer’s containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid and/or dusty conditions.

B. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Equipment Identifier of this specification.

C. Provide equipment and material specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

1.10 LABELING
A. Manufacturer shall securely attach in a prominent location, on each major item of equipment, a non-corrosive nameplate showing manufacturer’s name, address, model number, serial number, and pertinent utility or operating data.

B. All electrical equipment and materials shall be new and shall be listed by Underwriter’s Laboratories, Inc. (UL) in categories for which standards have been set by that agency and labeled as such in the manufacturer’s plant.

C. Provide air receivers meeting requirements of ASME Code for Unfired Pressure Vessels and carry ASME approval stamp.

PART 2 - PRODUCTS

2.01 COMPRESSOR, AIR, SIMPLEX, BASE MOUNTED, 10 HP
   Equipment Identifier: 2153

A. Manufacturer’s Reference:
   1. Prime manufacturer: Specifications are based on equipment identified by manufacturer's name and model to establish acceptable standard of quality, performance, features and construction.

   a. Champion
   b. Princeton, IL (866) 276-4330
   c. Model No.: BR-10
   d. Reference Equipment Drawings

   2. Alternate manufacturers: Contingent upon compliance with these specification and documentation requirements set forth in SUBMITALS equipment produced by other manufacturers, including the following, may be considered as an equal.

   a. Ingersoll Rand, Davidson, NC (704) 655-4000
   b. Quincy, Bay Minette, AL (251) 937-5900

B. General Description: Provide compressor unit consisting of motor compressor (10 HP), belt guard with after cooler, pressure reducing station, vibration isolators, oil monitor, moisture separator, and operating controls.

C. Capacities/Dimensions:
   1. Overall dimensions:

<table>
<thead>
<tr>
<th>Dimensions (inches)</th>
<th>Length</th>
<th>Width</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment</td>
<td>42-7/10</td>
<td>22-1/2</td>
<td>28-1/2</td>
</tr>
</tbody>
</table>

   2. Boltdown dimensions:
   a. Length: 29 inches
   b. Width: 18-5/8 inches
3. Bore diameters: 4-5/8 and 2-1/2 inches
4. Motor: 10 HP
5. Rating: 125 PSIG
6. Speed: 740 RPM
7. Displacement: 47.3 CFM
8. Delivery: 37.3 CFM
9. Output valve: 1-1/4 inches NPT (F)
10. Stroke: 3 inches
11. Number of cylinders: Four
12. Oil capacity: 4 quarts
13. Weight (approximate): 540 pounds
14. Minimum operating temperature: 32 degrees F
15. Maximum operating temperature: 104 degrees F

D. Features/Performance/Construction:

1. Compressor construction:
   a. Construct compressor unit with cast iron housing and head, heat treated forged steel or ductile iron shaft, aluminum alloy connection rods, aluminum pistons with lubricated carbon steel rings, high-strength alloy suction and discharge valves. Statically and dynamically balance rotating parts.
   b. Mount motor and compressor on one-piece ribbed cast iron or welded steel base with provision for V-belt adjustment.

2. After cooler:
   a. Provide air compressor with air after cooler suitable for operation under 135 PSIG working pressure.
   b. Provide a belt guard style after cooler mounted on the compressor belt guard.
   c. After cooler capacity to cool discharge air to within 25 degrees F of ambient air temperature with compressors operating at specified capacity.

3. Pressure reducing valve:
   a. Provide pressure reducing stations complete with automatic reducing valve and bypass, and low pressure side relief valve and gauge.
   b. Compressor shall be provided with automatic start/stop capacity controls. In addition, provide centrifugal unloading to ensure for an unloaded compressor at start-up.
   c. Valve capacity suitable to compressor reduce pressure from 50 PSI to 180 PSI. Pressure reducing valve to be adjustable upward from reduced pressure.
d. Provide valves with bronze or semi-steel bodies with stainless steel springs, stems, and seats.

e. Cylinders shall be multi-finned for efficient cooling. Pressure relief valves shall be installed on the unit.

E. Controls:
1. Pressure switch to cutout at 100 PSI with minimum differential of 35 PSI.
2. Compressor regulation through a lead-lag switch.
3. Provide electrical automatic alternation. In the event one compressor fails, another compressor automatically maintains air pressure.
4. Connect new compressors to an automatic alternator. Upon stopping, the opposite compressor shall start on air demand. Lead-lag regulation shall occur with the two compressors during high demand periods or in the event one amp fails.

F. Accessories:
1. Air receiver:
   a. Fittings to include adjustable pressure regulator, safety valve, pressure gauge, drain cock, and automatic pneumatic tank drain.
   b. Condensation filter: CFF170 AD, size for two

G. Utility Requirements:

<table>
<thead>
<tr>
<th>1. Electrical:</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Connection Requirements</td>
</tr>
<tr>
<td>Voltage</td>
</tr>
<tr>
<td>Phase</td>
</tr>
<tr>
<td>HP</td>
</tr>
<tr>
<td>Amps</td>
</tr>
</tbody>
</table>

H. Finish: Durable enamel in manufacturer's standard color

2.02 COMPRESSOR, SCREW, ROTARY, 30 HP
Equipment Identifier: 2188

A. Manufacturer's Reference:
1. Prime manufacturer: Specifications are based on equipment identified by manufacturer's name and model to establish acceptable standard of quality, performance, features and construction.

<table>
<thead>
<tr>
<th>a. Quincy Compressors</th>
</tr>
</thead>
<tbody>
<tr>
<td>b. Quincy, IL (217) 222-2700</td>
</tr>
<tr>
<td>c. Model No.: QSI-140 with accessories</td>
</tr>
</tbody>
</table>
d. Reference Equipment Drawings

2. Alternate manufacturers: Contingent upon compliance with these specification and documentation requirements set forth in SUBMITTALS equipment produced by other manufacturers, including the following, may be considered as an equal.

| a. Champion, Princeton, IL (866) 232-3440 |
| b. Ingersoll Rand, Davidson, NC (704) 655-4000 |

B. General Description: Provide rotary screw compressor unit consisting of air-cooled motor compressors (30 HP), after cooler, pressure reducing station, spring isolators and operating controls.

C. Capacities/Dimensions:

1. Overall compressor dimensions (approximate):

<table>
<thead>
<tr>
<th>Dimensions (inches)</th>
<th>Length</th>
<th>Width</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Equipment</td>
<td>61</td>
<td>33</td>
<td>49</td>
</tr>
</tbody>
</table>

2. Motor: 50 HP squirrel cage, induction type

3. Capacity: 135 CFM (nominal pressure)

4. Rating: 125 PSIG

5. Speed: 3,600 RPM

6. Output valve: 1 inch NPT (F)

D. Features/Performance/Construction:

1. Compressor:

a. The automatic capacity control shall allow full load, idle run, and start/stop.

b. Airend shall be directly mounted to air/fluid separator reservoir.

c. Airend shall have a 5 to 6 lobe combination with male and female rotors unequal in diameter or a 4 to 6 lobe combination with equal male and female rotor diameters.

d. Airend shall be directly coupled to the motor using a heavy duty, resilient coupling.

e. Airend shall be single-stage, oil flooded rotary screw.

f. A pressure relief valve shall be installed on the separator for over-pressure protection.

g. Provide a minimum pressure and check valve to assure minimum pressure on the oil reservoir and to prevent backflow of air when unit stops, unloads, or shuts down.

2. Enclosure: Compressor and all components shall have an epoxy-coated steel enclosure with control panel and side access panel.
3. Oil cooler/aftercoolers shall be provided.

E. Controls:

1. Compressor shall use PLC based controls which allow for full course modulation to match compressor capacity to system demand. If system demand should fall below 20 percent of compressor capacity, the compressor shall go into an unloaded condition.

2. System controls shall provide an emergency stop button and automatically shut down when motor, air, or pressure is detected and exceeds normal operating ranges. Alarms will be provided to monitor oil filter, inlet air filter, oil separator element, motor temperature discharge, air temperature, and service interval. Running indicators shall monitor pressure, temperature, and time that unit has been under full load, and the total running hours.

3. Unit shall be provided with pressure relief valve, automatic re-start after power failure, automatic belt tension device, three-way oil thermostat, and water trap with timer-controlled drain.

4. Pressure switch to cut out at 100 PSI with minimum differential of 20 PSI.

5. Installation and controls shall allow continuous operation by standby compressor if lead compressor is subject to mechanical or control failure.

F. Accessories:

| 1. Coalescing filter: Quincy No. CSNT-0425 (one each) |
| 2. Particulate filter: Quincy No. CPNT-0425 (one each) |
| 3. Electronic drain: Quincy No. Tech22 (one each) |

G. Utility Requirements:

| 1. Electrical: |
| a. Connection Requirements | Unit |
| Voltage | 460 |
| Phase | 3 |
| HP | 30 |
| Amps | 43.3 |

| 2. Plumbing: |
| a. Compressed Air: |
| Connection (inches) | 1 |
| Volume (CFM) | 122 |
| Capacity (PSI) | 125 |

H. Finish: Durable enamel in manufacturer’s standard color
A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified by manufacturer's name and model to establish acceptable standard of quality, performance, features and construction.

   a. Quincy
   b. Bay Minette, AL (217) 222-7700
   c. Model No.: QGD-50

   d. Reference Equipment Drawings

2. Alternate manufacturers: Contingent upon compliance with these specification and documentation requirements set forth in SUBMITALS equipment produced by other manufacturers, including the following, may be considered as an equal.

   a. Ingersoll Rand, Davidson, NC (704) 655-4000
   b. Kaesar Compressors, Surrey, BC, Canada (604) 516-7823

B. General Description: Provide rotary screw compressor unit consisting of air-cooled motor compressors (50 HP), after cooler, pressure reducing station, spring isolators and operating controls.

C. Capacities/Dimensions:

1. Overall compressor dimensions (approximate):

<table>
<thead>
<tr>
<th>Dimensions (inches)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Equipment</td>
<td>72</td>
<td>39</td>
<td>64</td>
</tr>
</tbody>
</table>

2. Motor: 50 HP squirrel cage, induction type
3. Capacity: 223 CFM (nominal pressure)
4. Rating: 125 PSIG
5. Speed: 1,200 RPM
6. Output valve: 1-1/2 inch NPT (F)

D. Features/Performance/Construction:

1. Compressor:

   a. The automatic capacity control shall allow full load, idle run, and start/stop.

   b. Airend shall be directly mounted to air/fluid separator reservoir.
c. Airend shall have a 5 to 6 lobe combination with male and female rotors unequal in diameter or a 4 to 6 lobe combination with equal male and female rotor diameters.

d. Airend shall be directly coupled to the motor using a heavy duty, resilient coupling.

e. Airend shall be single-stage, oil flooded, rotary screw.

f. A pressure relief valve shall be installed on the separator for over-pressure protection.

g. Provide a minimum pressure and check valve to assure minimum pressure on the oil reservoir and to prevent backflow of air when unit stops, unloads, or shuts down.

2. Enclosure: Compressor and all components shall have an epoxy-coated steel enclosure with control panel and side access panel.

3. Oil cooler/aftercoolers shall be provided.

E. Controls:

1. Compressor shall use PLC based controls which allow for full range modulation to match compressor capacity to system demand. If system demand should fall below 20 percent of compressor capacity, the compressor shall go into an unloaded condition.

2. System controls shall provide an emergency stop button and automatically shut down when motor, air, or pressure is detected and exceeds normal operating ranges. Alarms will be provided to monitor oil filter, inlet air filter, oil separator element, motor temperature discharge, air temperature, and service interval. Running indicators shall monitor pressure, temperature, and time that unit has been under full load, and the total running hours.

3. Unit shall be provided with pressure relief valve, automatic re-start after power failure, automatic belt tension device, three-way oil thermostat, and water trap with timer-controlled drain.

4. Pressure switch to cut out at 100 PSI with minimum differential of 20 PSI.

5. Installation and controls shall allow continuous operation by standby compressor if lead compressor is subject to mechanical or control failure.

F. Accessories:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Coalescing filter: Quincy No. CSNT0425 (one each)</td>
</tr>
<tr>
<td>2.</td>
<td>Particulate filter: Quincy No. CPNT-0425 (one each)</td>
</tr>
<tr>
<td>3.</td>
<td>Electronic drain: Quincy No. Tech22 (one each)</td>
</tr>
</tbody>
</table>

G. Utility Requirements:
1. Electrical:

<table>
<thead>
<tr>
<th>Connection Requirements</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>460</td>
</tr>
<tr>
<td>Phase</td>
<td>3</td>
</tr>
<tr>
<td>HP</td>
<td>50</td>
</tr>
<tr>
<td>Amps</td>
<td>65</td>
</tr>
</tbody>
</table>

H. Finish: Durable enamel in manufacturer's standard color

2.04 DRYER, AIR, REFRIGERATED, 100 CFM
Equipment Identifier: 2228

A. Manufacturer’s Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer’s name and model to establish minimal acceptable standards of quality, features, performance, and construction.
   a. Champion
   b. Princeton, IL (815) 875-3321
   c. Model No.: CRN100 with accessories
   d. Reference Equipment Drawings

2. Alternate manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.
   a. Ingersoll Rand, Davidson, NC (704) 896-4000
   b. Quincy Compressor, Quincy, IL (217) 222-7000

B. Capacities/Dimensions:

1. Overall dimensions:

<table>
<thead>
<tr>
<th>Dimensions (inches)</th>
<th>Length</th>
<th>Width</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment</td>
<td>29</td>
<td>20</td>
<td>38</td>
</tr>
</tbody>
</table>

2. Capacity:

   a. 38 degrees F: 100 CFM

3. Drain connection: 1 inch NPT(F)
4. Air connection: 1 inch NPT(M)

5. Maximum working pressure: 232 PSIG (Level 2 controller standard)

6. Weight: 251 pounds

C. Features/Performance/Construction:

1. Provide refrigerated air dryer of self-contained mechanical refrigeration type complete with heat exchanger, refrigeration compressor, moisture removal trap, internal wiring and piping, and full refrigerant charge.

2. Provide air inlet and outlet connections at same level and factory insulated.

3. Heat exchangers to consist of air-to-air and refrigerant-to-air coils. Provide centrifugal type moisture separator located at discharge of heat exchanger. Provide heat exchangers with automatic control system to bypass refrigeration system on low or no load condition.

4. Refrigeration unit of hermetically sealed type to operate continuously to maintain specified 38 degree F dew point. House unit in steel cabinet provided with access door and panel for maintenance and inspection.

5. Refrigerated air dryer shall be equipped with air inlet temperature gauge, air inlet pressure gauge, ON/OFF switch, high temperature LED, status indicators, refrigerant gauge, and Level 2 controller (standard).

6. Provide seismic bracing and anchorage to meet any local, state, and national codes and provisions.

7. Provide maintenance kit with separator element, drain, drain tube, hose fastener, wave spring, head O-ring, lube packet, and service reminder detail.

8. Provide coalescing maintenance kit with filter elements, electric drain rebuild kit, drain tube, hose fastener, head O-rings, lube packet, and service reminder decal.

D. Accessories:

| 1. Maintenance kit: Champion No. CRNMK-4 (one each) |
| 2. Coalescing maintenance kit: Champion No. CRNMK14 |

E. Utility Requirements:
1. Electrical:

<table>
<thead>
<tr>
<th>Connection Requirements</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>115</td>
</tr>
<tr>
<td>Phase</td>
<td>1</td>
</tr>
<tr>
<td>Amps</td>
<td>10.2</td>
</tr>
</tbody>
</table>

2. Plumbing:

a. Compressed Air:

<table>
<thead>
<tr>
<th>Connection (inches)</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume (CFM)</td>
<td>100</td>
</tr>
<tr>
<td>Capacity (PSI)</td>
<td>232</td>
</tr>
</tbody>
</table>

F. Finish: Durable enamel in manufacturer’s standard color

2.05 DRYER, AIR, REFRIGERATED, 360 CFM
Equipment Identifier: 2235

A. Manufacturer’s Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer’s name and model to establish acceptable standards of quality, performance, features, and construction.

   a. Kaesar Compressor, Inc.
   b. Fredericksburg, VA (540) 898-5500
   c. Model No.: TE-91

   d. Reference Equipment Drawings

2. Alternate manufacturers: Contingent upon compliance with these specification and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.

   a. Ingersoll Rand, Davidson, NC (704) 896-4000
   b. Quincy Compressor, Quincy, IL (217) 222-7700

B. Capacities/Dimensions:

1. Overall dimensions:
Dimensions (inches)

<table>
<thead>
<tr>
<th></th>
<th>Length</th>
<th>Width</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Equipment</td>
<td>42</td>
<td>54</td>
<td>62</td>
</tr>
</tbody>
</table>

2. Weight: 1,256 pounds

3. Capacity:
   a. 75 degrees F: 491 CFM
   b. 105 degrees F: 304 CFM

4. Drain connection: 3/8 inch NPT(F)

5. Air connection: 2 inch NPT(F)

6. Maximum working pressure: 230 PSIG

C. Features/Performance/Construction:

1. Provide refrigerated air dryer of self-contained mechanical refrigeration type complete with heat exchanger, refrigeration compressor, moisture removal trap, internal wiring and piping, and full refrigerant charge.

2. Provide air inlet and outlet connections at same level.

3. Heat exchangers to consist of air-to-air and thermal storage-refrigerant coils. Provide centrifugal type moisture separator located at discharge of heat exchanger.

4. Refrigeration unit of hermetically sealed type to operate continuously to maintain specified 35 degrees F dew point. House unit in steel cabinet provided with access door and panel for maintenance and inspection.

5. Provide dryer with dew point indicator, air inlet pressure gauge, ON/OFF switch, high temperature LED, status indicators, drain alarm light.

6. Provide seismic bracing and anchorage to meet any local, state, and national codes and provisions.

D. Utility Requirements:

1. Electrical:

   a. Connection Requirements | Unit
      Voltage                     | 460
      Phase                       | 3
      HP                          | 2.1
      Amps                        | 3.4

E. Finish: Durable enamel in manufacturer’s standard color
2.06 BREATHABLE AIR FILTER  
Equipment Identifier: 6290

A. Manufacturer's Reference:

1. **Prime manufacturer:** Specifications are based on equipment identified herein by manufacturer’s name and model to establish acceptable standards of quality, performance, features, and construction.

   | a. Deltech               
   | b. Chesapeake, VA (800) 866-8100  
   | c. Model No.: DM35 with accessories

2. **Alternate manufacturers:** Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.

   | a. Bullard, Cynthiana, KY (800) 227-0423  
   | b. 3M Respiratory Products, St. Paul, MN (888) 364-3577

B. General Description:

1. Provide a complete filtration and purification system. The integrated package shall produce respirable air from ordinary compressed air by using a combination of absorption, adsorption, and catalytic chemical reaction. The breathing air package accomplished this removing the liquid water, oil, particulate matter, moisture, odor and tastes and the conversion of carbon monoxide to carbon dioxide to produce clean, dry compressed breathing air. The quality of the air shall meet the standards set forth by the Federal Government (as published by OSHA) when the carbon monoxide concentration at the purifier inlet does not exceed 400 PPM. To meet Compressed Air and Gas Institute Commodity specification G-7.1 for Grade D air when the carbon monoxide content does not exceed 200 PPM, by volume. The air must not be oxygen deficient. The resulting air must meet Compressed Gas Association standards for Grade D air, ANSI/CGA G-7.1 in addition to OSHA and be suitable for face masks, hoods, helmets and other breathing apparatus.

2. The unit shall deliver purified air as specified:

   a. Total delivered capacity: 35 SCFM
   b. Inlet air temperature: 100 degrees F (standard conditions)
   c. Outlet oxygen: 19.5 to 23.5 percent
   d. Outlet oil (condensed) content: 5 mg/m³
   e. Outlet carbon monoxide content: 20 PPM (OSHA), 10 PPM (CGA)
   f. Outlet carbon dioxide content: 100 PPM
   g. Odor: Non detectable

C. Capacities/Dimensions:
1. Overall dimensions:

<table>
<thead>
<tr>
<th>Dimensions (inches)</th>
<th>Length</th>
<th>Width</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Equipment</td>
<td>35</td>
<td>35</td>
<td>49</td>
</tr>
</tbody>
</table>

2. Capacity:
   a. Inlet flow: 35 SCFM
   b. Outlet flow: 35 SCFM

3. Air connection:
   a. Inlet: 3/4 inch NPT
   b. Outlet: 3/4 inch NPT

4. Minimum working pressure: 75 PSI

5. Maximum working pressure: 150 PSI

6. Temperature range: 35 to 140 degrees F

7. Weight: 455 pounds

8. Rated capacity based on 100 PSIG, 100 degrees F inlet air, and 65 degrees F minimum inlet air temperature.

D. Features/Performance/Construction:

1. Coalescing oil and water removal filter
   a. Multi-stage coalescing compressor air filter to remove liquid water, solid particulate, liquid oil, and oil mists from the air.
   b. Filter shall have greater than 99.9 percent efficiency and be capable of removing 0.5 micron diameter solid particulate and oil aerosol.
   c. Filter shall use three stage filtration including impingement and mechanical interception to remove containments from the compressed air system in a single housing to prevent clogging of the element, while limiting pressure drop to a maximum of 3.0 PSI. Contaminants thus removed shall drain into a sump with external drain connection. A separate pre-filter and moisture separator shall not be acceptable for the removal of solids and normal amounts of condensed moisture.
   d. Filter elements shall employ a packed column of polymeric resin which turns red to indicate saturation with oil and shall be mounted in a transparent cast methyl methacrylate or extruded polycarbonate tube for visibility and inspection while on stream. Transparent tube shall be protected by expanded steel safety shield. When outlet flow is 140 SCFM at 100 PSIG, the replaceable element shall be mounted in an electrogalvanized steel tube with sight glass for element inspection.

2. Heatless air dryer:
a. Air dryer shall be capable of reducing the moisture content of the air to maintain a relative humidity at outlet of less than 1 percent. Dryer shall be an integral part of the construction. Numerically calculated scales indicating moisture content of the dry air exiting dryer shall be displayed by the position of a visible color indicator.

b. Dryer shall employ twin desiccant dryer towers for supplying a continuous flow of dry air by the automatically cycling operation of the towers. Reactivation of desiccant shall be accomplished by purging with a selected volume of dried air.

c. Unit shall be complete with panel-mounted gauges showing pressure in each drying tower, switch for selecting power on-off, indication light signaling power "ON" and calibrated gauge for purge air pressure.

d. Dryer shall be constructed of corrosion resistant material.

3. Catalytic converter:

a. A low temperature oxidation catalyst shall reduce the carbon monoxide concentration by conversion to less toxic carbon dioxide.

b. The catalyst shall be capable of converting in excess of 95 percent of carbon monoxide in the air stream to carbon dioxide. To maintain an adequate conversion efficiency, the relative humidity of the air stream must be 1 percent or lower.

c. The catalytic converter shall convert carbon monoxide to carbon dioxide and must provide one year’s continuous service before requiring cartridge replacement. The replaceable catalyst must be housed in a separate housing specially designed for this purpose. Catalyst must be packaged in a moisture-proof packing and shall have a 30-month shelf life prior to installation in system.

4. Activated and final particulate filter:

a. The activated carbon filter for odor and taste removal shall be carbon impregnated filter media using the principle of interception filtration to remove particles and desiccant fines to a nominal 3.0 micron carry over.

b. Carbon filter shall be replaced every 4 months.

5. Mounting and brackets:

a. Entire system shall be fabricated to allow ready installation at the point of use. All interconnecting piping, support brackets, and mounting stands shall be furnished.

E. Accessories:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Half-mask: E.D. Bullard No. FAMB230 (one each) (available in large, medium, small)</td>
</tr>
<tr>
<td>2</td>
<td>Spectrum series full mask: E. D. Bullard No. SPEC3O-L (one each) (available in large, medium, small)</td>
</tr>
</tbody>
</table>

F. Utility Requirements:
1. Electrical:
   a. Connection Requirements

<table>
<thead>
<tr>
<th></th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>208</td>
</tr>
<tr>
<td>Phase</td>
<td>1</td>
</tr>
<tr>
<td>Amps</td>
<td>60</td>
</tr>
</tbody>
</table>

2. Plumbing:
   a. Compressed Air:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection (inches)</td>
<td>3/4</td>
</tr>
<tr>
<td>Volume (CFM)</td>
<td>42</td>
</tr>
<tr>
<td>Capacity (PSI)</td>
<td>100</td>
</tr>
</tbody>
</table>

G. Finish: Durable enamel in manufacturer’s standard color

2.07 PUMP, AIR PISTON (CG), WITH HOIST
   Equipment Identifier: 7510

A. Manufacturer’s Reference:
   1. Prime manufacturer: Specifications are based on equipment identified by manufacturer's name and model to establish acceptable standard of quality, performance, features and construction.

      a. Graco, Incorporated
      b. Minneapolis, MN (612) 623-6000
      c. Model No.: 226018

      d. Reference Equipment Drawings: Chassis Grease Pump and Drum Detail

   2. Alternate manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS equipment produced by other manufacturers, including the following, may be considered as equal.

      a. Balcrank Corporation, Inc., Weaverville, NC (828) 645-4261
      b. Lincoln Industrial Corporation, St. Louis, MO (314) 679-4200

B. Capacities/Dimensions:
   1. Overall dimensions:

      |                      |       |      |
      |----------------------|-------|------|
      | Dimensions (inches)  | Length| Width| Height|
      | a. Equipment         | 24    | 30   | 56    |
2. Products: Chassis grease (CG)

3. Maximum fluid pressure: 4,000 PSI

4. Air motor diameter: 4-1/4 inches

5. Operating range: 40 to 80 PSI

6. Maximum continuous duty flow rate: 3.35 pounds per minute

7. Material outlet: 3/8 inch NPT(F)

8. Material inlet: Slotted

C. Features/Performance/Construction:

1. Provide pneumatic operated piston pump operable with maximum air pressure of 150 PSI.

2. Provide complete assembly with the following standard compressed air line accessories:
   a. Combination air filter-regulator, 3/4 inch: Graco No. 246948
   b. Bleed type air shut-off valve to relieve air trapped between air motor and valve.
   c. Lubricator, 3/4 inch NPT
   d. Air and product valves
   e. Provide compressed air runaway valve before product fluid pump to eliminate unregulated fluid flow in the event of a product pipe break.

3. Air motor shall be a non-corrosive design with no metal-to-metal contact compatible with product being delivered.

4. Provide base, inductor plate, elevator, and carriage support system for chassis grease.

5. Provide connection from pump back to product tank for proper drain back of fluid in piping riser line and pump.

6. Provide complete assembly complete with the following standard fluid line accessories:
   a. Hose and fitting kit suitable for product
   b. Fluid drain valve to assist in relieving fluid pressure in the pump, hoses, and dispensing valve
   c. Pump grounding wires to reduce the risk of static sparking

D. Utility Requirements:
1. Plumbing:

   a. Compressed Air:

      | Connection (inches) | 1/2 |
      | Volume (CFM)        | 19  |
      | Capacity (PSI)      | 70  |

2. PUMP, AIR PISTON 10:1 RATIO (ATF, EO, GO)
   Equipment Identifier: 7520

   A. Manufacturer's Reference:

      1. Prime manufacturer: Specifications are based on equipment identified by manufacturer's name and model to establish acceptable standard of quality, performance, features and construction.

      a. Graco, Inc.
      b. Minneapolis, MN (800) 533-9655
      c. Model No.: 425 Fire-Ball

      d. Reference Equipment Layout Drawings: Tank Mounted Oil Pump and Tank Detail

      2. Alternate manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.

      a. Balcrank Corporation, Inc., Weaverville, NC (828) 645-4261
      b. Lincoln Industrial Corporation St. Louis, MO (314) 679-4200

   B. Capacities/Dimensions:

      1. Overall pump dimensions:

      | Dimensions (inches) | Length | Width | Height |
      |---------------------|-------|------|-------|
      | Equipment           | 6 dia.| ---  | 12    |

      2. Products: Automatic transmission fluid (ATF), engine oil (EO), gear oil (GO)

      3. Maximum fluid pressure: 1,800 PSI

      4. Air motor diameter: 4-1/4 inches

      5. Operating range: 40 to 180 PSI

      6. Continuous duty flow rate at 100 PSI: 4 GPM
7. Air consumption at 100 PSI: 32 CFM
8. Air inlet: 1/2 inch NPT (F)
9. Fluid outlet: 3/4 inch NPT(F)
10. Fluid inlet: 1-1/2 inch NPT(F)

C. Features/Performance/Construction:

1. Provide pneumatic operated piston pump operable within the pressure range of 40 PSI to 180 PSI.
2. Air motor shall be a non-corrosive design with no metal-to-metal contact compatible with product being delivered.
3. Provide with complete and operable assembly for connection to both compressed air and lube system including the following:
   a. Lube system components:
      1) Provide adapters for mounting on storage tanks.
      2) Provide product valves compatible with product being delivered.
      3) Provide hose and fitting kit suitable for product being delivered.
      4) Provide thermal relief valves for the pumping system. Provide connection from pump back to product tank for proper drain back of fluid in piping riser line and pump.
      5) Provide suction tube properly sized for tank of product being delivered.
      6) Provide lower level cut-off valve.
   b. Compressed air components:
      1) Provide combination air filter, regulator and pressure gauge, 3/4 inch NPT.
      2) Provide air lubricator, 3/4 inch NPT.
      3) Provide hose and fitting kit for air connection to the pump.
      4) Provide compressed air runaway valve before product fluid pump to eliminate unregulated fluid flow in the event of a product pipe break.
      5) Provide air valves as required.

D. Utility Requirements:
1. Plumbing:
   a. Compressed Air:

<table>
<thead>
<tr>
<th>Connection (inches)</th>
<th>Volume (CFM)</th>
<th>Capacity (PSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 NPT(F)</td>
<td>32</td>
<td>100</td>
</tr>
</tbody>
</table>

2.09 PUMP, DIAPHRAGM, MIXING (EC)
Equipment Identifier: 7530

A. Manufacturer’s Reference:
   1. Prime manufacturer: Specifications are based on equipment identified by manufacturer’s name and model to establish minimal acceptable standards of quality, performance, features and construction.

   a. Graco
   b. Minneapolis, MN (612) 623-6000
   c. Model No.: 647016 with accessories

   d. Reference Equipment Layout Drawings: Tank with wall mounted diaphragm pump and water tank detail)

   2. Alternate manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.

   a. Balcrank Corporation., Weaverville, NC (828) 645-4261
   b. Lincoln Industrial Corporation, St. Louis, MO (314) 679-4300

B. Capacities/Dimensions:
   1. Overall dimensions:

<table>
<thead>
<tr>
<th>Dimensions (inches)</th>
<th>Length</th>
<th>Width</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment</td>
<td>14-3/4</td>
<td>10-3/4</td>
<td>16</td>
</tr>
</tbody>
</table>

   2. Products: Engine coolant (EC)
   3. Pump ratio: 1:1
   4. Maximum air pressure: 120 PSI
   5. Free flow rate: 50 GPM
6. Air consumption: 67 CFM
7. Fluid outlet: 1 inch NPT(M)
8. Fluid inlet: 1 inch NPT(M)

C. Features/Performance/Construction:

1. Provide pneumatic operated diaphragm pump operable with maximum air pressure of 120 PSI.
3. Pump shall handle oil, hydraulic oil, automatic transmission fluid, engine coolant, windshield washer fluid, water, or fuel.
4. Pump shall be aluminum/TPE (UL listed)
5. Provide pneumatic pump with complete and operational assembly including the following:
   a. Compressed air system:
      1) Provide a combination filter/regulator (3/4 inch NPT).
      2) Lubricator (3/4 inch NPT).
      3) Provide connection from pump back to product tank for proper drain back of fluid in piping riser line and pump.
      4) Provide a quick connect air coupler.
      5) Provide a quick connect air nipple.
      6) Provide bleed type air shut off valve as required.
   b. Fluid system:
      1) Provide compressed air runaway valve before product fluid pump to eliminate unregulated fluid flow in the event of a product pipe leak.
      2) Provide pressure relief kit to prevent over pressurization of system due to thermal expansion of fluid.
      3) Provide a grounding wire and clamp.
      4) Provide a suction hose kit compatible with fluid in system.
6. Provide a wall bracket for mounting pump on wall above tank.
7. Provide dual inlet manifold for mixing water and fluids together.
8. Provide 30 gallon drum with a float valve.

D. Utility Requirements:
1. Electrical:
   a. Connection Requirements
      | Unit |
      | Voltage | 120 |
      | Phase   | 1   |
      | Amps    | 2   |

2. Plumbing:
   a. Domestic Water:
      | 1/2 |
      | Connection (inches) |
   b. Compressed Air:
      | 1/2 |
      | Connection (inches) |
      | Volume (CFM) | 67 |
      | Capacity (PSI) | 120 |

2.10 PUMP, DIAPHRAGM, USED FLUID EVACUATION (UO)
   Equipment Identifier: 7540

A. Manufacturer's Reference:
   1. Prime manufacturer: Specifications are based on equipment identified by manufacturer's name and model to establish acceptable standards of quality, performance, features and construction.
      a. Graco, Inc.
      b. Minneapolis, MN (800) 533-9655
      c. Model No.: 647016 with accessories
   d. Reference Equipment Drawings: Used Fluid Pump Detail

   2. Alternate manufacturers: Contingent upon compliance with these specification and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.
      a. Balcrank Corp., Weaverville, NC (828) 645-4261
      b. Lincoln Industrial, St. Louis, MO (314) 679-4200

B. Capacities/Dimensions:
   1. Products: Used oil
   2. Pump ratio: 1:1
   3. Free flow rate: 50 GPM
4. Continuous duty delivery: 2.4 GPM

5. Fluid outlet: 1 inch NPT(M)

6. Fluid inlet: 1 inch NPT(M)

C. Features/Performance/Construction:

1. Diaphragm pump shall provide 120 PSI air pressure for pump size and capacity as scheduled.

2. Pump shall be provided in complete assembly, including accessories for mounting on walls or adjacent to storage tanks as scheduled, combination air filter, regulator, coupler, nipple, air valve, wall bracket, relief kit, relief valves, wire and clamp, hose kit, adapter kit, and dual inlet manifold suitable for this product.


4. Pump shall handle oil, hydraulic oil, automatic transmission fluid, anti-freeze, windshield washer fluid, water, or fuel.

5. Pump shall have a tank monitoring system that shuts off the pump via solenoid valve when the used fluid tank is full.

6. Monitoring system shall notify users with a strobe light and an audible alarm system.

7. Audible alarm shall be a minimum of 250 milliamps.

D. Accessories:

1. Hose filter: Banjo Corp. No. LST100-16 (one each per unit)

2. Ball valve: Graco No. 109077 (only required if connected to oil filter press)

E. Utility Requirements:

1. Electrical:
   a. Connection Requirements
      | Unit   |
      |--------|
      | Voltage| 120    |
      | Phase  | 1      |
      | Amps   | 2      |

2. Plumbing:
   a. Compressed Air:
      |      |         |
      | Connection (inches) | 1/2    |
      | Volume (CFM)        | 67     |
      | Capacity (PSI)      | 120    |
A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified by manufacturer's name and model to establish acceptable standards of quality, performance, features and construction.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Address</th>
<th>Contact Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graco, Inc.</td>
<td>Minneapolis, MN</td>
<td>(800) 533-9655</td>
</tr>
<tr>
<td>Model No.:</td>
<td>647016 with accessories</td>
<td></td>
</tr>
</tbody>
</table>

2. Alternate manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Address</th>
<th>Contact Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balcrank Corp.</td>
<td>Weaverville, NC</td>
<td>(828) 645-4261</td>
</tr>
<tr>
<td>Lincoln Industrial</td>
<td>St. Louis, MO</td>
<td>(314) 679-4200</td>
</tr>
</tbody>
</table>

B. Capacities/Dimensions:

1. Products: Used coolant
2. Pump ratio: 1:1
3. Free flow rate: 50 GPM
4. Continuous duty delivery: 2.4 GPM
5. Fluid outlet: 1 inch NPT(M)
6. Fluid inlet: 1 inch NPT(M)

C. Features/Performance/Construction:

1. Diaphragm pump shall provide 125 PSI air pressure for pump size and capacity as scheduled.
2. Pump shall be provided in complete assembly, including accessories for mounting on wall or adjacent to storage tanks as scheduled, combination air filter, regulator, coupler, nipple, air valve, wall bracket, relief kit, relief valves, wire and clamp, hose kit, adapter kit, and dual inlet manifold suitable for this product.
4. Pump shall handle oil, hydraulic oil, automatic transmission fluid, anti-freeze, windshield washer fluid, water, or fuel.
5. Pump shall have a tank monitoring system that shuts off the pump via solenoid valve when the used fluid tank is full.
6. Monitoring system shall notify users with a strobe light and an audible alarm system.
7. Audible alarm shall be a minimum of 250 milliamps.
D. Accessories:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Tank monitor strobe: Husky BJE (363) 825-7200, No. 7695</td>
</tr>
<tr>
<td>2.</td>
<td>Hose filter: Banjo Corp. No. LST100-16 (one each)</td>
</tr>
</tbody>
</table>

E. Utility Requirements:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Electrical:</td>
<td></td>
</tr>
<tr>
<td>a. Connection Requirements</td>
<td>Unit</td>
</tr>
<tr>
<td>Voltage</td>
<td>120</td>
</tr>
<tr>
<td>Phase</td>
<td>1</td>
</tr>
<tr>
<td>Amps</td>
<td>2</td>
</tr>
<tr>
<td>2. Plumbing:</td>
<td></td>
</tr>
<tr>
<td>a. Compressed Air:</td>
<td></td>
</tr>
<tr>
<td>Connection (inches)</td>
<td>1/2</td>
</tr>
<tr>
<td>Volume (CFM)</td>
<td>67</td>
</tr>
<tr>
<td>Capacity (PSI)</td>
<td>120</td>
</tr>
</tbody>
</table>

2.12 PUMP, SUBMERSIBLE, 3/4 HP
Equipment Identifier: 7600

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer’s name and model to establish minimal acceptable standards of quality, features, performance, and construction.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>KleerBlue Solutions</td>
</tr>
<tr>
<td>b.</td>
<td>Evansville, IN (800) 320-3122</td>
</tr>
<tr>
<td>c.</td>
<td>Model No.: BD-1000</td>
</tr>
</tbody>
</table>

2. Alternate manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>OEC Fluid Handling, Spartanburg, SC (864) 573-9200</td>
</tr>
<tr>
<td>b.</td>
<td>Franklin Fueling Systems, Madison, WI (608) 838-8786</td>
</tr>
</tbody>
</table>

B. Capacities/Dimensions:

1. Overall pump dimensions:
Dimensions (inches)

<table>
<thead>
<tr>
<th></th>
<th>Length</th>
<th>Width</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Equipment</td>
<td>5-9/10 dia.</td>
<td>--</td>
<td>14-4/5</td>
</tr>
</tbody>
</table>

2. Weight: 19 pounds
3. Products: Diesel Exhaust Fluid (DEF)
4. Liquid temperature range: 32 to 113 degrees F
5. Maximum ambient temperature: 104 degrees F
6. Maximum operating pressure: 4.6 bar (64 PSI)
7. Delivery: 2 to 20 GPM
8. Fluid outlet: 1.5 inch npt(M)

C. Features/Performance/Construction:
1. Materials:
   a. Compatible with product being shelved; 32.5 percent UREA solution.
   b. Pumps construction shall be non-metallic.
2. Provide package pumping system. Package pumping system shall include: check valve, discharge tube, and outlet tube seal.

D. Utility Requirements:

1. Electrical:
   a. Connection Requirements  Unit
      | Voltage  | 120 |
      | Phase    | 1   |
      | HP       | 3/4 |
      | Amps     | 8.4 |

2.13 REEL BANKS, GENERAL
Equipment Identifier: 7700

A. Manufacturer's Reference:
1. Prime manufacturer: Specifications are based on equipment identified by manufacturer's name and model to establish acceptable standards of quality, performance, features and construction.
2. Alternate manufacturers: *Contingent upon compliance with these specification* and documentation requirements set forth in SUBMITTALS equipment produced by other manufacturers, including the following, *may be considered as equal.*

| a. Lincoln Industrial Corporation, St. Louis, MO (314) 679-4200 |
| b. Balcrank Corporation, Weaverville, NC (828) 645-4261 |

B. General Description: High performance, heavy duty hose reels. Reels are available for the following products:

1. Automatic transmission fluid (ATF): Graco No. HSM65B
2. Compressed air (CA): Graco No. HSL56B
3. Chassis grease (CG): Graco No. HSH55B
4. Diesel exhaust fluid (DEF): Graco No. HSDD5B
5. Engine coolant (EC): Graco No. HSL65B
6. Engine oil (EO): Graco No. HSM65B
7. Gear oil (GO): Graco No. HSM65B
8. Water (CW): Graco No. HSL56B

C. Capacities/Dimensions:

1. Overall reel dimensions, XD20 series (ATF, CA, CG, EC, EO, GO, CW) nominal:
   a. Length: 20 inches
   b. Width: 7-1/2 inches
   c. Height: 25-1/2 inches

2. Overall reel dimensions, XD30 series (DEF), nominal:
   a. Length: 22-1/8 inches
   b. Width: 9 inches
   c. Height: 27-5/8 inches

3. Reel fluid inlet:
   a. CA, CW: 1/2 inch NPT(M)
   b. CG: 3/8 inch NPT(M)
c. ATF, EC, EO, GO: 1/2 inch NPT(M)
d. DEF: 3/4 inch NPT(M)

4. Hose:
a. CA, CW:
   1) Length: 65 feet
   2) Inside diameter: 3/8 inch
   3) Working pressure: 180 PSI

b. CG:
   1) Length: 50 feet
   2) Inside diameter: 3/8 inch
   3) Working pressure: 4,000 PSI

c. DEF:
   1) Length: 50 feet
   2) Inside diameter: 3/4 inch
   3) Working pressure: 50 PSI

d. GO:
   1) Length: 50 feet
   2) Inside diameter: 1/2 inch
   3) Working pressure: 1,500 PSI

e. ATF, EC, EO:
   1) Length: 50 feet
   2) Inside diameter: 1/2 inch
   3) Working pressure: 1,000 PSI

D. Features/Performance/Construction:

1. Reels:
a. Construction: Frames, discs, and drum shall be fabricated of heavy gauge steel.
b. Double pedestal arm: Reel frame shall have double pedestal arms that are welded and gusseted.
c. Hose guide arm: Reel hose guide arm shall be adjustable with nylon rollers on all four sides of roller assembly at hose opening.
d. **Rewind mechanism:** Reel spring shall be enclosed and fastened to reel drum with a reinforcing clip.

e. **Bearings and ratchet latch:** Reel shall have permanently lubricated bearings and extra large ratchet latch with audible hose position lock.

2. **Ball stop:** Adjustment of hose extension length shall be permitted by ball stop:
   a. 3/8 inch hose, Graco No. 218341, (one per hose reel) [CA, CG]
   b. 1/2 inch hose, Graco No. 218341, (one per hose reel) [ATF, EC, EO, GO]
   c. 3/4 inch hose, Graco No. 237873, (one per hose reel) [DEF]

3. **Hose covers and tubes:** Chassis grease hose shall have Buna-N tube and Buna-N PVC cover. All other commodity hoses shall have Buna N nitrile tube with nitrile PVC cover.

4. **Delivery kits:** Each commodity hose shall be fitted with the dispensing control as listed.
   a. **ATF:** Electronic in-line style english metered totalizing dispenser (up to 5 GPM) set to dispense in quarts to 0.01 increments, Graco No. 255351
   b. **CA:** Quick disconnect air coupler with necessary adapter fitting, Industrial Interchange Series 3/8 inch female
   c. **CG:** High pressure control valve with knurled grip body, 1/4 inch, Graco No. 242056 with taper nose coupler and extension; “Z” swivel, Graco No. 202577
   d. **DEF:** Dispense nozzles with swivel, Graco No. 24F529 and in-line meter, Graco No. 24H293
   e. **EC:** Electronic in-line style english metered totalizing dispenser (up to 5 GPM) set to dispense in pints to 0.01 increments, Graco No. 255356
   f. **EO:** Electronic in-line style english metered totalizing dispenser set to dispense (up to 5 GPM) in quarts to .01 increments, Graco No. 255200
   g. **GO:** Electronic in-line style english metered totalizing dispenser set to dispense (up to 5 GPM) in pints to 0.01 increments, Graco No. 255352
   h. **CW:** Water bibb control valve with thumb acting trigger, Graco No. 180685

5. **Inlet hose kit:** Each commodity reel shall be fitted with the inlet hose kit as listed.
   a. **CA, CW:** 1/2 inch ID by 24 inches, medium pressure hose and fittings, rated for 2,000 PSI, Graco No. 218549, (one each)
   b. **CG:** 3/8 inch ID by 24 inches, high pressure hose and fittings, rated for 4,000 PSI, Graco No. 218550, (one each)
   c. **ATF, EC, EO:** 1/2 inch ID by 24 inches, medium pressure hose and fittings, rated for 2,000 PSI, Graco No. 218549, (one each)
   d. **DEF:** 3/4 inch ID by 24 inches, medium pressure hose and fittings, rated for 1,250 PSI, Graco No. 124875, (one each)

6. **Mounting bracket:** Graco No. 204741, one per three reels
7. Identification labels: Each commodity reel shall have a 3/4 by 4-1/4 inch metal identification label indicating the commodity, attached adjacent to each hose guide arm roller assembly. Label kits including label and mounting hardware as listed for each commodity.
   a. ATF: Graco No. 218673
   b. CA: Graco No. 218675
   c. CG: Graco No. 218671
   d. DEF: Provide a fabricated identification label similar to the other specified commodities.
   e. EC: Similar to Graco No. 218677
   f. EO: Similar to Graco No. 218670
   g. GO: Similar to Graco No. 218672
   h. CW: Graco No. 218676

8. Mounting channel supply as required for specific reel bank:
   a. One reel: Graco No. 24A219
   b. Two reels: Graco No. 24A220
   c. Three reels: Graco No. 24A221
   d. Six reels: Graco No. 24A222

E. Accessories:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Fluid solenoid valve: Graco Horizon System No. 512927 (ATF, EO, GO)</td>
<td></td>
</tr>
<tr>
<td>2. Fluid solenoid valve: Graco No. 514150 (EC)</td>
<td></td>
</tr>
<tr>
<td>3. Pulse meter: Graco No. 238618 (ATF, EO, GO)</td>
<td></td>
</tr>
<tr>
<td>4. Pulse meter: Graco No. 215474 (EC)</td>
<td></td>
</tr>
</tbody>
</table>

F. Utility Requirements: Contractor shall provide process piping from product pumps to point of connection for each reel specified herein.

G. Finish: Durable enamel in manufacturer's standard color

2.14 REEL BANK (CA)
   Equipment Identifier: 7710
   
   A. Reel bank shall consist of one each (CA) reel as delineated in part 2.13 REEL BANKS, GENERAL of this specification section.

   B. Reference Equipment Drawings for Details.

2.15 REEL BANK (CA2)
   Equipment Identifier: 7711
A. Reel bank shall consist of one each (CA2) reel as delineated in part 2.13 REEL BANKS, GENERAL of this specification section.

B. Reference Equipment Drawings for Details.

2.16 REEL BANK (CW)
Equipment Identifier: 7712

A. Reel bank shall consist of one each (CW) reel as delineated in part 2.13 REEL BANKS, GENERAL of this specification section.

B. Reference Equipment Drawings for Details.

2.17 REEL BANK (CA, CW)
Equipment Identifier: 7720

A. Reel bank shall consist of one each (CA) reel, and one each (W) reel as delineated in part 2.13 REEL BANKS, GENERAL of this specification section.

B. Reference Equipment Drawings for Details.

2.18 REEL BANK (CA, CG, GO)
Equipment Identifier: 7730

A. Reel bank shall consist of one each (CA) reel, one each (CG) reel, and one each (GO) reel as delineated in part 2.13 REEL BANKS, GENERAL of this specification section.

B. Reference Equipment Drawings for Details.

2.19 REEL BANKS, FIVE COMMODITY (ATF, CA, EC, EO, W)
Equipment Identifier: 7750

A. Reel bank shall consist of one each (ATF) reel, one each (CA) reel, one each (EC) reel, one each (EO) reel, and one each (W) reel as delineated in part 2.13 REEL BANKS, GENERAL of this specification section.

B. Reference Equipment Drawings for Details.

2.20 REEL BANKS, FIVE COMMODITY (ATF, CG, EC, EO, GO)
Equipment Identifier: 7751

A. Reel bank shall consist of one each (ATF) reel, one each (CG) reel, one each (EC) reel, one each (EO) reel, and one each (GO) reel as delineated in part 2.13 REEL BANKS, GENERAL of this specification section.

B. Reference Equipment Drawings for Details.

2.21 REEL BANKS, SIX COMMODITY (ATF, CA, CW, DEF, EC, EO)
Equipment Identifier: 7760

A. Reel bank shall consist of one each (ATF) reel, one each (CA) reel, one each (CW) reel, one each (DEF) reel, one each (EC) reel, and one each (EO) reel as delineated in part 2.13 REEL BANKS, GENERAL of this specification section.

B. Reference Equipment Drawings for Details.

2.22 TANK, TRIPLE WALL, POLYETHYLENE, 1,000 GALLON (DEF)
Equipment Identifier: 7838

A. Manufacturer’s Reference:
1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer’s name and model to establish minimum acceptable standards of quality, features, performance, and construction.

   a. KleerBlue Solutions
   b. Evansville, IN (800) 320-2122
   c. Model No.: SBD KB3850 with accessories
   d. Reference Equipment Drawings

2. Alternate manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.

   a. Blue 1 USA, Duluth, GA (770) 668-1958
   b. Poly Processing, Winchester, VA (877) 591-4827

B. Capacities/Dimensions:

1. Overall dimensions:

<table>
<thead>
<tr>
<th>Dimensions (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
</tr>
<tr>
<td>Equipment</td>
</tr>
</tbody>
</table>

2. Capacity: 1,000 gallons

C. Features/Performance/Construction:

1. All above-ground DEF fluid storage systems shall be constructed with national, state, and locally recognized standards including: Certified by CSA to UL-508, ANSI/UL 50, CSA 22.2 No. 14-10 & 94-M1991, electrical safety standards for Industrial Control Equipment in the USA and Canada. Meets ISO 22241-3 & 4 Standards for the handling, storage and dispensing of Diesel Exhaust Fluid (DEF). Unit shall be fluid tested, pre-piped and wired.

2. Tank assembly: 1,000 gallon true capacity single wall polyethylene primary tank within a blue double-wall polyethylene containment shell that shall be UV8 protected, R16 insulated with 2# density polyurethane foam insulation (top, sides and bottom), impact resistant, corrosion proof

3. Environmentally safe triple wall containment.

4. Digital level gauge shall be mounted on tank fill end. Display in gallons.

5. Unit shall include a securable DEF fill access door.

6. Mechanical overfill protection.

7. Venting: Primary and secondary

8. Submersible pump: Reference equipment ID #7600 Pump, submersible, 3/4 HP
9. Tank shall include an external dial thermometer in fill access compartment for verifying tank temperature.

10. Tank fill inlet: 2 inches. Include a 2 inch stainless steel ball valve and stainless steel male kamvalok adaptor OPW No. 1672, 2 inch mounted on the 2 inch stainless steel ball valve.

11. Installation of tank shall include all seismic bracing and anchorage to meet local, state, and federal codes and provisions.

D. Controls:

1. Switch box and motor starter shall include Switch box and motor starter product with one pump relay and two dispenser relays, KleerBlue No. SBD SWBOX2D.

2. Tank product and discharge shall include a black, powder coated steel cover; KleerBlue No: SBD TRANCVR-1:

E. Utility Requirements:

<table>
<thead>
<tr>
<th>1. Electrical:</th>
<th>Unit Heater/TM</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Connection Requirements</td>
<td></td>
</tr>
<tr>
<td>Voltage</td>
<td>120</td>
</tr>
<tr>
<td>Phase</td>
<td>1</td>
</tr>
<tr>
<td>Amps</td>
<td>20</td>
</tr>
</tbody>
</table>

2.23 TANK, DOUBLE WALL, CUBE, 500 GALLON (ATF, EC)
Equipment Identifier: 7970

A. Manufacturer’s Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer’s name and model to establish minimum acceptable standards of quality, features, performance, and construction.

| a. Containment Solutions, Incorporated |
| b. Conroe, TX (936) 756-7731 |
| c. Model No.: LC500DW with accessories |

| d. Reference Equipment Drawings for Details |

2. Alternate manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.

| a. Dynafab Corporation, Tomball, TX (281) 590-5467 |

B. Capacities/Dimensions:
1. Overall dimensions:

<table>
<thead>
<tr>
<th>Dimensions (inches)</th>
<th>Length</th>
<th>Width</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Equipment</td>
<td>61</td>
<td>46</td>
<td>61</td>
</tr>
</tbody>
</table>

2. Capacity: 500 gallons

3. Dry weight: 1,425 pounds

C. Features/Performance/Construction:

1. Above ground used oil collection and fluid storage systems shall be constructed in accordance with national, state, and locally recognized Above Ground Storage Tank standards, including: Uniform Fire Code, Article 79, National Fire Protection Association Sections 30, 30A, and 31, and Underwriters Laboratory Standard 142.

2. The components of the system shall be assembled and tested at the factory and shall be covered under warranty.

3. The above ground double wall tank shall be designed and UL listed as an atmospheric tank with a maximum working pressure of 1 PSI.

4. The primary and secondary storage tanks shall have passed a proof of design hydrostatic pressure test of 25 PSI.

5. The above ground double wall tank shall be equipped with nine NPT openings including two for primary and secondary emergency venting as required by UL-142.

6. Primary tank enclosure:
   a. Primary storage tank shall be rectangular in design and constructed with ASTM A-569 or A-36 carbon steel with continuous welds. Tank shall be equipped with lifting lugs.
   b. Primary storage tank shall be constructed and pressure tested (minimum 3 PSI) in accordance with UL-142 standards and carry the appropriate marking.
   c. Tank enclosure shall be supported by two 3-inch high steel support feet channels with internal anchoring holes to maintain ground clearance.

7. Secondary tank enclosure:
   a. Secondary storage tank shall be a rectangular design constructed with ASTM A-569 or A-36 carbon steel with continuous welds and listed by Underwriters Laboratories as secondary containment.
   b. Secondary enclosure shall provide a minimum of 110 percent secondary containment.
   c. Secondary enclosure shall be equipped with a 2 inch monitoring port and a 4 or 6 or 8 inch emergency vent port as required by Underwriters Laboratories.
   d. Secondary storage tank shall be constructed and pressure tested (minimum 3 PSI) in accordance with UL-142 standards and carry the appropriate marking.
8. Installation of tank shall include seismic bracing and anchoring to meet all local, state, and federal codes and provisions.

9. Double float tank gauge that is calibrated by gallons or inches (Scully or equal).

10. Venting:
    a. Primary: 4 inch NPT(M) (Morrison Brothers or equal)
    b. Secondary: 6 inch NPT(M) (Morrison Brothers or equal)

11. Spill box, 7 gallon, welded to tank

D. Accessories:

| 1. Tank monitoring system with high level detection and alarm siren: BJ Enterprises, (800) 457-0749 Model No. 007 10706 (one each per UC/UO tank) |

E. Utility Requirements:

<table>
<thead>
<tr>
<th>1. Electrical:</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Connection Requirements</td>
</tr>
<tr>
<td>Voltage</td>
</tr>
<tr>
<td>Phase</td>
</tr>
<tr>
<td>Amps</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Mechanical:</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Venting:</td>
</tr>
<tr>
<td>Connection (inches)</td>
</tr>
</tbody>
</table>

F. Finish: Durable enamel in manufacturer's standard color

2.24 DRAIN PAN, USED OIL, ROLLING

Equipment Identifier: 7996

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer’s name and model to establish minimal acceptable standards of quality, features, performance, and construction.

<table>
<thead>
<tr>
<th>a. Graco Incorporated</th>
</tr>
</thead>
<tbody>
<tr>
<td>b. Minneapolis, MN (612) 623-6000</td>
</tr>
<tr>
<td>c. Model No.: 218 969 with accessories</td>
</tr>
</tbody>
</table>
2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Location</th>
<th>Phone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balcrank Products, Inc.</td>
<td>Weaverville, NC</td>
<td>(828) 645-4261</td>
</tr>
<tr>
<td>Lincoln (A Pentair Company)</td>
<td>St. Louis, MO</td>
<td>(314) 679-4200</td>
</tr>
</tbody>
</table>

B. Capacities/Dimensions:

1. Overall dimensions:

<table>
<thead>
<tr>
<th>Dimensions (inches)</th>
<th>Length</th>
<th>Width</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Equipment</td>
<td>33</td>
<td>24</td>
<td>11</td>
</tr>
</tbody>
</table>

2. Wheels: 3 inches

3. Track width: 37.5 to 46 inches

4. Running width: 2.5 inches

5. Capacity: 30 gallons

C. Features/Performance/Construction:

1. Drain pan wheels shall be adjustable to fit pit opening width of 37.5 to 46 inches.

2. Wheels: Drain pan shall be equipped with four wheels, each having a 3 inch diameter minimum suitable for rolling in 4 by 2 inch steel channels recessed in inspection pit walls below the top edge of the finished shop floor.

3. Drain: The drain pan shall be equipped with 1/4 turn shut-off valve and dry break disconnect coupler with 6 feet of 1-1/2 inch suction hose for emptying pan.

4. Hose shall be hard plumbed to the used oil tank. Provide a wall mounted hook for storing hose/coupler assembly when not in use.

5. Unit shall be constructed of 12 gauge steel.

6. The unit shall contain anti-splash grill and baffles to provide for large drain area and prevent spills.

7. The unit shall include following as standard equipment:
   a. 1-1/2 inch NPT drain valve
   b. 1-1/2 inch NPT quick coupler (two)
   c. 1-1/2 inch NPT coupler cap
   d. 1-1/2 inch NPT camlock

D. Accessories:
1. Hose, 6 feet at 1-1/2 inch diameter: Graco No. 108205 (one each)
2. "J" hook to hold hose at coupler

E. Finish:
   1. Primed and finished in Owner’s choice of manufacturer’s standard enamel
   2. Provide “USED OIL” label in minimum 2 inch high painted red letters on both long sides of drain pan

2.25 DRAIN PAN, USED COOLANT, ROLLING
Equipment Identifier: 7997

A. Manufacturer’s Reference:
   1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer’s name and model to establish minimal acceptable standards of quality, features, performance, and construction.
      a. Graco Incorporated
      b. Minneapolis, MN (612) 623-6000
      c. Model No.: 218 969 with accessories
   2. Alternate manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.
      a. Balcrank Products, Inc., Weaverville, NC (828) 645-4261
      b. Lincoln (A Pentair Company), St. Louis, MO (314) 679-4200

B. Capacities/Dimensions:
   1. Overall dimensions:
      
      | Dimensions (inches)         | Length | Width | Height |
      |----------------------------|--------|-------|--------|
      | Equipment                  | 33     | 33    | 14     |

   2. Wheels: 3 inches
   3. Track width: 37.5 to 46 inches
   4. Running width: 2.5 inches
   5. Capacity: 30 gallons

C. Features/Performance/Construction:
1. Drain pan wheels shall be adjustable to fit pit opening width of 37.5 to 46 inches.

2. Wheels: Drain pan shall be equipped with four wheels, each having a 3 inch diameter minimum suitable for rolling in 4 by 2 inch steel channels recessed in inspection pit walls below the top edge of the finished shop floor.

3. Drain: The drain pan shall be equipped with 1/4 turn shut-off valve and dry break disconnect coupler with 6 feet of 1-1/2 inch suction hose for emptying pan.

4. Hose shall be hard plumbed to the used coolant tank.

5. Unit shall be constructed of 12 gauge steel.

6. The unit shall contain anti-splash grill and baffles to provide for large drain area and prevent spills.

7. The unit shall include following as standard equipment:
   a. 1-1/2 inch NPT drain valve
   b. 1-1/2 inch NPT quick coupler
   c. 1-1/2 inch NPT coupler cap
   d. 1-1/2 inch NPT camlock

D. Accessories:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Hose, 6 feet at 1-1/2 inch diameter: Graco No. 108205 (one each)</td>
</tr>
<tr>
<td>2.</td>
<td>&quot;J&quot; hook to hold hose at coupler</td>
</tr>
</tbody>
</table>

E. Finish:

1. Primed and finished in Owner’s choice of manufacturer’s standard enamel

2. Provide “USED COOLANT” label in minimum 2 inch high painted red letters on both long sides of drain pan

2.26 RECEIVER, USED COOLANT, 25 GALLON

Equipment Identifier: 7998

A. Manufacturer’s Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer’s name and model to establish minimal acceptable standards of quality, features, performance, and construction.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Graco, Incorporated</td>
</tr>
<tr>
<td>b.</td>
<td>Minneapolis, MN (800) 533-9655</td>
</tr>
<tr>
<td>c.</td>
<td>Model No.: 248632</td>
</tr>
</tbody>
</table>
2. Alternate manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.

| a. Balcrank Corporation, Weaverville, NC (828) 645-4261 |
| b. Lincoln, A Pentair Company, St. Louis, MO (314) 679-4200 |

B. Capacities/Dimensions:

1. Overall dimensions:

<table>
<thead>
<tr>
<th>Dimensions (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
</tr>
<tr>
<td>a. Equipment</td>
</tr>
</tbody>
</table>

2. Dry weight: 54 pounds
3. Fluid inlet/inspection port size: 3 inch (76 millimeter) buttress
4. Capacity: 25 gallons
5. Fluid outlet fitting size: 3/4 inch NPT
6. Collection funnel size: 22 by 24 inches

C. Features/Performance/Construction:

1. Unit shall be constructed of heavy duty, durable UV-stabilized polymer.
2. Unit shall include a 3/4 inch gravity feed drain valve and a quick disconnect method of suction-evacuation from the top of the unit.
3. Unit shall be mounted on semi-pneumatic, synthetic rubber wheels and polyurethane front casters.
4. Unit shall contain a funnel assembly capable of extending to 72 inches.
5. Unit shall be dent, rust, and corrosion resistant.
6. Unit shall be capable of handling coolant ant temperatures below 31 degrees F to above 219 degrees F.
7. Tank shall be equipped with tool holders and sight gauge.
8. Tank shall be equipped with a removable filter to prevent debris from entering the tank.

D. Finish: UV-stabilized polymer complete with necessary markings to readily identify contents.
1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer’s name and model to establish minimal acceptable standards of quality, features, performance, and construction.

   a. Graco, Inc.
   b. Minneapolis, MN (800) 533-9655
   c. Model No.: 238866

2. Alternate manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.

   a. Balcrank Corporation, Weaverville, NC (828) 645-4261
   b. Lincoln (A Pentair Company), St. Louis, MO (314) 679-4200

B. Capacities/Dimensions:

1. Overall dimensions:

<table>
<thead>
<tr>
<th>Dimensions (inches)</th>
<th>Length</th>
<th>Width</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Equipment</td>
<td>24</td>
<td>24</td>
<td>45</td>
</tr>
</tbody>
</table>

2. Fluid inlet/inspection port size: 3 inch (76 millimeter) buttress

3. Fluid outlet fitting size: 3/4 inch NPT

4. Collection funnel size: 22 by 24 inches

5. Capacity: 25 gallons

C. Features/Performance/Construction:

1. Unit shall be constructed of heavy duty, durable UV-stabilized polymer.

2. Unit shall include a gravity feed drain valve and a quick disconnect method of suction-evacuation from the top of the unit.

3. Unit shall be mounted on semi-pneumatic, synthetic rubber wheels and polyurethane front casters.

4. Unit shall contain a funnel assembly capable of extending to 72 inches.

5. Unit shall be dent, rust, and corrosion resistant.

6. Unit shall be capable of handling oil at temperatures of below 31 degrees F to above 219 degrees F.

7. Tank shall be equipped with tool holders and a sight gauge.

8. Tank shall be equipped with a removable filter to prevent debris from entering the tank.
D. Finish: UV-stabilized polymer complete with necessary markings to readily identify contents

PART 3 - EXECUTION

3.01 INSPECTION

A. Coordinate location of rough-in work and utility stub-outs to assure match with equipment to be installed.

B. Inspect equipment for damage from shipping and exposure to weather. Compare delivered equipment with packing lists and specifications to assure receipt of all equipment items and specified accessories.

3.02 INSTALLATION

A. Perform work under direct supervision of Foreman of Construction Superintendent with authority to coordinate installation of scheduled equipment with Architect.

B. Install equipment in accordance with plans, shop drawings, and manufacturer's instructions:

1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level (or slight slope as required by instructions), plumb, and at right angles to adjacent work.

2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.

3. Anchorage: Attach equipment as detailed or directed by Architect or designated representative. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.

4. Air compressor and dryer system:
   a. Install compressor unit on concrete foundation with sole plates and isolators. Level, grout, and bolt in place.
   b. Make air cock and drain connection on horizontal casing.
   c. Install line size ball valve and anti-return valve on compressor discharge.
   d. Install replaceable cartridge type filter silencer of adequate capacity for each compressor.
   e. Install condensate filter between compressor and dryer
   f. Connect condensate drains to nearest floor drain.
   g. Install valved bypass around air dryer. Factory insulate inlet and outlet connections.
   h. Install takeoffs to outlets from top of main with shutoff valve after takeoff.

5. Fluid storage tanks:
   a. Tank shall be seismically braced and anchored to meet all local, state, and federal codes and provisions.
   b. Used oil tank shall be vented to the outside of the building.
   c. Remove support feet channels prior to final installation.

C. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.
3.03 TESTING
   A. After final connections are made and prior to authorizing payment, specified equipment shall be tested for compliance with specifications in the presence of the Architect or designated representative using acceptance procedures provided by the manufacturer. Testing report shall be submitted to the Architect or designated representative.

3.04 CLEANUP
   A. Touch-up damage to painted finishes.
   B. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.
   C. Clean area around equipment installation and remove packing and installation debris from job site.
   D. Notify Architect or designated representative for acceptance observation.

3.05 TRAINING
   A. Direct the technical representative to provide specified hours of training to designated Owner’s maintenance personnel in operation and maintenance of the following equipment. Coordinate, with Owner, training schedule and list of personnel to be trained.
      1. 2153 Compressor, air, base mounted, 10 HP; 2 hours (minimum)
      2. 2188 Compressor, screw, rotary, 30 HP; 1 hour (minimum)
      3. 2189 Compressor, screw, rotary, 50 HP; 1 hour (minimum)
      4. 2228 Dryer, air, refrigerated, 100 CFM; 1 hour (minimum)
      5. 2235 Dryer, air, refrigerated, 360 CFM; 1 hour (minimum)
      6. 6290 Breathable air filters; 2 hours (minimum)
      7. 7510 Pump, air piston (CG), with hoist; 1 hour (minimum)
      8. 7520 Pump, air piston, 10:1 ratio (ATF, EO, GO); 1 hour (minimum)
      9. 7530 Pump, diaphragm, mixing (EC); 1 hour (minimum)
     10. 7540 Pump, diaphragm, used fluid evacuation (UO); 1 hour (minimum)
     11. 7541 Pump, diaphragm, used fluid evacuation (UC); 1 hour (minimum)
     12. 7600 Pump, submersible, 3/4 HP (DEF); 1 hour (minimum)
     13. 7700 Reel banks, general; 1 hour (minimum)
     14. 7838 Tank, triple wall, polyethylene, 1,000 gallon; 2 hours (minimum)
     15. 7970 Tank, double wall, cube, 500 gallon (ATF, EC); 1 hour (minimum)
     16. 7998 Receiver, used coolant, 25 gallon; 1 hour (minimum)
     17. 7999 Receiver, used oil, 25 gallon; 1 hour (minimum)
B. Obtain, from technical representative, a list of Owner's personnel trained in equipment operations and maintenance.

END OF SECTION
SECTION 11 11 29
SHOP EQUIPMENT

PART 1 - GENERAL

The General Provisions of the Contract, including General and Special Conditions and the requirements of Division 1, apply to the Work in this Section.

1.01 WORK INCLUDED

A. Equipment items as listed below by Equipment Identifier:
   1. 2042 Charger, battery, multiple (Ref. Part 2.01)
   2. 2043 Charger, battery, multiple (Ref. Part 2.02)
   3. 3718 Washer, high pressure, hot water, NG, 4 GPM (Ref. Part 2.03)
   4. 3784 Washer, parts, automatic, front load (Ref. Part 2.04)
   5. 7490 Press, oil filter, electric (Ref. Part 2.05)
   6. 9315 Cover, safety, metal (Ref. Part 2.06)
   7. 9565 Probe, farebox (Ref. Part 2.07)
   8. 9901 Vault, collection, revenue, mobile (Ref. Part 2.08)

B. Roughing-in, installation of equipment, and final connection of utilities, with labor, services, and incidentals necessary for complete and operational equipment installation.

C. Piping, wiring, and switching between equipment and utilities.

1.02 QUALITY ASSURANCE

A. Equipment shall be produced by a manufacturer of established reputation with a minimum of five years experience supplying specified equipment.

B. Manufacturer’s Representative:
   1. Installation: Provide a qualified manufacturer’s representative at site to supervise work related to equipment installation, check out, and start up.
   2. Training: Provide technical representative to provide training to Owner’s maintenance personnel in operation and maintenance of specified equipment.

1.03 BUY AMERICA COMPLIANCE

A. The Contractor shall comply with the applicable Buy America requirements set forth in 49 U.S.C. 5323(j) and the applicable regulations in 49 C.F.R. Part 661, as amended. If the Contractor procures any capital items with Federal funds, it is the Contractor’s responsibility to obtain the Buy America certification required under such regulations.

B. Reference Division 1 for Buy America compliance.

1.04 SUBMITTALS
A. Product Data:
   1. Submit Product Data in accordance with Division 1 - General Requirements of these specifications.
   2. Restrict submitted material to pertinent data. For instance, do not include manufacturer’s complete catalog when pertinent information is contained on a single page.

B. Operations and Maintenance Manual:
   1. Submit Operations and Maintenance Manuals in accordance with Division 1 - General Requirements of these specifications.
   2. Provide complete parts, operating, and maintenance manual covering equipment at time of installation.
   3. Description of system and components.
   4. Schematic diagrams of electrical, plumbing, and compressed air system.
   5. Manufacturer’s printed operating instructions.
   6. Printed listing of periodic preventive maintenance items and recommended frequency to validate warranties. Failure to provide maintenance information will indicate that preventive maintenance is not a condition for validation of warranties.

C. Shop Drawings:
   1. Submit Shop Drawings in accordance with Division 1 - General Requirements of these specifications.
   2. Submit site specific installation drawings and procedures.

1.05 PRODUCT SUBSTITUTIONS

A. Follow requirements specified in Division 1 - General Requirements.

B. Additional costs resulting from substitution of products other than those specified, by model number, including drawing changes and construction, will be at the expense of the Contractor.

C. Substitution Approval: Prior to delivery or installation, submittals for each equipment item by Equipment Identifier shall be provided in accordance with Division 1 - General Requirements. Acceptance will be based on the technical requirements herein as determined by Owner and Architect.

1.06 WARRANTY

A. Warrant work specified herein for one year from substantial completion against defects in materials, functions, and workmanship.

B. Warranty shall include materials and labor necessary to correct defects.

C. Defects shall include, but not be limited to noisy, rough or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish.

D. Submit warranties in accordance with Division 1 - General Requirements of these specifications.

E. All parts shall be readily available locally in the United States.
1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in manufacturer’s containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid and/or dusty conditions.

B. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Equipment Identifier of this specification.

C. Provide equipment and materials specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

1.08 LABELING

A. Manufacturer shall securely attach in a prominent location, on each major item of equipment, a non-corrosive nameplate showing manufacturer’s name, address, model number, serial number, and pertinent utility or operating data.

B. All electrical equipment and materials shall be new and shall be listed by Underwriter’s Laboratories, Inc. (UL) in categories for which standards have been set by that agency and labeled as such in the manufacturer’s plant.

PART 2 - PRODUCTS

2.01 CHARGER, BATTERY, MULTIPLE

Equipment Identifier: 2042

A. Manufacturer’s Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer’s name and model to establish minimal acceptable standards of quality, features, performance, and construction.

   a. Auto Meter Products
   b. Sycamore, IL (866) 883-8378
   c. Model No.: BusPro-600s

2. Alternate manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.

   a. Clore Automotive, Lenexa, KS (913) 310-1050
   b. Schumer Electric Corporation, Mount Prospect, IL (800) 621-5485

B. Capacities/Dimensions:

1. Overall dimensions:
Dimensions (inches)

<table>
<thead>
<tr>
<th></th>
<th>Length</th>
<th>Width</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment</td>
<td>36</td>
<td>3</td>
<td>8</td>
</tr>
</tbody>
</table>

2. Charging output: 5 A, maximum
3. Charging capacity: Up to 12, 12 volt batteries
4. Maintenance output: 0 to 2.5 A variation as needed
5. Battery charger weight: 29 pounds

C. Features/Performance/Construction:
1. Cabinet: Unit shall be enclosed in bonderized steel cabinet with reinforced frame and gasketed access panel, suitable for permanent installation, including wall mounting.
2. Unit shall have six 6 foot, 18 GA leads.
3. Unit shall include wall mounting brackets.
4. Unit shall have integrated bus bar.

D. Utility Requirements:

1. Electrical:
   a. Connection Requirements
      
      | Voltage | Unit  |
      |---------|-------|
      | 120     |       |
      | Phase   | 1     |
      | Amps    | 7.5   |

E. Finish: Durable enamel in manufacturer's standard color

2.02 CHARGER, BATTERY, MULTIPLE
Equipment Identifier: 2043

A. Manufacturer’s Reference:
1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer’s name and model to establish minimal acceptable standards of quality, features, performance, and construction.

   a. Auto Meter Products
   b. Sycamore, IL (866) 883-8378
   c. Model No.: BusPro-620s
2. Alternate manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.

<table>
<thead>
<tr>
<th>No.</th>
<th>Manufacturer</th>
<th>Phone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Clore Automotive, Lenexa, KS (913) 310-1050</td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>Schumer Electric Corporation, Mount Prospect, IL (800) 621-5485</td>
<td></td>
</tr>
</tbody>
</table>

B. Capacities/Dimensions:

1. Overall dimensions:

<table>
<thead>
<tr>
<th>Dimensions (inches)</th>
<th>Length</th>
<th>Width</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Equipment</td>
<td>38</td>
<td>3</td>
<td>8</td>
</tr>
</tbody>
</table>

2. Charging output: 5 A, maximum
3. Charging capacity: up to 12, 12 volt batteries
4. Maintenance output: 0 to 2.5 A variation as needed
5. Battery charger weight: 29 pounds

C. Features/Performance/Construction:

1. Cabinet: Unit shall be enclosed in bonderized steel cabinet with reinforced frame and gasketed access panel, suitable for permanent installation, including wall mounting.
2. Unit shall have six 6 foot, 18 GA leads.
3. Unit shall include wall mounting brackets.
4. Unit shall have integrated bus bar.

D. Utility Requirements:

<table>
<thead>
<tr>
<th>1. Electrical:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Connection Requirements</td>
<td>Unit</td>
</tr>
<tr>
<td>Voltage</td>
<td>220</td>
</tr>
<tr>
<td>Phase</td>
<td>1</td>
</tr>
<tr>
<td>Amps</td>
<td>3.75</td>
</tr>
</tbody>
</table>

E. Finish: Durable enamel in manufacturer’s standard color

2.03 WASHER, HIGH PRESSURE, HOT WATER, NG, 4 GPM
Equipment Identifier: 3718
A. Manufacturer’s Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer’s name and model to establish minimum acceptable standards of quality, features, performance, and construction.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Address</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hotsy Corporation</td>
<td>Camas, WA (360) 833-1600</td>
<td></td>
</tr>
<tr>
<td>945N with accessories</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Alternate manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Address</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landa, Inc.</td>
<td>Camas, WA (800) 526-3248</td>
<td></td>
</tr>
<tr>
<td>Alkota Cleaning System</td>
<td>Alcester, SD (605) 934-2222</td>
<td></td>
</tr>
</tbody>
</table>

B. Capacities/Dimensions:

1. Overall dimensions:

<table>
<thead>
<tr>
<th>Dimensions (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length Width Height</td>
</tr>
<tr>
<td>47-1/2 21 51</td>
</tr>
</tbody>
</table>

2. Net weight: 545 pounds
3. Pump motor: 460 VAC, 3 phase, 5 HP
4. Operating pressure: 2,000 PSI
5. Maximum discharge capacity: 4 GPM

C. Features/Performance/Construction:

1. Burner: NG fired, 365,000 BTU/hr, AGA-listed gas controls, ring type with aspirating spuds, natural draft.
2. All open flames and fire rings shall be mounted at minimum of 18 inches above the finished floor.
3. Heating coil: vertically-fired; 7/8 inch OD, hydrostatic-pressure tested; 14,900 PSI burst-rated.
4. Water pump: Triplex water pump with positive displacement, ceramic plungers, brass manifold, and oil bath crankcase.
5. Fabrication: Welded angle iron frame shall have heavy gauge tank and cabinet.
6. Piping: Supplier shall provide piping (Schedule 80) from high-pressure wash unit to each trigger gun wand for a complete and operable system.
7. Manufacturer shall supply all necessary soap system equipment including piping, fittings, distribution hose, and connections for a complete and operable soap distribution system.

8. Shall have a time delay shut down.

D. Controls: Adjustable temperature controller, safety pressure relief valve, pressure switch, ON/OFF electric motor switch with overload protection, unloader, water heater switch, detergent valve and automatic, non-contaminating float valve.

E. Accessories:

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Model/Serial Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Contractor supplied scabbard for trigger gun, wall mounted, fabricated, one each per trigger gun location</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Scabbard: Hotsy No. 711135 (one each per hose reel)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Trigger gun: Hotsy No. 353010 (one each per hose reel)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>50 foot hose: Hotsy No. 87391210 (one each per hose reel)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>36 inch wand: Hotsy No. 87112690 (one each per hose reel)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Nozzle (154, 4,000 PSI hardened steel): Hotsy No. 87087020 (one each per hose reel)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Quick coupler: Hotsy No. 844850 (one each per hose reel)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>360 rapid reel pivot reel: Hotsy No. 87504860 (one each per location shown on Equipment Drawing)</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Remote starter: Hotsy No. 89169890 (one each per hose reel)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Remote soap option: Hotsy No. 8916988 (one each per hose reel)</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Additional nozzles (four pack, 0, 15, 25, 45 degrees, color coded, QC nozzles): Hotsy No. 87087120 (one each per washer)</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>360 ceiling boom: Zierco No. 204, 12 feet (one each)</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Draft diverter: Hotsy No. 87177280 (one each per washer)</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Breakthrough detergent, 55 gallons: Hotsy No. 89053900 (one each per washer)</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Powershine plus detergent, 55 gallons: Hotsy No. 89051800 (one each per washer)</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Contractor supplied replacement nozzle holder, wall mounted, fabricated, one each per trigger gun location</td>
<td></td>
</tr>
</tbody>
</table>

F. Utility Requirements:
### 1. Electrical:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>460</td>
</tr>
<tr>
<td>Phase</td>
<td>3</td>
</tr>
<tr>
<td>HP</td>
<td>5</td>
</tr>
<tr>
<td>Amps</td>
<td>8</td>
</tr>
</tbody>
</table>

- **a.** Connection Requirements
- **b.** Connection Type: Provide disconnect

### 2. Plumbing:

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic Water</td>
<td></td>
</tr>
<tr>
<td>Connection (inches)</td>
<td>5/8</td>
</tr>
<tr>
<td>Flow Rate (GPM)</td>
<td>4</td>
</tr>
<tr>
<td>Capacity (PSI)</td>
<td>30</td>
</tr>
</tbody>
</table>

- **a.** Domestic Water:
- **b.** Natural Gas:

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection (inches)</td>
<td>3/4</td>
</tr>
<tr>
<td>Capacity (BTU)</td>
<td>364,835</td>
</tr>
</tbody>
</table>

### 3. Mechanical:

- **a.** Venting:

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection (inches)</td>
<td>8</td>
</tr>
</tbody>
</table>

G. **Finish:** Durable enamel in manufacturer’s standard color

---

2.04 **PARTS WASHER, AUTOMATIC, FRONT LOAD**

**Equipment Identifier:** 3784

**A. Manufacturer’s Reference:**

1. **Prime manufacturer:** Specifications are based on equipment identified herein by manufacturer’s name and model to establish minimum acceptable standards of quality, features, performance, and construction.

   - **a.** Better Engineering
   - **b.** Baltimore, MD (410) 931-0000
   - **c.** Model No.: G-2000 (mild steel)

2. **Alternate manufacturers:** Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.
a. Karcher Cuda Series, Denver, CO (303) 738-2400  
b. Landa Inc., Camas, WA (360) 833-9100

B. Capacities/Dimensions:

1. Overall dimensions:

<table>
<thead>
<tr>
<th>Dimensions (inches)</th>
<th>Length</th>
<th>Width</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Equipment</td>
<td>42</td>
<td>49</td>
<td>79</td>
</tr>
</tbody>
</table>

2. Interior working dimensions:
   a. Turntable diameter: 27 inches
   b. Working height: 35 inches

3. Load capacity: 500 pounds

4. Pump performance: Total output: 60 GPM at 45 PSI

5. Sump capacity: 55 gallons

C. Features/Performance/Construction:

1. The cabinet shall be built with mild steel and sheet metal with a thickness of at least 1 gauge.

2. Roll away door shall roll into unit without requiring any additional space around the unit footprint.

3. Turntable:
   a. Turntable rim and spokes shall have a minimum thickness of 3/16 inches
   b. 1 inch open mesh material covers the surface of the turntable
   c. Drive chain

4. Turntable drive system:
   a. Positive wrap-around chain drive
   b. Anti-jamming protection
   c. TEFC drive motor

5. The cleaning chamber shall be sealed off from the holding tank to prevent parts from falling into the holding tank and forces the solution into a removable chip basket above the tank solution level.

6. Water filtration system shall recirculate the solution to filter out and remove large particles and floating oils.
a. Removable chip basket with 1/16 inch perforations shall filter solution before it returns to the reservoir.

b. Oil may be skimmed by opening a side valve which allows floating oil to run into a weir pan.

7. Heating system/holding tank:
   a. Standard heating system is electric
   b. Heating system is turned on and off with a programmable timer
   c. Temperature controlled with an adjustable thermostat that has a probe sensor

8. Spray manifolds:
   a. Stainless steel, "V" jet spray nozzles
   b. Manifolds positioned above, below, and on the outside of the turntable
   c. Front loading models have a mid-level, overhead spray manifold that pivots out of the way for tall parts

9. Mid-swing cleaning manifold

10. Unit shall have a 29 inch loading height

11. Portable: Unit shall be mounted on 3 inch casters

12. Unit shall be insulated to prevent heat loss

13. Standard features include the following:
   a. ZXG-11 upper level turntable:
      1) A removable upper turntable is installed which doubles the machine's cleaning capacity for smaller parts.
      2) Both levels have "C-shaped" spray manifolds for full coverage.
   b. WLS-F1 low water shut down and fill:
      1) Whenever the float sensor is not in its high position, a solenoid valve opens to fill the tank.
      2) Fill solenoid is deactivated during the cleaning cycle and for 30 seconds after the completion of the cleaning cycle to prevent a false "fill" signal.
      3) Water is added in small increments (when the water level drops as little as 1/16 inches) preventing a big drop in tank temperature that would otherwise occur if a lot of cold water was added at once.
      4) If the water level reaches "critical low", the heaters are turned off and a warning light is illuminated.
   c. OSK-11 oil skimmer:
1) The operator simply opens a side valve... the floating oils run into a built-in weir pan and out the side drain.

2) When the flow stops (approximately 5 minutes), the operator closes the side-drain which activates a limit switch.

3) The limit switch re-activates the unit and the water level rises to the normal level.

4) Includes a receiver bucket with a bottom drain to remove water content.

d. ILS-11 In-line strainers:

1) Installed between pump and spray manifolds to prevent clogged nozzles.

2) Removable screen with 1/32 inch perforations.

3) Rosedale brand with hinged top and eye bolts (not band clamp style). Rated for 100 GPM.

4) Pressure gauge indicates when filter must be cleaned.

e. ILF-22 micron filters:

1) Filter housing with micron rated bag installed between pump and spray manifolds.

2) Prevents re-deposition of fine particles.

3) Rosedale brand with hinged top and eye bolts (not band clamp style).

4) Rated for 100 GPM.

5) Pressure gauge indicates when filter has to be changed.

f. ASX-11 automatic steam exhaust:

1) Cast aluminum direct driven fan evacuates steam from the cleaning chamber.

2) Three-mode selector switch on control panel includes the following commands:

a) OFF

b) Auto 1: Steam exhaust fan runs during entire cleaning cycle until door/lid is opened.

c) Auto 2: Starts after spray stages and remains on until door/lid is opened.

3) Condensate return line feeds condensed water back to the wash holding tank, preventing the accumulation of water in the fan housing.

g. ATC-24-1 automatic 7-day/24-hour timer:

1) Automatically turns the tank heaters on and off.

2) Allows manual over-ride.
h. SSB-22 hand brush:
   1) Stainless steel pump sends wash solution through the brush.
   2) Controlled with panel mounted on/off switch.

i. SPB-11 and SPB-22 small parts baskets:
   1) Rectangular basket with handles and a hinged lid, 1/16 inch perforations.
   2) Recommended for small parts that could otherwise get blown-out of the standard parts basket.
   3) SPB-11 measures 12 inch length by 6 inch width by 6 inch height.
   4) SPB-22 measures 15 inch length by 9 inch width by 6 inch height.

j. CTR-11 Center rod and PTR-11 parts tree:
   1) The CTR-11 is a removable center rod that helps to stabilize tall parts.
   2) The PTR-11 is a removable parts tree to hang smaller parts.

k. HAR-11 Hydro-air rinse gun:
   1) Hand-held gun for manual rinsing with fresh water gun has connection points for a water line and an air line.

D. Controls:
   1. Control system shall include:
      a. Digital temperature control including heat timer
      b. Digital temperature read out
      c. Digital water level controls (normal, low and emergency high)
      d. Automatic water fill
      e. Foam sensor and shutdown
      f. Programmable heat timer
      g. Self diagnostics
      h. Automatic oil skimmer
      i. Turntable Rotation Sensor/Jam Protection
      j. Low water warning and shutdown

   2. NEMA 12 control panel and junction boxes

E. Utility Requirements:
1. **Electrical:**
   a. **Connection Requirements**
      
      | Requirement       | Unit |
      |-------------------|------|
      | Voltage           | 460  |
      | Phase             | 3    |
      | HP                | 3    |
      | Amps              | 18   |

2. **Plumbing:**
   a. **Domestic Water:**
      
      | Connection (inches) | 1/2 |

3. **Mechanical:**
   a. **Venting:**
      
      | Connection (inches) | 3    |

---

F. **Finish:** Prime washer with epoxy compatible primer and finish with epoxy enamel in manufacturer's standard color.

2.05 **PRESS, OIL FILTER**

**Equipment Identifier:** 7490

A. **Manufacturer’s Reference:**

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish acceptable standards of quality, performance, features, and construction.

   a. Oberg International
   b. Monroe, WA (360) 805-9099
   c. Model No.: P-200L

2. Alternate manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.

   a. Caterpillar, Inc., Peoria, IL (309) 675-1000
   b. Lincoln (A Pentair Company), St. Louis, MO (314) 679-4200

B. **Capacities/Dimensions:**

1. Overall dimensions:
### Dimensions (inches)

<table>
<thead>
<tr>
<th></th>
<th>Length</th>
<th>Width</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Equipment</td>
<td>23-1/2</td>
<td>32-1/2</td>
<td>92</td>
</tr>
</tbody>
</table>

2. Cavity size: 9 by 11 by 16 inches
3. Weight: 700 pounds
4. Motor: 1 HP
5. Hydraulic pressing force: 31,416 pounds
6. Cycle time: 35 seconds

#### C. Features/Performance/Construction:

2. Material thickness:
   a. Tower and leg components: 5/16 inch
   b. Shrouds, top and back panels: 1/16 inch
3. Structural components: All structural components used in cylinder mounts and crusher block assemblies shall be made of A-36 merchant quality steel or better.
4. Hydraulic system: Hydraulic system components shall be designed to operate at a minimum on 2,500 PSI with a 3:1 safety factor.
5. Safety switch: Press shall be equipped with a safety switch to prevent operation when door is open.
6. Crushed filter storage: Unit shall have a trap door and provision for a 55 gallon drum to be located beneath to collect crushed filters.
7. Waste oil storage: Unit shall be plumbed directly to waste oil storage tanks located in the lower level of the Inspection Bay.
8. Shut off: Unit shall automatically shut off after each cycle.

#### D. Controls:
Controls and electrical components shall meet applicable National Electrical Code requirements.

#### E. Utility Requirements:
1. Electrical:

<table>
<thead>
<tr>
<th></th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>120</td>
</tr>
<tr>
<td>Phase</td>
<td>1</td>
</tr>
<tr>
<td>Amps</td>
<td>15</td>
</tr>
</tbody>
</table>

F. Finish: Durable enamel in Owner's choice of manufacturer's standard colors. All completed components shall be acid dipped prior to power coating.

2.06 COVER, SAFETY, METAL

Equipment Identifier: 9315

A. Manufacturer’s Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer’s name and model to establish minimal acceptable standards of quality, features, performance, and construction.

   a. Unilube Systems
   b. Ft. Worth, TX (817) 222-2253
   c. Model No.: Pit Guard, Pit Cover

2. Alternate manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers may be considered as equal.

   a. Devon Industries, Oklahoma City, OK (405) 943-3881
   b. TSS, Warren, MI (800) 682-7446

B. Capacities/Dimensions:

1. Inspection pit span: 44 inches; field measure prior to order
2. Inspection pit length: 60 feet, field measure prior to order
3. Pit cover size:
   a. Custom length and width per inspection pit; provide inspection pit dimensions prior to order
   b. Height: 2 inches
4. Weight: 35 to 38 pounds per pit cover
5. Capacity: Up to 1 ton

C. Features/Performance/Construction:
1. Pit cover shall be constructed of welded metal tubing, flat bar, and expanded metal.

2. Wheels shall be attached to frame with rivets

3. Covers roll on top of each other.

4. Pit covers shall cover entire pit opening.

D. Finish: Manufacturer’s standard color safety yellow, powder coat paint

2.07 PROBE, FAREBOX, AND SOFTWARE SYSTEM
Equipment Identifier: 9565

A. Manufacturer’s Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer’s name and model to establish acceptable standards of quality, performance, features, and construction.

   a. Genfare
   b. Elkgrove, IL (847) 593-8855
   c. Model No.: Garage Data System with accessories

B. General Description

1. The data collection and reporting system (DCRS) shall communicate with the fareboxes to extract transaction and event data and download operating parameters and related information. The DCRS shall communicate with the vault to extract cashbox identification from cashboxes inserted in the receiver. The DCRS shall provide data probes linked to a PC-compatible computer capable of extracting and storing data from the bus fareboxes during routine servicing. The data system shall be capable of generating comprehensive management reports for use by the Owner. Any existing system migrating from another location will be required to become integrated into the new DCRS system.

2. System equipment: Equipment shall include but not be limited to the following:

   a. Data probes, each with junction box, probe holder, lock boxes to secure the probe when not in use, interconnecting cabling, and an isolation box for transient voltage protection.

   b. Computer system consisting of a PC-compatible computer with display and keyboard, laser printer, and other hardware and software. Computer equipment to be provided by Owner.

   c. Uninterruptible Power Supply (UPS) for computer system, isolation box, and cashbox I.D. computer. UPS to be provided by Owner.

   d. Data collection software and single site use license.

   e. Miscellaneous hardware as required for a complete and operable installation.

   f. Cashbox ID computer (optional)

C. Features/Performance/Construction:
1. Data probe:
   a. A data probe shall be provided to permit bi-directional communications between the farebox and the data system by means of infrared technology.
   b. The probe shall be a handheld device positioned and touched to a mating data port on the farebox, requiring no plugs or physical electrical contact.
   c. The case of the data probe shall be a hardened aluminum extrusion or casting, containing the necessary hardware for communication between the probe and the farebox.
   d. The probe shall be configured with a window of infrared-transparent plastic behind which is a communications link composed of an LED and photosensor.
   e. A slot shall be provided within the extrusion to support the probe printed circuit board.
   f. A strain relief shall be provided to support the data cable.
   g. The data probe and cabling shall be capable of withstanding extended operations under extreme temperature and humidity variations and shall be impervious to degradation due to diesel fuel, gasoline, oil, transmission fluid, road salts, and sunlight. The data probe shall be capable of withstanding being dropped from a height of three feet onto a concrete surface with no resulting loss of operation.
   h. An LED lamp shall be provided in an easy-to-see location on the probe to aid in proper orientation and operation of the data probe. The LED shall pulse at a rate of once per second to indicate that the data computer is operational and the data probe is ready for use. Once the probe is interfaced with the farebox data port, the LED shall flicker while data is being exchanged and then glow steadily for five seconds to indicate that transmission has been completed.

2. Probe data cable:
   a. The data cable shall be custom made with three twisted wire pairs, a shield, and a heavy polyurethane jacket flexible at low temperatures and resistant to salt, moisture, abrasion and fuel.
   b. Cable length shall be 25 feet. The cable shall be supported in the center by a retractor mechanism designed to hold the cable out of the way when not in use.

3. Data probe balancer and hanger:
   a. The retractor may be attached to a supporting pole or wall.
   b. A probe holder shall be provided to hold the data probe between uses and a lockable box shall be provided to hold the data probe when not in use.

4. Junction box:
   a. Each data probe cable shall terminate in a junction box containing one or more connectors for the data probe cable(s) and a terminal strip for a cable connecting the junction box to the central isolation box.
   b. Junction boxes may be mounted on the supporting pole or to an existing structure, as appropriate
5. Supporting poles:
   a. Data probe supporting poles and all other equipment shall be properly grounded for
      lightning protection through existing electrical outlets.
   b. The data probe printed circuit board and isolation boxes shall have transient protection
      circuits.

6. Interconnection cable:
   a. Each data probe junction box shall be connected to a central isolation box. Both ends of
      the cable shall attach to screw terminals.
   b. Maximum cable length is not to exceed 1,500 feet.

7. Central isolation box:
   a. The data probe subsystem shall include an isolation box designed to protect the data
      computer and its operator from a near-hit by lightning.
   b. The isolation box shall contain a separate opto-isolating printed circuit board for each
      data probe powered from a common power supply.
   c. Terminal strips shall be provided for connection to each of the data probes.
   d. The isolation box shall typically be mounted on a wall within 10 feet of the data computer,
      where its case can be properly grounded.
   e. Cables shall connect the isolation box to the data computer. The isolation box shall have
      its own grounded power cord.

8. Computer equipment: Computer equipment to be provided by Owner.

D. Accessories:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Additional probe lane (quantity of three)</td>
<td></td>
</tr>
<tr>
<td>2. Probe data cable: Genfare No. A00469-001 (400 feet)</td>
<td></td>
</tr>
<tr>
<td>3. Data probe: spare, Genfare No. C00133-0006 (quantity of three)</td>
<td></td>
</tr>
</tbody>
</table>

E. Utilities:

<table>
<thead>
<tr>
<th></th>
<th>Connection Requirements</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Voltage</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>Phase</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Amps</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

2.08 VAULT, COLLECTION, REVENUE, MOBILE
Equipment Identifier: 9901
A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish acceptable standards of quality, performance, features, and construction.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. SPX Genfare</td>
<td>Elk Grove Village, IL (847) 593-8855</td>
</tr>
<tr>
<td>c. Model No.: Mobile Revenue Vault</td>
<td></td>
</tr>
</tbody>
</table>

B. Capacities/Dimensions:

1. Overall dimensions:

<table>
<thead>
<tr>
<th>Dimensions (inches)</th>
<th>Length</th>
<th>Width</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Equipment</td>
<td>38</td>
<td>41</td>
<td>60</td>
</tr>
</tbody>
</table>

2. Vault dimensions:

a. Length: 38 inches
b. Width: 41 inches
c. Height: 39 inches

3. Mobile bin:

a. Length: 30 inches
b. Width: 37 inches
c. Height: 35 inches

4. Receiver dimensions:

a. Length: 15 inches
b. Width: 32-3/4 inches
c. Height: 27 inches

5. Capacity:

a. Coins: $10,000
b. Bills: $10,000

6. Weight:

a. Empty: 460 pounds
b. Full: 1,100 pounds

C. Features/Performance/Construction:

1. The equipment used to transfer revenue from the cash box shall include a mobile bin (vault assembly), cashbox receiver, and mobile bin housing.

2. Vault shall be constructed of carbon steel.

3. Heavy duty casters shall be 6 inches (two fixed and two swivel).

4. Mobile bin shall be no more than 32 inches wide to fit through a 36 inch-wide door.

5. Mobile bin shall have channels to accept forks of a forklift.

6. Revenue transfer:
   a. The revenue transfer process shall be automatic and require only 15 seconds.
   b. Coin discharge process shall be gravity fed into the stainless steel bottom surface.
   c. Coin access door shall reside in a captive track that is secured by a high security lock.
   d. Bill access door shall have a continuous hinge secured by a high security lock.
   e. Mechanical interlocks shall sense a properly closed revenue door to allow revenue transfer process.
   f. Receiver shall have a five digit mechanical counter to show the number of revenue transfer cycles.
   g. Receiver door indicators shall signify ready and process.

D. Accessories:

1. Mobile bin, spare (see drawings for quantity)
2. Vault bin ID (one each)

E. Finish: Durable polyurethane in high visibility orange

PART 3 - EXECUTION

3.01 INSPECTION

A. Coordinate location of rough-in work and utility stub-outs to assure match with equipment to be installed.

B. Inspect delivered equipment for damage from shipping and exposure to weather.

C. Compare delivered equipment with packing lists and specifications to assure receipt of all equipment items.

3.02 INSTALLATION

A. Perform work under direct supervision of Foreman of Construction Superintendent with authority to coordinate installation of scheduled equipment with Architect or designated representative.
B. Install equipment in accordance with plans, shop drawings, and manufacturer’s instructions:

1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level (or slight slope as required by instructions), plumb, and at right angles to adjacent work.

2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.

3. Anchorage: Attach equipment as directed by Architect or designated representative. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.

C. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.

3.03 TESTING

A. After final connections are made and prior to authorizing payment, specified equipment shall be tested for compliance with specifications in the presence of the Architect or designated representative using acceptance procedures provided by the manufacturer. Testing report shall be submitted to the Architect or designated representative.

3.04 CLEANUP

A. Touch-up damage to painted finishes.

B. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.

C. Clean area around equipment installation and remove packing and installation debris from job site.

D. Notify Architect or designated representative for acceptance observation.

3.05 TRAINING

A. Direct the technical representative to provide specified hours of training to designated Owner’s maintenance personnel in operation and maintenance of the following equipment. Coordinate, with Owner, training schedule and list of personnel to be trained.

1. 2042 Charger, battery, multiple, 120 V; 1 hour (minimum)
2. 2043 Charger, battery, multiple, 460 V; 1 hour (minimum)
3. 3718 Washer, high pressure, hot water, NG, 4 GPM; 2 hours (minimum)
4. 3784 Washer, parts, automatic, front load; 1 hour (minimum)
5. 7490 Press, oil filter, electric; 1 hour (minimum)
6. 9565 Probe, farebox; 16 hours (minimum)
7. 9901 Vault, collection, revenue, mobile; 1 hour (minimum)

B. Obtain, from technical representative, a list of Owner’s personnel trained in equipment operations and maintenance.

END OF SECTION
PART 1 - GENERAL

The General Provisions of the Contract, including General and Special Conditions and the requirements of Division 1, apply to the Work in this Section. This section covers existing Owner-supplied equipment that shall be relocated and installed by the Contractor as specified herein.

1.01 WORK INCLUDED

A. Existing equipment items as listed in the Equipment Schedule Table on Drawing Sheet No Q0.1 with an equipment identification number (ID) having 5 digits and noted in this table labeled as OF/CI Equipment Schedule as as being "Owner Furnished and Contractor Installed" (OF/CI) shall be relocated and installed by the contractor. All OF/CI equipment is located at D3.

B. Disconnection, cleaning, removal, transport, and re-installation of existing equipment located at other facilities with labor, services, and incidentals necessary for complete and operational equipment re-installation.

1.02 QUALITY ASSURANCE AND CONDITION DOCUMENTATION

A. Existing Equipment shall be tested and certified as operational and safe by the Contractor prior to removal by the contractor or his agents.

B. Owner and Contractor's staff to note all existing defects, and damage to existing equipment to be relocated and provide this document to the Contractor. Defects shall include, but not be limited to, noisy, rough or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish.

C. Contractor to ensure that only qualified, licensed and certified equipment installers are involved in the relocation process. Contractor is responsible for equipment during removal, relocation, installation, testing, and until building is occupied by Owner.

1.03 SUBMITTALS

A. Drawings for existing equipment shall be required where re-installation is provided by the original equipment manufacturer.

1.04 IMPACT ON ORIGINAL WARRANTY

A. The Contractor is responsible for all aspects of relocation including coordination with Original Equipment Manufacturer on the impact of existing equipment still under original warranty.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. A relocation and transport plan listing each item in Part 2.0 requiring re-installation by the contractor must be submitted to the Owner’s Representative. Plan shall be developed by the Contractor and must convey a complete understanding of required utility disconnection and reconnections and responsibility; crating, transportation, and tie-down methods; and temporary storage methods if required.

B. Contractor is responsible for constructing or providing any necessary or special crates or packing materials to ensure that equipment is protected during transport or shipment and storage in humid and/or dusty conditions.

C. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Equipment Identifier of this specification.
D. Contractor is responsible for providing any required specialized personnel or equipment manufacturer/supplier representatives required for re-installation of existing equipment.

PART 2 - PRODUCTS

2.01 RELOCATION, TRANSPORTATION, AND RE-INSTALLATION

A. Each of the Existing Equipment items has been designated as an Owner Furnished/Contractor Installed item. This indicates that the item may require special utility connections, special transportation, or special expertise to successfully re-install the existing equipment.

B. The Relocation Plan shall be developed by the Contractor and must convey an understanding of utility disconnection and reconnection methods and responsibility, transportation and tie down method, and temporary storage methods if any.

C. Contractor is solely responsible for the security, safety and operation of all Existing Equipment during relocation.

D. Existing Equipment Schedule: Reference Equipment Layout Drawings for final installation instruction and other directives delineated on the drawing.

2.02 EXISTING EQUIPMENT SCHEDULE

A. Reference Equipment Demolition Drawings for location of existing equipment.

B. Reference Equipment Layout Drawings for final installation instruction and other directives delineated on the drawing.

PART 3 - EXECUTION

3.01 INSPECTION

A. Coordinate location of rough-in work and utility stub-outs to assure match with existing equipment to be installed.

B. Inspect existing equipment transported from other sites for damage from shipping and exposure to weather. Compare delivered equipment with document prepared by the Owner noting any pre-existing defects. Contractor and Owner’s Representative to resolve any differences to this list prior to re-installation and again upon completion of re-installation for each item.

3.02 INSTALLATION

A. Perform work under direct supervision of Construction Superintendent with authority to coordinate re-installation of existing equipment with Architect, and Owner’s Representative.

B. Install equipment in accordance with manufacturer’s instructions where available:

1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level (or slight slope as required by instructions), plumb, and at right angles to adjacent work.

2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.

3. Anchorage: Attach equipment as required by existing equipment or as directed by Architect or designated representative. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.
C. Upon completion of work, finish surfaces shall be free of any new (not previously noted) tool marks, scratches, blemishes, and stains.

3.03 TESTING

A. After final connections are made and prior to authorizing payment, re-installed existing equipment shall be tested to ensure re-installation has resulted in a complete and operable equipment item. This test should take place in the presence of the Owner’s Representative, the Architect or designated representative. Where available, the test should be conducted using acceptance procedures provided by the manufacturer.

3.04 CLEANUP

A. Touch-up damage to painted finishes.

B. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.

C. Clean area around equipment installation and remove packing and installation debris from job site.

D. Notify Architect or Owner’s Representative for acceptance observation.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section includes the following types of parking control equipment for control of gate operators.

1. Vehicle detectors.
2. Card readers.
3. Transmitter cards.

B. Related Sections:

1. Electrical is specified in Division 26.
2. Gate operators are specified in Section 32 31 13.73.

1.02 SUBMITTALS

A. General: Comply with Division 01.
B. Product Data: Manufacturer's product data, specifications, installation, and maintenance instructions for each type of parking equipment required.
C. Shop Drawings: Include plans, elevations, and details of typical members and other components. Show layout and installation details, including anchorage details.
D. Maintenance Instructions: Provide manufacturer's instructions for maintenance of parking control equipment. Include recommended methods and frequency for maintaining equipment in optimum operating condition under anticipated traffic and use conditions. Include precautions against materials and methods that may be detrimental to finishes and performance.

1.03 QUALITY ASSURANCE

A. Manufacturer: Regularly providing equipment of the type specified for not less than 5-years, and maintaining repair and emergency services within 48-hours after service is requested.
B. Installer: Authorized representative of equipment manufacturer.

1. Installer shall furnish maintenance and call-back service following installation and for duration of the one-year warranty period.
2. Service shall consist of examination of equipment, adjustments, supplies, and parts required to keep equipment in proper operation, except such adjustments, parts, or repairs made necessary by abuse, misuse, or any other causes beyond manufacturer's or installer's control.
3. Service shall be done by trained employees during regular working hours.
4. Emergency service shall be available when called for, at additional cost, except where attributable to faulty materials or equipment.
C. UL and NEMA Compliance: Provide internal electrical components required as part of parking control equipment that are listed and labeled by UL and comply with NEMA standards.

1.04 COORDINATION

A. Furnish to jobsite wiring diagram and layouts necessary for properly locating service conduit stubouts.

B. Install below-grade and embedded portions of the work in advance of construction of curbs, walks, and pavement.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS


2.02 PARKING CONTROL EQUIPMENT

A. Vehicle Detector Loops:

1. Provide solid state, electronic vehicle detector units designed to detect the presence or transit of a vehicle over an embedded loop of wire and emit an electrical pulse to close the overhead coiling grille. Provide a 3-position sensitivity switch and detection indicator light on the front panel.

2. Provide detector loops consisting of multiple strands of wire of the gauge, number of turns, size, and method of placement as recommended by the parking equipment manufacturer.

B. Hand-Held Transmitter Cards: Door King Model PROXmtr or approved equal combination Prox Card and RF Transmitter. Provide two per assigned parking space and 25% extra.

C. Card Reader: Door King, Inc. DKS 10 or approved equal with mounting housing.

PART 3 - EXECUTION

3.01 PREPARATION

A. Furnish templates for anchor bolts and other items encased in concrete or below finished surfaces in sufficient time so as not to delay the work.

3.02 INSTALLATION

A. Install parking equipment in accordance with the manufacturer's instructions and placement drawings.

1. Coordinate placement of anchors and accessories encased in concrete with Division 03 Sections.

3.03 DEMONSTRATION

A. Instruct Owner's personnel in the proper operation and maintenance of parking control equipment. Train the personnel in procedures to follow in the event of operational failures or malfunctions.

3.04 CLEANING

A. After installation, clean finished surfaces. Touch up damaged shop-applied finishes as required to restore damaged areas.

3.05 SCHEDULE OF EQUIPMENT
A. Ingress Lane: Hand held transmitter car to open automatic gate operators and vehicle detector loop to close gates.

B. Egress Lane: Vehicle detector loops to open and close gates.

END OF SECTION
PART 1 - GENERAL

The General Provisions of the Contract, including General and Special Conditions and the requirements of Division 1, apply to the Work in this Section.

1.01 WORK INCLUDED

A. Equipment items as listed below by Equipment Identifier:
   1. 3145 Dust collector, body shop (Ref. Part 2.01)
   2. 3461 Reel, vehicle exhaust, motor operated, 6 inch hose (Ref. Part 2.03)

B. Roughing-in, installation of equipment, and final connection of utilities, with labor, services, and incidentals necessary for complete and operational equipment installation.

C. Piping, ductwork, wiring, and switching between equipment and utilities.

1.02 QUALITY ASSURANCE

A. Experience: Equipment shall be produced by a manufacturer of established reputation with a minimum of five years experience supplying specified equipment.

B. Manufacturer’s Representative:
   1. Installation: Provide a qualified manufacturer’s representative at site to perform work related to equipment installation, check out and start up.
   2. Training: Provide technical representative to train Owner’s maintenance personnel in operation and maintenance of specified equipment.

1.03 BUY AMERICA COMPLIANCE

A. The Contractor shall comply with the applicable Buy America requirements set forth in 49 U.S.C. 5323(j) and the applicable regulations in 49 C.F.R. Part 661, as amended. If the Contractor procures any capital items with Federal funds, it is the Contractor’s responsibility to obtain the Buy America certification required under such regulations.

B. Reference Division 1 for Buy America compliance.

1.04 SUBMITTALS

A. Product Data: Restrict submitted material to pertinent data. For instance, do not include manufacturer’s complete catalog when pertinent information is contained on a single page.

B. Operations and Maintenance Manual:
   1. Submit Operations and Maintenance Manuals in accordance with Division 1- General Requirements of these specifications.
   2. Provide complete parts, operating, and maintenance manual covering equipment at time of installation.
   3. Description of system and components.
4. Schematic diagrams of electrical, plumbing, and compressed air system.
5. Manufacturer’s printed operating instructions.
6. Printed listing of periodic preventive maintenance items and recommended frequency to validate warranties. Failure to provide maintenance information will indicate that preventive maintenance is not a condition for validation of warranties.

C. Shop Drawings: Submit Shop Drawings in accordance with Division 1 - General Requirements of these specifications.

1.05 PRODUCT SUBSTITUTIONS

A. Follow requirements specified in Division 1 - General Requirements.
B. Additional costs resulting from substitution of products other than those specified, by model number, including drawing changes and construction, will be at the expense of the Contractor.

A. Substitution Approval: Prior to delivery or installation, submittals for each equipment item by Equipment Identifier shall be provided in accordance with Division 1 - General Requirements. Acceptance will be based on the technical requirements herein as determined by Owner and Architect.

1.06 WARRANTY

A. Warrant work specified herein for one year from acceptance by Owner against defects in materials, function and workmanship.
B. Warranty shall include materials and labor necessary to correct defects.
C. Defects shall include, but not be limited to noisy, rough or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish.
D. Submit warranties in accordance with Division 1 - General Requirements of these specifications.
E. All parts must be readily available locally in the United States.

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in manufacturer’s containers, appropriately packaged and/or crated for protection during domestic shipment and in humid, dusty conditions.
B. Indelibly label all containers, including those contained in others, on outside with item description(s) per title of this specification.
C. Provide equipment with materials specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

1.08 LABELING

A. Manufacturer will securely attach in a prominent location on each major item of equipment a noncorrosive nameplate showing manufacturer’s name, address, model number, serial number, and pertinent utility or operating data.
B. All electrical equipment and materials shall be new and shall be listed by Underwriter’s Laboratories, Inc. (U.L.) in categories for which standards have been set by that agency and labeled as such in the manufacturer’s plant.

PART 2 - PRODUCTS
A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

   - Dustcontrol
   - Wilmington, NC (910) 395-1808
   - Model No.: DC 11-Module

2. Alternate manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.

   - Clean Air Technologies, Chagrin Falls, OH (800) 265-3878

3. General Description: The system incorporates two-stage cyclone filtration with course filtration in the cyclone and fine filtration in the cylindrical pleated polyester washable cartridge filter. Filter cleaning is by reverse pulse, compressed air with discharge through a flap valve into a disposable plastic waste sack. The turbo pump is a branch-of-canal design, directly coupled to a continuous duty-rated, totally enclosed fan cooled (TEFC) motor. The unit is mounted on a common chassis.

B. Capacities/Dimensions:

1. Overall dimensions:

<table>
<thead>
<tr>
<th>Dimensions (inches)</th>
<th>Length</th>
<th>Width</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment</td>
<td>66-1/4</td>
<td>29</td>
<td>25-1/2</td>
</tr>
</tbody>
</table>

2. Motor: 10 HP, 7.5kW, 3600 RPM type

3. Suction rating:
   - Max flow: 294 SCFM
   - Max static pressure: 88 inches water column

4. Filtration:
   - Primary cyclone separator: Up to 95% of total dust, nominal
   - Main filter: 99.89% down to 1-3 microns per DIN 24184/3
   - Filter area: 90.4 square feet
   - Material collected in 13-gallon plastic sack
5. Noise rating: less than 65 dB (A)

C. Features/Performance/Construction:

1. **General:** The design specifications of the DC11-Module Dust Extractor unit incorporates 7.5 kW (10 HP at 3600 RPM) turbo pump with a suction rating of 500m³/h (294 CFM) and 22 kPa (88 inch water gauge) with a rated sound level not to exceed 65 dB(A). The system incorporates two-stage cyclone filtration with coarse filtration in the cyclone and fine filtration in the cylindrical pleated polyester washable cartridge filter. Filter cleaning is by reverse pulse, compressed air with discharge through a flap valve into a disposable plastic waste sack. The turbo pump is a branch-of-canal design, directly coupled to a continuous duty-rated, totally enclosed fan cooled (TEFC) motor. The unit is mounted on a common chassis.

2. **Pre-separator:** The DCF 8000 high efficiency cyclonic pre-separator is installed ahead of the dust extractor to remove heavy dust, as well as debris collected during cleaning operations. Working on the high-speed cyclonic principle, the pre-separator removes up to 75% of the dust to prevent heavy dust loads from reaching the dust extractor, thus extending filter life. The discharge from the pre-separator is a flap valve and bag system, identical to the dust extractor.

3. **Ducting:** Suction pressure is distributed for 6 outlets through an overhead and wall mounted balanced ducting system of 3 inch diameter, with .06 inch wall thickness galvanized steel pipe. Elbows, reducers, Y-pipes, and other fittings are connected with rubber-lined, steel clamping joints that are tightened with two socket head bolts. This provides a continuous, smooth interior surface for minimum friction loss and no dirt build-up.

4. **Suction hose:** The hose and hose couplings shall be extremely flexible with smooth inside walls for low pressure drop. All hose and connectors must be conductive to eliminate static charge. Wire hose is not acceptable. Hose diameter shall not exceed 2 inches.

5. **Suction casings:** Casings shall be from system manufacturer. Inlet must be of metal construction to resist abrasion. Flexible rubber collars shall be replaceable. Metal clamps shall be used for durability.

6. **Electrical control panel:** A microprocessor control type Siemens 1212 governs the turbo pump operations (start up and shut down) and reverse pulse procedures for the filters. The turbo pump shall be programmed to shut down to conserve energy during periods of non-use, breaks, lunch, and end of shift. During this time the filter will be automatically cleared of dust to maintain optimum performance of the filter and turbo pump. A small HMI touch screen panel shall be included on the panel door. Start and stop buttons will be incorporated into the Panel front door. The front door shall also System ON lamp, hour meter, system Fault lamp, E-stop push button type.

   The panel shall be manufactured to comply with UL508 standards and ships with a serialize sticker of compliance.

D. Accessories:

| a. Clean Air Technologies, Chagrin Falls, OH (800) 265-3878 |

E. Utility Requirements:
### 1. Electrical:

<table>
<thead>
<tr>
<th>Connection Requirements</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>460</td>
</tr>
<tr>
<td>Phase</td>
<td>3</td>
</tr>
<tr>
<td>HP</td>
<td>10</td>
</tr>
</tbody>
</table>

### 2. Plumbing:

#### a. Compressed Air:

<table>
<thead>
<tr>
<th>Connection (inches)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume (CFM)</td>
<td>9</td>
</tr>
<tr>
<td>Capacity (PSI)</td>
<td>90</td>
</tr>
</tbody>
</table>

### 3. Mechanical:

#### a. Venting:

<table>
<thead>
<tr>
<th>Connection (inches)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4.25</td>
</tr>
</tbody>
</table>

F. Finish: Dark blue enamel

2.02 REEL, VEHICLE EXHAUST, MOTOR OPERATED, 6 INCH HOSE

Equipment Identifier: 3461

#### A. Manufacturer’s Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer’s name and model to establish minimum acceptable standards of quality, features, performance, and construction.

   a. Nederman, Inc.
   b. Livonia, MI (734) 729-3344
   c. Model No.: 20802865 with accessories

2. Alternate manufacturers: *Contingent upon compliance with these specifications and documentation requirements set forth in Section 01300 SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.*

   a. Plymovent, Cranbury, NJ (609) 395-3500
   b. Monoxivent, Rock Island, IL (309) 794-1000

#### B. Capacities/Dimensions:

1. Overall dimensions:
### Dimensions (inches)

<table>
<thead>
<tr>
<th></th>
<th>Length</th>
<th>Width</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>a. Equipment</strong></td>
<td>57-1/2</td>
<td>31</td>
<td>32</td>
</tr>
</tbody>
</table>

2. Outlet duct length: 12 inches

3. Exhaust hose:
   a. Diameter: 6 inches
   b. Length: 33 feet

4. Drum storage capacity hose length: 29 feet, 6 inches

C. Features/Performance/Construction:

1. Exhaust hose drum:
   a. The exhaust hose drum, Nederman No. 20802865 shall consist of a heavy steel coated with an aluminum zinc alloy to resist corrosion.
   b. The stand shall consist of two aluzinc-lined supports and two aluzinc-plated steel tubes.
   c. The hose guide shall guide the hose on the first revolution of the drum.
   d. The drum shall be motorized and shall be capable of lifting 65 pounds of hose.
   e. The connecting tube of aluminum, flexible, 6-1/4 inches in diameter, 12 inches in length, shall be used in a straight position when bends are needed in the duct system.
   f. The hose reel without the hose shall not exceed 70 pounds.

2. Exhaust hose:
   a. The hose Nederman series NFC 3.5 No. 87800019:
      1) Constructed of high temperature fabric with an external steel helix. The steel helix shall have a plastic coating to prevent it from scratching vehicles.
      2) Provide 24 feet of hose.
      3) The exhaust hose shall be resistant to temperatures of up to 800 degrees F continuously.
      4) Hose stop shall be adjustable so that the hose will hang at any required height.
   b. Nederman hose series NFC 6.5 No 87001007:
      1) Constructed of a coated high temperature fabric with an external stainless steel wire helix.
      2) Provide 9 feet of hose.
      3) The exhaust hose shall be resistant to temperatures of up to 1,200 degrees F continuously.
D. Controls:
1. Remote control shall contain switches for hose up/hose down and fan ON/OFF shall be controlled by pendant switch, Nederman No. 20373712.

2. Limit switches:
   a. Limit switch shall stop drum rotation during hose coil/recoil and prevent damages to the hose.
   b. Lower limit switch shall stop drum rotation when hose has uncoiled from drum to prevent recoil.
   c. Limit switch shall override the remote switch and disengage supply current to the motor and override the remote switch when the hose is totally coiled.

3. Electrical control box with fan contactor and 24V transformer to start/stop fan, Nederman No. 87000295

E. Accessories:
1. Exhaust extraction nozzle with clamp:
   a. A 6 inch galvanized steel exhaust extraction nozzle with cane Nederman No. 20816661, one each per reel
   b. Nozzle shall be capable of withstanding temperatures up to 660 degrees F.
   c. A fully adjustable locking clamp shall be used to secure the nozzle to the vehicle exhaust pipe.
   d. A steel mesh inlet guard shall be used to prevent passage of debris to hose.

2. Exhaust extraction nozzle with lifting sleeve:
   a. A 6 inch stainless steel exhaust extraction nozzle with lifting sleeve Nederman No. 89298067, one each per reel
   b. Nozzle shall be capable of withstanding temperatures up to 1,000 degrees F.
   c. A steel mesh inlet guard shall be used to prevent passage of debris to hose.
   d. Telescopic lifting pole, Nederman No. 20374287, one each per nozzle

3. Exhaust extraction nozzle
   a. A 6 inch aluminum exhaust extraction nozzle with sleeve Nederman No. 20100728, one each per reel
   b. Nozzle shall be capable of withstanding temperatures up to 660 degrees F.
   c. A steel mesh inlet guard shall be used to prevent passage of debris to hose.
   d. Telescopic lifting pole, Nederman No. 20374287, one each per nozzle.

F. Utility Requirements:
1. Electrical:

<table>
<thead>
<tr>
<th>Connection Requirements</th>
<th>Hose Reel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>120</td>
</tr>
<tr>
<td>Phase</td>
<td>1</td>
</tr>
<tr>
<td>HP</td>
<td>1/3</td>
</tr>
<tr>
<td>Amps</td>
<td>3</td>
</tr>
</tbody>
</table>

2. Mechanical:

<table>
<thead>
<tr>
<th>Venting:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection (inches)</td>
</tr>
<tr>
<td>Volume (CFM)</td>
</tr>
</tbody>
</table>

PART 3 - EXECUTION

3.01 INSPECTION

A. Coordinate location of rough-in work and utility stub-outs to assure match with equipment to be installed.

B. Inspect delivered equipment for damage from shipping and exposure to weather.

C. Compare delivered equipment with packing lists and specifications to assure receipt of all items.

3.02 INSTALLATION

A. Perform work under direct supervision of Foreman or Construction Superintendent with authority to coordinate installation of scheduled equipment with Architect or designated representative.

B. Install equipment in accordance with plans, shop drawings and manufacturer’s instructions:

1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level, plumb and at right angles to adjacent work.

2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.

3. Anchorage: Attach equipment securely to floor, as directed by Architect or designated representative, to prevent damage resulting from inadequate fastening. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.

C. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.

3.03 CLEANING

A. Touch-up damage to painted finishes.

B. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.

C. Clean area around equipment installation and remove packing and installation debris from job site.

D. Notify Architect or designated representative for acceptance observation.
3.04 TESTING
   A. After final connections are made and prior to authorizing payment, specified equipment shall be tested for compliance with specifications in the presence of the Architect or designated representative using acceptance procedures provided by the manufacturer. Testing report shall be submitted to the Architect or designated representative.

3.05 TRAINING
   A. Direct the technical representative to provide specified hours of training to designated Owner’s maintenance personnel in operation and maintenance of the following equipment. Coordinate, with Owner, training schedule and list of personnel to be trained.

      1.  3145 Dust collector, body shop; 3 hours (minimum)
      2.  3461 Reel, vehicle exhaust, motor operated, 6 inch hose; 2 hours (minimum)

   B. Obtain, from technical representative, a list of Owner’s personnel trained in equipment operations and maintenance.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION
A. This Section describes the requirements for furnishing and installing residential appliances.
B. Related Sections:
   1. Architectural wood casework is specified in Section 06 41 00.
   2. Plumbing is specified in Division 22.
   3. HVAC is specified in Division 23.
   4. Electrical requirements are specified in Division 26.

1.02 SUBMITTALS
A. General: Comply with Division 01.
B. Product Data: Manufacturer's specifications and installation instructions for each type of appliance. Include operating and maintenance instructions for each item.

1.03 QUALITY ASSURANCE
A. Certification Labels: Furnish residential appliances with UL labels. Provide gas-burning appliances with American Gas Association seal of approval.
B. Uniformity: Provide products of same manufacturer for each type of residential appliance required. Where specified, provide residential appliances by a single manufacturer for the entire Project.

1.04 REGULATORY REQUIREMENTS
A. Accessibility: Conform to the more restrictive provisions of Title III of the American with Disabilities Act or the California Building Code (CBC).
   1. Accessible appliances shall conform to all reach requirements per CBC Figure 11B-16 and 11B-17.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING
A. General: Comply with Division 01.
B. Deliver appliances to Project site in manufacturer's undamaged protective containers, after spaces to receive them have been fully enclosed.
C. Store appliances in a dry protected area in manufacturer's protective containers, away from construction traffic and debris areas, until installation.

PART 2 - PRODUCTS

2.01 RESIDENTIAL APPLIANCES
A. Refrigerators: Energy Star Compliant Top Freezer Refrigerator available from retailers such as Sears, Home Depot, and Lowes. “Kenmore” model # 60603 or approved equal.

1. Priced below $800.

2. Stainless Steel exterior finish.

3. Maximum overall width including door handle w/ door open 90 degrees: 36”

4. Capacity: 18-24 cubic feet

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install appliances in accordance with manufacturer's instructions and recommendations.

B. Securely anchor built-in appliances to supporting cabinetry or countertops with concealed fasteners. Verify that clearances are adequate for proper operation and rough openings are completely concealed.

3.02 ADJUST AND CLEAN

A. Test each appliance to verify proper operation. Make necessary adjustments.

B. Remove packing material from appliances and leave in clean condition, ready for operation.

END OF SECTION
SECTION 11 99 00
MISCELLANEOUS EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION
A. This Section describes the requirements for furnishing and installing the miscellaneous equipment items listed in the Maintenance Equipment Manual. A copy is available from the Architect.

1.02 SUBMITTALS
A. General: Comply with Division 01.
B. Product Data: Manufacturer's literature, including product description, illustrations, specifications, installation drawings, and utility and mounting rough-in information.
C. Shop Drawings: Show dimensions, required clearances, location, mounting, finish and where required, size, location, and capacity of mechanical and electrical services.
D. Operating Instructions: Furnish operation, adjustment, care and maintenance instructions.

1.03 PRODUCT DELIVERY, STORAGE, AND HANDLING
A. General: Comply with Division 01.
B. Deliver, store, and handle products upright and in accordance with the manufacturer's instructions.
C. Protect equipment items as required to prevent damage during storage and construction.

PART 2 - PRODUCTS

2.01 MISCELLANEOUS EQUIPMENT
A. Refer to Maintenance Equipment Manual.

PART 3 - EXECUTION

3.01 INSTALLATION
A. Set equipment items securely in place, rigidly or flexibly mounted in accordance with manufacturer's directions.
B. Securely attach to backing plates as required.
C. Touch-up and restore damaged or defaced finishes.

3.02 ADJUSTMENT, CLEANING, AND PROTECTION
A. Make required adjustments for proper operation.
B. Repair or replace items not acceptable to the Architect.
C. Upon completion of installation, clean equipment items in accordance with manufacturer's recommendations, and protect from damage until final acceptance of work.

END OF SECTION
SECTION 12 21 13
HORIZONTAL LOUVER BLINDS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing horizontal blinds.

1.02 SUBMITTALS

A. General: Comply with Division 01.
B. Product Data: Furnish product data and installation instructions. Include methods of installation for each kind of opening and supporting structure.
C. Shop Drawings: Shop location and extent of blinds. Show installation details and relationships to adjoining work. Indicate location of blind controls and blind sizes.
D. Samples: For verification purposes, furnish 12-inch long slat for each color slat required.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has specialized in installing horizontal louver blinds similar to those required for this Project.

1.04 PROJECT CONDITIONS

A. Field Measurements: Check openings by field measurements before fabrication. Show recorded measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS


2.02 MATERIALS AND FABRICATION

A. Slats: Unperforated slats, nominal 1-inch wide.
   1. Position of Tilter Control: As directed by the Architect.
   2. Tilt: Full.
C. Cord Lock Operation: Cord lock, locks pull cord to stop blind at any position in ascending or descending travel.
   1. Position: As directed by the Architect.
D. Cord Equalizers: Self-aligning to maintain horizontal blind position.
E. Valance: Match color of slats.
F. Color: As selected by the Architect from manufacturer's full range of colors.
G. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows:

1. Blind Units Installed Between Jambs: Width and length equal to 1/2-inch less than opening dimensions formed by jamb, head, and sill members of opening in which each blind is installed.

2. Blind Units Installed Outside Jambs: Width and length as indicated, with terminations between blinds of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

H. Installation Fasteners: Not less than two fasteners per bracket, fabricated from metal non-corrosive to blind hardware and adjoining construction and to support blind units under conditions of normal use.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine openings where horizontal louver blinds will be installed. Verify that critical dimensions are correct and surface conditions acceptable.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install blinds level, plumb, and located so that slat edges in any position are not closer than 1-inch to interior face of glass lites, gaps between slat ends and jambs do not exceed 1/4-inch plus or minus 1/8-inch, and bottom rail in fully lowered position is within 1/2-inch of bottom of window or other opening.

3.03 CLEANING

A. After completing the installation, clean blind surfaces according to the manufacturer's instructions.

B. Remove surplus materials, packaging, rubbish and debris resulting from the installation. Leave areas where installation occurred neat, clean, and ready for use.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing stainless steel countertops.

B. Related Sections:

1. Architectural wood casework is specified in Section 06 41 00.

2. Solid surfacing countertops are specified in Section 12 36 61.

1.02 SUBMITTALS

A. General: Comply with Division 01.

B. Manufacturer's literature including full product description with illustrations and specifications.

C. Shop Drawings: Show dimensions, locations, finish, and required clearances.

1.03 QUALITY ASSURANCE

A. Fabricator-installer shall be experienced in fabrication and installation of stainless steel countertops similar to those required for this Project and be able to show evidence of such experience if requested by the Architect.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Division 01.

B. Deliver items to job site only after proper facilities are available for handling, storing, and protecting items; receiving areas are broom-clean; exterior openings are closed up; wet work and mechanical and electrical rough-ins are complete.

C. Provide temporary protective covers for items during delivery and storage.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Stainless Steel: ASTM A167, Type 304.

2.02 FABRICATION

A. Preparation:

1. Coordinate openings with plumbing, electrical and other work prior to fabrication.

2. Dimensions noted for custom fabricated items are approximate. Verify dimensions at job site before fabrication.

B. General Requirements:

1. Fabricate exposed surfaces from stainless steel.
2. Run grain of stainless steel in same plane in same direction.

C. Welding:
   1. Use electric arc method for smooth, nonporous bead free of pits and fractures.
   2. Neither tinning of welds nor soldering of joints shall be permitted.
   3. Remove burrs, flux, welding oxide, air spots, and discoloration from exposed surfaces.

D. Countertops: 16-gauge unless otherwise noted.
   1. Turn down tops 1-1/2-inches and back 1/2-inch unless otherwise indicated.

2.03 FINISHES

A. Exposed Stainless Steel: Manufacturer's No. 4 finish.

B. Exposed Welds: Grind smooth and polish to match specified finish where occurring in stainless steel.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine work to receive countertops prior to delivery and verify dimensions and correctness of backing or support conditions and utility rough-ins.

B. Do not install items until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Set items securely in place.

B. Protect items from damage during construction; do not use sinks for receptacles or cleaning purposes.

C. Touch-up and restore finishes where damaged.

END OF SECTION
SECTION 12 36 61
SOLID SURFACING COUNTERTOPS

PART 1 — GENERAL

1.01 DESCRIPTION

A. This Section includes solid surfacing countertops, sinks, and backsplashes.

B. Related Sections:
   1. Architectural wood casework is specified in Section 06 41 00.
   2. Joint sealants are specified in Section 07 92 00.
   3. Stainless steel countertops are specified in Section 12 36 16.

1.02 SUBMITTALS

A. General: Comply with Division 01.

B. Product Data: Include product data for each product.

C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices and other components.
   1. Show full-size details, edge details, thermoforming requirements, and attachments.
   2. Show locations and sizes of furring, blocking, including concealed blocking and reinforcement specified in other Sections.
   3. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, and other items installed in solid surface.

D. Samples:
   1. For each type of product indicated.
      a. Furnish minimum 6-inch by 6-inch sample in specified gloss.
      b. Cut sample and seam together for representation of inconspicuous seam.
      c. Indicate full range of color and pattern variation.
   2. Approved samples will be retained as a standard for work.

E. Maintenance Data: Furnish manufacturer’s care and maintenance data, including repair and cleaning instructions.

1.03 QUALITY ASSURANCE

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

B. Fabricator/Installer Qualifications: Work of this Section shall be by a certified fabricator/installer, certified in writing by the manufacturer.
C. Fire Test Response Characteristics: Provide with the following Class A (Class I) surface burning characteristics as determined by testing identical products per UL 723 (ASTM E84) or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Flame Spread Index: 25 or less.
2. Smoke Developed Index: 450 or less.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. General: Comply with Division 01.
B. Do not deliver components to Project site until areas are ready for installation.
C. Store components indoors prior to installation.
D. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

1.05 WARRANTY

A. Warrant solid surfacing countertops to be free from defects in materials and workmanship for a period of 10-years from date of Substantial Completion. Damage caused by physical or chemical abuse or damage from excessive heat will not be warranted. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

1.06 MAINTENANCE

A. Provide maintenance requirements as specified by the manufacturer.

PART 2 — PRODUCTS

2.01 MATERIALS

A. Manufacturer, Pattern and Color: As indicated in the Finish Legend.
B. Thickness: 1/2-inch unless otherwise indicated.
C. Edge Treatment: As indicated.

2.02 ACCESSORIES

A. Joint Adhesive: VOC-compliant one- or two-part adhesive kit to create inconspicuous, nonporous joints.
B. Sealant: VOC-compliant mildew-resistant, FDA-compliant, NSF 51-compliant (food zone — any type), UL-listed silicone sealant in colors matching components.

2.03 FACTORY FABRICATION

A. Shop Assembly

1. Fabricate components to greatest extent practical to sizes and shapes indicated, in accordance with approved shop drawings and manufacturer’s printed instructions and technical bulletins.
2. Form joints between components using manufacturer’s standard joint adhesive without conspicuous joints. Reinforce with strip of solid polymer material, 2-inches wide.
3. Provide factory cutouts for plumbing fittings and bath accessories as indicated.

4. Rout and finish component edges with clean, sharp returns. Rout cutouts, radii and contours to template. Smooth edges. Repair or reject defective and inaccurate work.

PART 3 — EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with fabricator present for compliance with requirements for installation tolerances and other conditions affecting performance of work.

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

3.02 INSTALLATION

A. Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and product data.

1. Provide product in the largest pieces available.

2. Form field joints using manufacturer’s recommended adhesive, with joints inconspicuous in finished work. Exposed joints/seams shall not be allowed.

3. Reinforce field joints with solid surface strips extending a minimum of 1-inch on either side of the seam with the strip being the same thickness as the top.

4. Cut and finish component edges with clean, sharp returns.

5. Rout radii and contours to template.

6. Anchor securely to base cabinets or other supports.

7. Align adjacent countertops and form seams to comply with manufacturer’s written recommendations using adhesive in color to match countertop.

8. Carefully dress joints smooth, remove surface scratches and clean entire surface.

9. Install countertops with no more than 1/8-inch sag, bow or other variation from a straight line.

B. Back and Side Splashes: Install applied back and side splashes using manufacturer’s standard color-matched silicone sealant.

3.03 REPAIR

A. Repair or replace damaged work which cannot be repaired to Architect’s satisfaction.

3.04 CLEANING AND PROTECTION

A. Keep components clean during installation.

B. Remove adhesives, sealants and other stains.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION
   A. This Section describes the requirements for furnishing and installing prefabricated shelters.
      1. Prefabricated shelters may be fabricated from steel or aluminum components, at Contractor's option.

1.02 SUBMITTALS
   A. General: Comply with Division 01.
   B. Shop Drawings: Furnish shop drawings showing shelter layouts. Include location, type, and spacing of supports, method of attaching supports, and method of attaching metal panels to supports.
   C. Samples: 12-inch square sample of metal panel with specified finish.
   D. Engineering Calculations: Furnish calculations signed and stamped by a registered professional engineer licensed in the State of California, showing that canopy covers conform to all applicable codes and regulations. Design loads shall be those required by California Building Code (CBC).

1.03 QUALITY ASSURANCE
   A. Manufacturer's Qualifications: Minimum 10-years' experience providing prefabricated shelters of the type required for this Project.
   B. Installer's Qualifications: Minimum 5-years' experience installing prefabricated shelters.
   C. Regulatory Requirements: Comply with applicable requirements of CBC.

1.04 PROJECT CONDITIONS
   A. Field Measurements: Field-verify existing dimensions, elevations, and conditions prior to fabrication of canopy covers.

PART 2 - PRODUCTS

2.01 STEEL PREFABRICATED SHELTERS
   A. Roof Deck and Trim: Galvanized steel complying with ASTM A446, Grade D, 50,000-psi, galvanized in accordance with ASTM A525, G90 coating designation. Panel profile shall be corrugated in configuration selected by the Architect.
   B. Beams: ASTM A446, Grade D, 50,000-psi yield, galvanized in accordance with ASTM A525, G90 coating designation.
   C. Columns: Square tubing complying with ASTM A500, Grade B, hot-dip galvanized after fabrication with a minimum zinc coating of 2-ounces per sq. ft.
   D. Finish:
      1. Beams and Columns: Field painted as specified in Section 09 91 00.
      2. Decking and Trim: Factory-applied baked polyester, color as selected by the Architect from manufacturer's standards.
   E. Sizes: As indicated.

2.02 ALUMINUM PREFABRICATED SHELTERS
A. Aluminum Extrusions: Alloy 6061-T6, 6063-T5 & T6 as required. Columns, beams, and fascias shall be notched and fabricated for mechanical connection.

B. Aluminum Sheeting: Roll formed roof panels alloy 3105H-28, minimum 30,000-ksi or equal. Panel profile as selected by the Architect.

C. Hardware: Plated non-corrosive.

D. Finish:
   1. Extrusions: Baked on enamel conforming to AAMA 603.8, color as selected by the Architect from manufacturer's standards.
   2. Sheeting: Factory-finished with baked-on polyester coating, color as selected by the Architect from manufacturer's standards.

E. Sizes: As indicated.

PART 3 - EXECUTION

3.01 INSTALLATION
   A. Install prefabricated shelters in locations indicated in accordance with manufacturer's instructions and reviewed shop drawings.

3.02 ADJUSTMENTS AND CLEANING
   A. Touch-up unpainted and abraded paint and galvanized surfaces of frame and accessories.
   B. Repair or replace damaged prefinished components as directed by the Architect.
   C. Clean soiled components as directed by the Architect.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION
A. This Section describes general requirements, products, and methods of execution relating to prefabricated guard booth.

1.02 REQUIREMENTS
A. Completed installation shall comply with California Building Code (CBC) requirements.
B. Design Requirements: Pre-engineered officers station shall be designed by an independent structural engineer, licensed in the State of California, to resist all dead, live, and lateral loads as specified under the CBC.
C. Wind load requirements shall be in accordance with ASCE 7-10.
D. Electrical system shall be in compliance with NEC.
E. Structure shall be pre-assembled, designed and structurally engineered to withstand 50-lbf/sq. ft. floor live load and 30-lbf/sq. ft. wind load, ready to be shipped, off-loaded and installed.

1.03 SUBMITTALS
A. General: Comply with Division 01.
B. Shop Drawings: Indicate components, materials, dimensions, attachments, finishes, installation details. Provide dimensioned layout drawing showing bolting to the foundation slab and utility stub-outs required.
C. Product Data: Include manufacturer's product literature and description of components.
D. Manufacturer's certificate that completed installation conforms to specified requirements.

1.04 QUALITY ASSURANCE
A. Manufacturer: Minimum 10-years' experience in the design and fabrication of steel booths.
B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1, D1.2 and D1.3.
C. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency and marked for intended location and application.
D. Safety Glazing: Comply with 16 CFR 1201, Category II.

1.04 DELIVERY, STORAGE, AND HANDLING
A. General: Comply with Division 01.
B. Deliver prefabricated guard booth to site ready for installation.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS
A. Ameristar Booth & Building Structures “Citadel Outlook” modified as indicated or approved equal.

2.02 MATERIALS

A. Steel material for booth framework, wall panels and fascia/soffit assemblies shall conform to ASTM A653, with a minimum yield strength of 45,000-psi and a minimum zinc coating weight of .090-oz./sq. ft., coating designation G90.

B. Materials for framework shall be size, shape and gauge required to meet the minimum structural requirements for CBC and wind load capabilities. Minimum framework size shall be 2-inch square x .090 wall.

C. Materials for wall panel systems shall be minimum 14-gauge exterior wall panel and a minimum 16-gauge interior wall panel. Fascia and soffit materials shall be a minimum 14-gauge.

D. Aluminum diamond tread plate materials for booth flooring shall conform to requirements of ASTM B6342 and shall be a minimum 1/8-inch thick. Booth subfloor shall be minimum 3/4-inch plywood and shall conform to PS 1 exterior grade.

E. Stainless steel materials for booth work counter shall be a minimum 14-gauge, Type 304 stainless steel sheet and comply with ASTM A666.

F. Insulation materials for booth wall panels and door shall have a minimum R-10 value and roof/ceiling shall have a minimum R-19 value.

2.03 FABRICATION

A. Provide a complete, integrated set of mutually dependent components that form a completely assembled, prefabricated guard booth, ready for installation on site. Building model shall comply with the standard Citadel Outlook design as indicated on the project drawings.

B. Structure and base framework shall be square or rectangular tubing of size, shape and gauge required meeting booth building and wind load requirements. Structure and base framework components shall be cut to length and joined by welding.

C. Wall panel systems shall be fabricated of exterior and interior panels formed to fit securely within each framework void. Cavity between exterior and interior face panels shall be insulated as to specified R values.

D. Flat roof assembly shall consist of roof framework, exterior roof panel and gutter/downspout system. Exterior roof panel shall be cut to length and fabricated to fit roof framework, each intersection of the roof panel shall be joined with a continuous weld. Flat roof assembly shall be fabricated with integrated gutter/downspout system and shall be sloped to encourage water run-off toward integrated gutter.

E. Roof fascia and soffit shall be cut to length, formed and joined by welding at each intersection to fabricate a complete fascia and soffit assembly supported by the roof framework. Roof fascia height and soffit depth shall be detailed within the project drawings. Removable lifting eyes shall be fabricated into booth structure at locations required to adequately support booth off-loading and positioning for overhead installation.

F. Window framing system shall consist of continuous galvanized steel interior and exterior retainer along window perimeter used to secure window glazing. All windows and doors shall contain a minimum ¼” clear tempered safety glass.
G. Sliding doors shall be fabricated of galvanized steel tubing using the same construction materials and method as wall panel systems. Door window glazing shall match booth window glazing. Sliding doors shall be equipped with commercial grade threshold and full weather stripping encompassing entire doorframe. Sliding doors shall be suspended from enclosed track with a pair of ball-bearing trollies, and secured at base with door-track guide system. Sliding door hardware shall include deadlock (hook bolt type), lock support and door stop.

H. Work counter shall be full width of guard booth and mechanically fastened into place to allow for manual height adjustment if required. Counter depth shall be a minimum 18 inches and installed at a height of 40 inches unless otherwise noted on the project drawings. Work counter shall have 2" diameter access hole trimmed with grommet, access hole shall be located toward the back of the counter for accessing necessary cabling required for work space.

I. Electrical power service load center shall be sized by a licensed engineer to provide service capacity for all booth functions as shown on contract documents. Booth shall be delivered prewired and ready for site power connections. Site power connections shall be three wire 120/240V single-phase service. Booth shall be complete with necessary wiring for fluorescent light with lamp fixtures and switch, and 4 qty 20 amp 120 VAC duplex wall outlets. All wiring shall be copper #12 AWG contained in EMT conduit and surface mounted. Load center shall be prewired 125 amp max., 120/240V, 3 wire, 8/16 panel, single phase to be flush mounted in control cabinet. All electrical components shall be UL approved and installed in accordance with N.E.C.

J. Lighting shall be fluorescent light fixture with dual lamps and operated via single light switch. Lighting shall be recessed in acoustical ceiling grid and located as noted on project drawings.

K. Climate control requirements for cooling shall be a roof mounted air conditioner 13,500/15,000 BTU, 115 VAC, 60 Hz, 1 phase with built in thermostat. Climate control requirements for heat shall be an electrical wall heater unit 1500W, 120V with fan and internal thermostat control and shall be integrated into booth control cabinet.

L. Finish exposed metal surfaces, including structural framework, wall panels, fascia, soffit, ceiling and roof. Coating process shall consist of a pretreat cleaning of all exposed surfaces, followed by a rust inhibitive epoxy primer and one finish coat of industrial polyurethane coating. Topcoat finish color shall be selected by specifier, from manufacturer’s standard colors.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify conditions are suitable to receive the work of this Section.

B. Verify utilities are properly sized and located.

C. Do not commence installation until unsuitable conditions have been corrected. Beginning installation means acceptance of existing conditions.

3.02 INSTALLATION

A. Install pre-engineered officer's station in accordance with manufacturer's instructions.

B. Anchor in place; secure so that floor is level and complete assembly does not rock, lean, or twist.

C. Connect electrical power service to power distribution system.

3.03 CLEANING
A. Clean exposed interior and exterior surfaces with non-abrasive cleansers as recommended by manufacturer.

3.04  ADJUSTING

A. Adjust all components for proper operation.

END OF SECTION
1.01 DESCRIPTION

A. Work Included in This Section: Modernize two (2) existing hydraulic elevators complete as specified.

1. Modernize hydraulic passenger Elevator Nos. 1 and 2 including new controls, steel cab enclosures, power units, signals, fixtures, door operating equipment, hoistway wiring and recondition other equipment including as specified.

2. Interim and warranty maintenance.

3. Bid shall include all work required to provide a complete code complying project including all sections of the specifications. The work includes, but is not limited to, all electrical and fire life safety work related to this project.

B. Examination of Site

1. Bidders shall visit the building, examine the existing elevator, determine condition of all retained components; space conditions, power supply, mainline disconnect, and make all surveys necessary to meet the requirements of this specification.

2. If any discrepancies are noted, or if work not specified is required, bidders shall bring such matters to the Owner’s Representative’s attention two (2) weeks prior to bidding. If no discrepancies are noted or exceptions taken, it is assumed that all conditions are satisfactory.

3. It is intended that, when completed, the installation shall be modern in all respects.

4. All components specified as new shall be provided new. All components specified to be retained may be provided new at bidder’s option subject to approval of Owner’s Representative. All retained components are to be examined, cleaned, adjusted, repaired and/or replaced with new parts. Bidder must be willing to accept all retained equipment on full maintenance without prorating.

5. The elevators shall be weighed before work begins to determine actual weight of car enclosures. Elevator Contractor shall keep a log of all equipment and weight removed and added to the suspension system. The Elevator Contractor is responsible for complying with all agencies having jurisdiction.

6. The Elevator Contractor shall assume responsibility and provide full maintenance of the elevator equipment upon award of this contract and shall continue such throughout the modernization.

7. All elevator equipment not to be reused shall be promptly removed from the project premises by and become the property of the Elevator Contractor. Any damage to building surfaces and surrounding areas shall be corrected by Elevator Contractor.

C. Related Work

1. Access: Legal access consisting of self-closing and locking access doors.


3. Clean existing sumps, make repairs or replace floor grates and eliminate plumbing within hoistways.
4. Provide access for materials and tools.
5. Remove existing abandoned fire sprinkler piping from machine rooms and overhead of hoistway.
6. Remove existing non-elevator related wiring and or conduit from machine rooms.
7. Waterproof elevator pits.
8. Power washing pits and pit equipment.
9. Repair damaged sheetrock in machine rooms and hoistways.
10. Standby labor for waterproofing, sheetrock work in hoistways and removal of abandoned sprinkler lines in hoistways and machine rooms.
11. HVAC: Provide wall mounted HVAC in each elevator machine room with proper condensation discharge piping to a drain outside of the machine room.

D. Related Electrical Work

1. Power Feeders: Modification to existing or installation and connection of three phase power through new grounded and lockable fused mainline switches or circuit breakers, with auxiliary contact for emergency battery lowering and extended to terminals of controllers.
2. Light Circuits: Single phase circuit through disconnect and extended to controller for car lights and fan.
3. Communication Circuit: Telephone circuit terminated at junction box of each controller.
4. Illumination: Lights, light switches and convenience GFCI outlets in pits, machine rooms.
5. Conduit: Installation of electrical conduit and pull boxes with pull wire between hoistways and remote locations of each indicator and control panel. Additional conduit and pull boxes required for the complete installation shall be included under this Section. Wire and final connections by the Elevator Installer. The following conduit is to be provided under the Electrical Section.

<table>
<thead>
<tr>
<th>No. of Elev. In Bank</th>
<th>No. of Conduits</th>
<th>Conduit Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Car</td>
<td>1</td>
<td>2”</td>
</tr>
</tbody>
</table>

7. Sensing Devices: Smoke detectors or products of combustion sensors in elevator lobbies with circuits terminated at junction box in machine rooms for emergency fire service operation.
8. Life Safety Circuits: Circuits terminated at junction box at each controller for life safety speakers and fireman's phone communication.
10. Identify and remove all wire and equipment in the elevator machine rooms and hoistways not directly related to the operation of the elevators.

E. Related Work Interfaced With This Section

2. Painting: Field painting of prime finish of raw metalwork constituting final finishes.

3. Maintain a temperature between 55° and 95° with a relative humidity of 85%.
   a. Should HVAC be required, based on manufacturer’s heat release calculation submittals, provide wall mounted type in machine rooms with condensation discharge piping from machine room to suitable discharge location outside the building or as selected by the Owner’s Representative.

F. Definitions
   1. Main Lobby: *1 Landing.
   2. Fire Recall Floor: *1 Landing.
   3. Alternate Fire Recall Floor: As approved by Fire Marshal.

1.02 QUALITY ASSURANCE

A. Qualifications of Bidders
   1. Manufacturer’s Qualifications: The design, engineering and manufacture of major elevator components such as machines, controllers, door operators, etc. shall be from manufactures that have been in the business for the last ten (10) years. Equipment proposed must have a history of successful operation under similar conditions for the last two (2) years.

   2. Installer and Maintenance Qualifications: Installer must be licensed Elevator Contractor in the State of California.
      a. Show evidence of successful experience in complete installation and maintenance of proposed manufacturer’s elevator equipment for at least five (5) years.
      b. Directly employ sufficient competent personnel within 50 miles of project to handle construction and maintenance duties.
      c. Maintain local stock of parts adequate for replacement on permanent or emergency basis.
      d. Be able to respond to trouble calls within one hour.
      e. Offer the Owner agreement for continuing maintenance after expiration of maintenance period under this contract.

   3. Elevator Cars and Entrances: Rehabilitated by manufacturer or approved by Owner’s Representative.

B. Requirements of Regulatory Agencies
   1. Codes: In accordance with the latest applicable edition requirements of the following and as specified:
      a. ADA: Americans with Disabilities Act.
      b. CA Title 24: Accessibility Requirements.
d. CBC: California Building Code.

e. NEC: National Electric Code.


g. All local codes which govern.

2. Permits: Arrange and pay for inspections by governing authorities and obtain operating permits.

1.03 SUBMITTALS

A. Shop Drawings: Submit as required by Owner’s Representative. The Owner’s Representative reserves the right to require any details of any portion of the equipment.

1. Details: Submit details of cabs, fixtures and entrances.

2. Data: Indicate on layouts or separate data sheets; machine spaces heat release, power requirements, conduit runs outside of hoistways and machine rooms, car roller guides and door operators.

B. Samples: Provide samples of materials and finishes exposed to public view and additional, if specifically requested, 6 inch x 6 inch panels, 12 inch lengths or full size if smaller, as applicable.

C. Operating Instructions: Submit manufacturer's literature describing system operations and special operations as specified.

D. Electrical Shutdowns: Temporary electrical shutdowns will not be allowed except for brief periods to be scheduled for outside normal hours and that at least 48 hours in advance and approved by Owner's Representative.

1.04 PROJECT RECORD DOCUMENTS

A. As-Built Drawings: The Contractor shall maintain at the job site a separate and complete set of contract drawings which will be used solely for the purpose of recording changes made in any portion of the work during the course of construction, regardless of the reason for such change. Changes, as they occur, will be marked on the record set of drawings on a daily basis. The monthly payment will be withheld until the Owner's Representative has verified that "as-built" corrections are current. Before final payment is authorized, the Contractor shall certify that all changes in the work are included on the drawings and will deliver such to the Owner's Representative.

B. Record Drawings

1. The Contractor shall prepare "as-built" drawings in duplicate of any changes to electrical work on prints supplied by the Owner's Representative. During the course of construction, actual locations to scale shall be shown for all runs of mechanical and electrical work, installed in walls and floors or otherwise concealed. This shall cover all piping, electrical wiring, whether in conduit or cable, duct work, etc., shall be located, in addition, by dimension. All services shall be identified in ink on the prints.

2. In addition, the Contractor shall keep a complete record copy of the plans and specifications for the use in preparing "as-built" plans and specifications at the end of the job. The Contractor shall sign and date the prints and deliver them to the Owner's Representative.

1.05 NOISE CONTROL
A. The Contractor, in the preparation and the execution of the work, shall recognize the particular and mandatory requirements of the remodeling project due to the character of the work and the use occupancy of the building.

B. Noise and vibration generated by this construction for this work may, at times, create a problem for the operations of the building. In the event the noise produced by the construction work conflicts with the building function, the Contractor, at the request of the Owner's Representative, shall reduce or stop the noise.

C. The noise level shall be measured on the "A" Scale of a sound level meter as follows:
   1. With the meter located 3'-0" from the nearest staff work station to the elevator lobby, the sound level shall not exceed 75 dBA.
   2. With the meter located 3'-0" from each machine room door at floor level, the sound level shall not exceed 85 dBA.
   3. With the meter located 3'-0" from any hoistway door at any level, the sound level shall not exceed 90 dBA.

D. Contractor shall perform all noisy work as is generally outlined below or as directed by Owner's Representative:
   1. Weekdays: Before normal working hours.
   2. Saturdays, Sundays and holidays.

E. Types of noise generating work:
   1. All heavy demolition (concrete walls and floors).
   2. All grinding, chipping, pounding, sanding and cutting of holes and core drilling.

1.06 WARRANTY

A. Provide special project warranty, signed by Contractor, Installer and Manufacturer, agreeing to replace/repair/restore defective materials and workmanship of elevator work which may develop within one (1) year from final date of completion and acceptance of the entire installation. "Defective" is hereby defined to include, but not by way of limitation, operation or control system failures, performances below required minimums, excessive wear, unusual deterioration or aging of materials or finishes, unsafe conditions, the need for excessive maintenance, abnormal noise or vibration and similar unusual, unexpected and unsatisfactory conditions.

1.07 SUB-CONTRACTORS

A. The Contractor shall be solely responsible for any and all of the work done by their sub-contractor or other employees and all orders or instructions from the Owner's Representative shall be through him to them. It shall be the Contractor's duty to see that all of his sub-contractors commence their work properly at the proper time, and carry it on with due diligence so that they do not delay or injure either work or materials; and that all damage caused by them or their workmen is properly made good by them or by himself at his cost. Contractor shall submit names of his sub-contractors for approval by the Owner's Representative.

B. The use of sub-contractors is to be limited to work outside the scope of elevator construction work; example, patching, painting, coring of walls, marble work and refinishing.

1.08 ALTERNATES

A. Alternate No. 1 - Continuing Full Maintenance Contract
1. Quote cost and submit manufacturer's proposal for full maintenance contract for a period of five (5) years after expiration of 12 month maintenance provided with this new installation.

2. Provide examinations, replacements and call-back service as specified for maintenance under this Section.

B. Alternate No. 2 - Cylinder & Piston Assembly

1. Quote costs and submit manufacturer’s proposal for new cylinder & piston assemblies.

PART 2 - PRODUCTS

2.01 DESCRIPTION OF SYSTEMS

A. Elevator Nos. 1 & 2:

1. Type: Hydraulic Direct Plunger
2. Capacity: Elev. 1: 4,000
             Elev. 2: 2,500
3. Speed: 125 FPM
4. Stops: Elev. 1: Two (2) @ *1 and 2
             Elev. 2: Three (3) @ *1, 2 and 3
5. Travel: Elev. 1: 14-ft. / Verify Existing
             Elev. 2: 21-ft. / Verify Existing
6. Car Enclosure Type: Elev. 1: New / Passenger/Service
                   Elev. 2: New / Passenger
7. Machine Location: Elev. 1: Adjacent
                  Elev. 2: Adjacent
8. Control: AC Resistive
11. Controller: New / Closed Loop Type Microprocessor
12. Power Unit: New
13. Cab Interior: New
15. Car Operating Panel: New
16. Signal Fixtures: New
17. Guide Rails: Retain Existing
18. Guide Shoes: New / Adjustable Spring Type
19. Door Operator: New / Closed Loop
20. Door Protection: New / Electronic 3-D
21. Car Doors: New / Stainless Steel
22. Entrance Doors: New / Steel With Painted Finish
23. Entrance Frames: Retain Existing / Refurbish
24. Cylinder & Piston: Retain Existing / See Alternate No. 2
25. Miscellaneous Items: New / Handicap Requirements / Key Operated Hoistway Access / Ventilation Exhaust Fans / Clean hoistways, machine rooms & equipment / Clean & paint all existing metal work

2.02 MATERIALS

A. Aluminum: Alloy and temper best suited for anodizing finish specified.
B. Nickel Silver: CDA Alloy 796, leaded nickel silver.
C. Plywood: PS-1, A-D exterior Grade Douglas Fir, fire retardant treated.
D. Sheet Steel: ASTM A366, uncoated, pickled, free from defects.
E. Sound Deadener: Fire retardant; spray, roller or adhesive applied; 3/16 inch thick.
F. Stainless Steel: ASTM A167; type 302 or 304.

2.03 FINISHES

A. Exposed-to-View Surfaces. Provide as follows unless otherwise specified.

1. Aluminum: Clear anodized finish.
3. Sheet Steel:
   a. Shop Prime: Degrease clean of foreign substances and apply one (1) coat of corrosion inhibiting primer compatible with finish paint selected. Hoistway items visible to public shall be painted one (1) additional coat of black paint.
   b. Finish Paint: Electro Powder Coating or three (3) coats baked enamel; sand each coat smooth; color as selected.
4. Stainless Steel:
   a. Plain: Satin, directional polish, clear coated No. 4 finish.
   b. Mirror: Non-directional polish, No. 10 finish unless otherwise specified.
5. Touch-Up:
   a. Prime Surfaces: Use same paint as factory for field touch-up.
   b. Finish Painted Surfaces: Refinish whole panel with shop prime and finish paint as specified above.

B. Non-Exposed-to-View Surfaces: Degrease and shop paint manufacturer's standard corrosion inhibiting primer.

2.04 AUTOMATIC OPERATION

A. General Operation of Individual Elevators

1. Provide microprocessor-controlled dispatching system designed to monitor all types of traffic and sufficiently flexible so that it can be modified to accommodate changes in traffic patterns. Include hardware necessary to protect motors and door operators. Software shall control group and simplex program operations.

2. The system shall continuously monitor the demand based on real time calculations to assign and reassign the elevator to handle the traffic in the most efficient manner.

3. Design the control system to accept reprogramming with no shutdown of system.

4. The system shall be flexible irrespective of the number of elevators in normal service.

5. Individual elevator shall operate on the basis of directional single cancellation collective automatic control in accordance with the following:
   a. The control and indicating devices and supplementary service modes to be provided, together with the basic functioning of these and of power doors, door protective devices and similar items, are detailed in the relevant paragraphs of this specification.
   b. Car and landing calls in each direction of travel shall be answered in the order in which required floors are approached by the car, provided that the call is registered sufficiently in advance of the car's arrival to permit a stop to be made.

6. Serial Link Communications: Provide a distributed processing network consisting of localized processors located in machine rooms, car stations, hall stations and top of car to allow system to make fast decisions based on data shared by the processor involved in the different operations of the elevator. For group dispatch operations, all elevators in the group shall be capable of acting as a group common dispatcher as the need arises.

7. Fault Diagnostic System and Machine Room Monitor:
   a. Diagnostic system shall be capable of determining faults most difficult to find. It shall constantly monitor the condition of all car computers. When variances occur from the normal mode, the change or fault shall be detected, the location of the elevator, time of day, number of times fault occurred, along with fault code message shall be stored on memory. This information shall be retrievable to a minimum of the last 200 entries.

B. Simplex Selective Collective Operation

1. Arrange for Simplex Selective Collective automatic operation. Operate elevators from a single riser of landing buttons and from operating device in car.
2. Momentary pressure of one or more car or landing buttons, other than those for landing at which
car is standing, starts car, and causes car to stop at first landing for which a car or landing call is
registered corresponding to direction in which car is traveling. Stops made in order in which
landings are reached, irrespective of sequence in which calls are registered.

3. Double door operation not permitted. If an up traveling car has a passenger for an intermediate
floor and a down call is registered at that floor, with no calls above car, it travels to floor, opens
door to let passenger out, then lights down direction arrow in hall lantern and accepts waiting
passenger without closing and reopening doors.

2.05 SPECIAL OPERATIONS

A. Inspection Operation: Provide key-operated hoistway access device and car top operating device. Key
switches shall be wall mounted with a faceplate fabricated of 1/8 inch stainless steel with clear coated No. 4
finish and located in the lobby walls within twelve (12) inches of the entrance jamb.

B. Independent Service: Independent service operation shall be provided so that, by means of a switch located
in the car service cabinet, the car can be removed from automatic operation and be operated by an
attendant. The attendant shall have full control of the starting, stopping and direction of car travel. The car
shall respond to car buttons only. The hall signals for the car on independent service shall not operate.

C. Operation under Fire or Other Emergency Conditions: Provide special emergency service to comply with
ASME A17.1, UBC and local codes having jurisdiction. Provide Phase 1 recall switch at Main Floor Elevator
Lobby. Key switches shall be integrated in hall button station with engraved instructions with pictograph.

2.06 DOOR OPERATION

A. Passenger Type, Horizontal Sliding

1. Provide door times available as specified under "Design Criteria."

2. Car and hoistway doors shall open and close simultaneously, quietly and smoothly; door
movement shall be cushioned at both limits of travel. Door operation shall not cause cars to move
appreciably.

3. Door hold open times shall be readily and independently adjustable when car stops for a car or hall
call. Main floor door hold times shall be adjustable independent of other floors.

B. Door Operator

1. Provide new heavy-duty master type operator for use with Elevator No. 1 two speed side opening
(2SSO) doors and Elevator No. 2 single speed side opening (SSSO) doors with closed loop
microprocessor controls, AC motor and compatible door relating equipment as required. As a
standard of quality provide G.A.L. MOVFR 2 or approved equal. Submittals required.

C. Door Protection

1. Passenger Elevator
   a. Electronic Scanning Type Door Protection: Provide Janus Panachrome 3D door
      protective system. No known equal.
   b. The system does not rely on physical contact with, or the motion of, a person or object to
      inhibit door movement or initiate door reversal.
   c. Provide red and green illuminated segments along the edges to visually inform
      passengers of the doors movement. The segments are to glow green when it is safe to
      enter and exit the elevator and flash red to signal the doors are closing.
d. Provide warning voice announcement.

e. The system shall be able to detect a 2 inch diameter rod introduced at any position within the door movement and between the height of 2 inches and 63 inches above sill level.

e. Detection of intrusion into the protected area shall cause the doors, if fully open, to be held in the "open" position and, if closing, to stop then reverse to the fully "open" position.

g. The first intrusion during a stop at any landing shall cancel the normal dwell time and substitute a door protective system time delay which shall be adjustable between 1 to 10 seconds commencing with removal of the intrusion. If, during this period, a further intrusion occurs, upon its removal, the same delay period shall be reemployed and this cycle shall continue until traffic through the doorway ceases.

h. The doors shall commence to close immediately after the expiration of the determined period once the last intrusion has been removed.

i. If doors are prevented from closing for an adjustable period of 15 to 45 seconds or upon activation of Fire Emergency Service, they shall proceed to close at reduced speed and a loud buzzer shall sound. Door closing force shall not exceed 2-1/2 ft.-lb. When door re-opening device is not in operation.

2.07 SIGNALS AND OPERATING FIXTURES

A. General: Provide signals and fixtures as specified. Location and arrangement of fixtures shall comply with handicap requirements. Submittals required.

1. Buttons: Provide minimum 1 inch diameter mechanical, white fully illuminated buttons, raised 1/8 inch from surrounding surface with square shoulders. Operation of car and/or hall button shall cause button to fully illuminate over the face of the button. Response of car to car or hall call shall cause corresponding button to extinguish.

2. Buttons: Hall Calls and Car Calls; Provide California approved vandal-resistant plastic type buttons with metallic squared shoulder edges equal to Adams, EPCO or GAL fixtures.

3. Switches: Toggle type typically or key operated where noted.

4. Faceplates: Provide stainless steel with clear coated No. 4 finish; 1/8 inch minimum thickness with sharp edges relieved. Faceplates shall be sized to cover holes left by removal of existing fixtures where new fixtures are provided.

5. Fastenings: Provide with concealed fasteners or flush tamper-proof screws of material and finish matching faceplates.

6. Cabinets: Provide with pulls, concealed hinges and doors mounted flush with hairline joints to adjacent surface.

7. Arrangement: Arrangement of fixtures shall generally conform to that specified, but components may be rearranged, if desired, subject to the approval of the Owner’s Representative.

8. Engraving: Of size indicated; color backfill with epoxy paint in contrasting color as selected.


10. Provide fully adjustable Voice Announcement to comply with the ADA/CA Title 24 Accessibility guidelines.

11. Audible Chimes: Electronic adjustable audible chimes; bell type gong not acceptable.
B. Car Operating Panels

1. General: Remove existing and provide new with buttons numbered to conform to floors served and the following:
   
a. Locate top operating button at 48 inches above floor.

b. Locate emergency stop and illuminated alarm button in bottom row at 35 inches above floor. Wire emergency stop to ring alarm bell.

c. Provide "Door Open" and "Door Close" buttons located above emergency stop and alarm of same design as car button.

d. Engrave main panel with capacity and number of passengers in 1/4 inch lettering, and elevator number in 1/2 inch letters. Engrave auxiliary panel with NO SMOKING in 1 inch characters. All other signage required by local codes shall be engraved as directed by Owner's Representative.

e. Provide lockable Firefighter's control cabinet with fire emergency key switch, engraved instructions and call cancel button with audible/visual signals and fire department phone jack located below emergency stop and alarm.

2. Integrate cabinets, buttons and engraving into new fixed front return panel without applied faceplate. The entire car operating panel shall be fabricated from 14 gauge stainless steel with No. 4 finish and flush to the new return panel with hair line joints at adjacent surfaces and swing on concealed hinges with concealed locking means for servicing.

C. Car Position Indicators: Provide car position indicators in new car operating panels with indications corresponding to floor designations with matching direction arrows.

D. Service Cabinet: Provide new cabinet, door with a lock and concealed hinge as an integral part of car operating panel mounted with flush hairline joints. Cabinet door shall be provided with a flush glazed window of required size to hold and display full size elevator operating permit. Service cabinet shall contain the following:

   1. Independent service switch.

   2. Two-speed ventilation switch.

   3. Light switch or dimmer as applicable.

   4. Inspection switch, key operated.

   5. Duplex GFCI convenience outlet.

   6. Buzzers as required.

   7. Test switch for emergency car lighting.

E. Communication Equipment: Provide a new complete communication system in compliance with ADA/CA Title 24 regulations consisting of a combination speaker/microphone, amplifier, automatic dialer and push button to activate system and acknowledgement lights. Mount in main car operating panel behind a pattern of holes, wire to machine room and program automatic dialer as directed by Owner's Representative.

F. Hall Button Fixtures: Each fixture shall contain California approved vandal resistant buttons which fully illuminate to indicate hall call registration and extinguish when call is answered. Provide intermediate fixtures with two (2) buttons and terminal fixtures with one (1) button. Engrave fire-exiting instructions with pictograph on faceplates.
1. Provide each simplex elevator with one (1) riser of hall button stations.
   a. All Floors: Provide extended and oversized rectangular shaped faceplates, to cover voids from removal of existing fixtures, fabricated from stainless steel with clear coated No. 4 finish.
   b. The top of the terminal button shall be at 42 inches above the finished floor.
   c. The centerline between the intermediate buttons shall be at 42 inches above the finished floor.
   d. Surface mounted hall button fixtures are acceptable.
   e. Submittals required.

G. Directional Car Lanterns: Provide two (2) lantern fixtures in each elevator with single audible tone for up and double audible tone for down direction. Lantern illuminates white for up and red for down. As car approaches floor, lantern shall illuminate to indicate next direction of travel.
   1. Provide in new return panel and columns, manufacturer's flush type plug-in type lanterns with flush triangular lenses fitted to flush faceplates with hairline joints at adjacent surfaces and fabricated from 1/8 inch stainless steel with clear coated No. 4 finish.

H. Handicap Requirements: Provide to meet local codes having jurisdiction including handrail and button configuration.
   1. Car Operating Panels: Provide raised Braille and alpha characters, numerals or symbols to the left of operating buttons and devices used by the public. Indications may be engraved directly on faceplates or separate plates flush mounted with hairline joints and concealed mechanical fasteners. Raised characters shall be white on a black background with Braille designation directly below the character. The white character on black background finishes shall be resilient to rubbing off and scratching. Braille designation shall be below the raised character.
   2. Entrances: Provide raised Braille and alpha characters, numerals or symbols similar to those for car stations of size required by governing authority. Locate on each entrance jamb at 60 inches above floor indicating floor designation. Material and finish of plates shall match hall button station faceplates. Provide with white characters on black background and mounting means similar to those on car panels. Braille designation shall be below the raised character.

2.08 WIRING

A. General: Remove all existing elevator related hoistway and machine room conduit, gutter and wiring and provide new. Permanently remove all existing non-elevator related hoistway and machine room conduit, gutter and wiring.

B. Provide all necessary wiring and 15% spares between cars and controllers and to all remote control stations; minimum of four. Furnish shielded wires in cables for all communications card readers and speakers. Include two (2) additional pairs of shielded spares for each car.

C. Traveling Cables: Use minimum number of traveling cables with flame retarding and moisture resisting covers. Include shielded wires and spares as noted above. Cord thoroughly and protect cables from rubbing against hoistways or car items. Provide with steel cable core and properly anchored to relieve strain on individual conductors.

D. Work Light and GFCI Convenience Outlet: Provide on top of car with wire lamp guard.

E. Stop Switch: Provide in each pit and on top of car.
F. Alarm Bell: Six-inch size, 110 volt. Provide one (1) on top of each car and one (1) per group inside of hoistway at level main "*" landing, total of 4, to be actuated by corresponding alarm button or emergency stop switch.

G. Auxiliary Disconnect Switches: Provide as required in remote controller rooms or at remote equipment not in view of mainline switches; include all wiring and conduit.

2.09 CAB ENCLOSURES

A. General: Provide new cab enclosures. Fabricate finish work smooth and free from warps, buckles, squeaks and rattles.

1. Emergency Exit: Top of car per code. Provide new lock and electrical contact to impede car movement should the emergency exit be open or ajar.


3. Car Doors: Fabricate from 16-gauge stainless steel with clear coated No. 4 finish sufficiently reinforced with steel to insure rigidity and sound deadened. Provide two (2) guides per panel located 1 inch from each end. Provide full-length neoprene astragals. Mount doors on structural header, not on car enclosure. Finish car side with finish 1/2 inch around edge of doors.

4. Front Return Panels: Remove existing and provide fixed panels with integral flush swing type car operating panel fabricated from 14 gauge stainless steel with clear coated No. 4 finish.

5. Transom and Return Panels & Columns: Provide new fabricated from 14 gauge stainless steel with clear coated No. 4 finish.

B. Emergency Lighting: Provide an emergency car lighting unit mounted on top of car, battery driven and self-rechargeable. Upon outage of normal power the unit shall, within five (5) seconds, light two (2) lamps as part of normal car lighting. The unit shall have sufficient capacity to keep the lights in continuous operation for four (4) hours and also the alarm bell for one (1) hour. Provide a readily accessible means for testing the unit in service cabinet. Light fixtures mounted in car front returns or operating panels are not acceptable.

C. Car Interiors:

1. Interior Panels: Provide removable panels of 3/4 inch particle board core with balance sheet; align joints with ceiling grid. Finished surfaces shall be patterned Rigidized 5WL applied to face and edges for Elevator No. 1 and plastic laminate applied to face and edges with design and color as selected by Owner's Representative for Elevator No. 2.

2. Base and Metal Trim: Provide base below removable panels, vertical joints between panels and other metal fabricated from stainless steel clear coated No. 4 finish.

3. Ceiling and Lighting: Provide a suspended drop in ceiling fabricated from stainless steel clear coated No. 4 finish applied to particle board with code compliant access to escape hatch. Provide six (6) equally spaced low-voltages LED down lights in ceiling with dimmer switch controls located in service cabinet.

4. Flooring: Remove existing and provide new single piece heavy duty easy clean rubberized flooring. Prepare subfloor per the manufacturer's recommendations and to be free of squeaks and rattles. Design and color as selected by Owner's Representative.

2.10 HOISTWAY ENTRANCES, PASSENGER TYPE

A. General: Retain existing and refurbish if compatible with new door operators and as specified, otherwise replace.
1. Hangers and Tracks: Retain existing door tracks and refurbish, resurface to provide for smooth operation. Provide new hanger assemblies of the sheave type with two-point suspension. Steel sheaves with flanged groove and resilient sound absorbing tires. Minimum 2-1/2 inch diameter for hoistway, 3 inches for car. Provide with ball or roller bearing with adjustable upthrusts.

2. Closers: Provide new cable relating as required for door assembly. Weighted type closers are not acceptable.

3. Interlocks: Provide all new. Equip each hoistway door with a tamper-proof interlock which shall prevent operation of the car until doors are locked in the close position as defined by the Code and shall prevent opening of doors at landing from corridor side unless car is at rest at landing in leveling zone or, hoistway access switch is used. Provide all new high temperature wiring for interlock circuits.

4. Pick-Up Roller Assemblies: Provide all new pick-up roller assemblies as required for door operating equipment furnished.

5. Dust and Hanger Covers: Retain existing, clean and refinish with black paint.

6. Fascia and Head Guards: Retain existing and refinish with black paint; refasten for greater rigidity.

7. Toe Guards: Provide new toe guard fabricated from minimum 14-gauge sheet steel of size and reinforced to comply with code requirements. Paint black.

8. Sills: Retain existing, power clean to metal and refinish.

B. Entrance Frames

1. Frames: Retain existing and refurbish. Make repairs to metal surfaces, clean, fill, sand, prime and paint.

C. Hoistway Doors

1. Provide New. Fabricate from 14-gauge sheet steel sufficiently reinforced with steel to ensure rigidity and sound deadened. Escutcheons and key holes are not acceptable. Provide two (2) guides per panel which will remain engaged in sill if guiding member is destroyed. Provide full length neoprene astragals on leading edge and non-vision wings of material and finish to match doors.

a. Primed and painted with colors as selected by Owner’s Representative.

b. The leadings edges are to be flush or slightly behind the face of the jamb when fully opened and idle to maximize the clear open entry.

2.11 HYDRAULIC ELEVATOR EQUIPMENT

A. Design Criteria

1. Performance

a. Contract Speed: Maximum twenty percent (20%) speed variation under any loading condition in either direction.

b. Motion Time: From start to stop of elevator’s motion as measured in both directions for a typical one floor run under any loading condition. Initiate movement of car within 1.5 second after make-up of hoistway door interlock.

c. Door Open Times:
1) Passenger/Service Elevator No. 1: 2.4-2.6 seconds

2) Passenger Elevator No. 2: 1.9-2.0 seconds

d. Door Close Times: Minimum, without exceeding kinetic energy and closing force, allowed by code.

e. Door Dwell Times: Comply with ADA/CA Title 24 formula and provide separate adjustable timers with initial settings as follows:

1) Main Lobby Hall Call: 5.0 seconds.

2) Upper Lobby Hall Call: 5.0 seconds.

3) Car Call: 5.0 seconds.

4) Interruption of Door Protective Device: Reduce dwell to 1 second.

f. Leveling: Within 1/4 inch under any loading condition. Level into floor at all times, do not overrun floor and level back.

g. Hydraulic Pressure: Hydraulic components shall be factory tested for 600 PSI. Maximum operating pressure shall be 425 PSI.

2. Operating Qualities: Architect and Owner will judge riding qualities of cars and enforce the following requirements. Make all necessary adjustments.

a. Starting and stopping shall be smooth and comfortable. Slowdown, stopping and leveling shall be without jars or bumps.

1) Vertical Acceleration: Maximum 2.5 ft. per second squared. Maximum jerk 35 ft. per second cubed.

2) Horizontal Acceleration: Maximum 30 mg peak-to-peak measured at full speed for full travel in both directions.

b. Full Speed Riding: Free from vibration and sway.

3. Sound Control

a. Vibration: Sound isolate power units from building structure to prevent objectionable noise and vibration transmission to occupied building spaces.

b. Airborne Noise: Maximum acoustical output level of:

1) 75 dBA measured in machine room.

2) 60 dBA measured in elevator cars during all sequences of operation.

3) 50 dBA measured in elevator lobbies.

2.12 HYDRAULIC ELEVATOR HOISTWAY EQUIPMENT

A. Guide Rails and Brackets: Retain existing rails and refurbish. Wire brush to be clean and free of rust. Prime and paint non running surfaces with rust inhibiting epoxy based paint. Realign, check, tighten and replace Code non-complying brackets, fishplates and bolts. Provide log of the alignment corrections to the Owner’s Representative.
B. **Guide Shoes:** Provide new ELSCO, Model B guide shoes of the roller type with neoprene tires, minimum 3/4 inch wide and fully adjustable spring loaded to provide continuous contact with rail surfaces. Provide adaptor plates and retainer plates. Balance car to insure equal guide shoe pressure on all wheels and not exceed manufacturer's recommendations. Nominal roller/tire diameter shall be 6 inches.

C. **Buffers:** Retain existing spring type buffers and refurbish. Wire brush to be clean and free of rust. Prime and paint surfaces with rust inhibiting epoxy based paint.

1. **Car Frame and Platform:** Retain existing car frame and platform. Clean down with wire brush and paint with rust inhibitive paint. Inspect and refurbish to be free of squeaks, rattles and oil can noises. Tighten frame bolts and static balance weight to be added as required.

D. **Platen Isolation:** Provide minimum 3/4 inch thick steel plates between top of plunger and car frame with 1 inch rubber or neoprene isolation material between.

E. **Cylinder:** Retain existing and refurbish;

1. Replace the cylinder head packing seals.

2. Conduct full load test.

F. **Alternate No.2 – Cylinder & piston assemblies, Elevator Nos. 1 & 2.**

1. **Cylinder Well and Casing:** Remove existing cylinder & plunger unit and provide new as follows:

   a. **Well:** The Elevator Installer shall familiarize himself with existing conditions and be responsible for drilling cylinder wells.

   b. **Casing:** Provide steel casing to proper depth to retain hole and provide structural integrity of PVC casing. Provide minimum 10-gauge corrosion resistant well casing having minimum 0.20 percent copper content; watertight joints and closed bottom. Weld seams solid at multiple casing joints. Provide a steel ring at top of casing to be keyed into pit floor. Provide watertight seal at bottom using a minimum of 2 feet thick, non-shrink concrete plug of type for installation under water where drive casing is required and closed bottom casing cannot be installed.

   c. Provide minimum 3/8 inch thick PVC casing with watertight sealed couplings and bottom end caps. Inside diameter shall be 6 inches greater than outside diameter of cylinder. Extend PVC above pit floor to fit snug against cylinder head.

   d. **Installation:** Set cylinder and PVC casing within steel casing and backfill between all voids with clean dry neutral silica sand or pea gravel well tamped. After cylinder is set, provide a watertight laminating or epoxy resin seal between PVC and top of cylinder. Plunger and cylinder shall be plumb within 1/16 inch.

   e. **Cylinder:** Steel pipe, factory tested for 400 pounds/square inch working pressure. Sandblast or wire brush outside of cylinder to remove rust and scale. Paint with heavy coat of epoxy or mastic. Wrap with 20 mil wrapping of Trantex, Tapecoat, Glasswrap or approved equal. Work shall be done in shop and repaired in field if coating is damaged.

   f. **Plunger:** Use seamless steel pipe or tubing, minimum Schedule 80. Plunger shall be no more than 0.010 inch out of round and straight within 1/16 inch. Protect during shipping and installation to avoid damage. If plunger is gouged, scarred or shows visible tool marks, it shall be replaced. Finish shall be 12 micro inches or finer. Plunger top shall be isolated from car frame. Plungers with follower guides are not acceptable.

G. **Packing:** Provide packing that inhibits leaking of oil with drip ring. Replace packings following state inspection of the elevator.
H. Oil Return Pump: Provide new securely anchored to pit floors or pit channels, prime and test operation electrically. Provide 1/4 inch copper tubing for oil return line to new oil reservoir in machine rooms with a dielectric connection.

I. Oil: Provide Chevron OC turbine oil or approved equal, 150 SSU at 100 degrees F. temperature.

J. Piping: Provide new in machine rooms and elevator pits with code compliant identification labels on each section of pipe. Minimum Schedule 80 steel pipe and Victaulic fitting suitable for 400 pounds pressure. No hoses shall be used in any part of piping. Provide sound isolating couplings in oil line between jack and pumping plant. Support piping using Vibration isolating mounts or hangers with integral felt or neoprene at least 1/4 inch thick.

1. Testing: Before enclosing pipe system, close ends, fill with fluid, establish 400 PSI pressure and allow to stand for 24 hours. Make corrective repairs to leaks or pressure drop.

K. Pit Valves: Provide in the elevator pit a gate valve to shut off oil between cylinder and pumping plant, and a pressure type line rupture safety valve to shut off oil between cylinder head and pit valve. Activation of safety valve shall not void operation of lowering valve.

L. Pit Ladder: Provide new collapsible type in each elevator pit with electrical contact to disconnect power to the controller when ladder is ajar or in open position. Properly anchor for code compliance. Fabricated from aluminum or galvanized steel having painted surfaces of rust inhibiting epoxy based paint. Submittal drawings required.

M. Power wash the pit floors, walls and all pit equipment. Paint pit floors and equipment prior to waterproofing of pits.

N. Waterproof Elevator Pits: Provide injection method in pit floor and walls utilizing BRS Construction’s PENE-Grout or GeoGrout’s expandable systems with five (5) year written warranty for all labor and materials.

2.13 MACHINE ROOM EQUIPMENT

A. General: Provide equipment to fit existing space and structural limitations. Coordinate related electrical, structural and mechanical work with other trades.

B. Pumping Plant: Provide new.

1. General: Submersible type if compatible with existing three phase electrical service and increased contract car speed of 125 fpm or Dry Belt-Drive with self-contained unit with sound reducing cabinet and sound isolated base.

2. Pump: IMO, Roper or accepted equal for 150 SSU oil, belt driven. Maximum speed 3600 RPM. Maximum pressure 360 pounds per square inch.

3. Tank: Capacity equal to plunger displacement plus 25%. Provide strainers, oil level gauge and device to maintain uniform oil temperature.


5. Motor: General Electric, Imperial, Westinghouse or accepted equal; maximum speed 1800 RPM. Provide minimum 120 starts/hour heavy-duty motor, continuous rated, 50 degrees C. temperature rise, Class A insulation or 70 degrees C. rise for Class B insulation.


C. Controller: Provide non-proprietary microprocessor controls from Motion Control Engineering (MCE), Smart Rise or Elevator Controls (EC) with emergency battery lowering operation. Include door operating relays
combined with controller. Provide electronic soft start starting with starting switches rated at minimum 57% of horsepower rating. IEC method of line starter application is unacceptable. Provide three (3) manual reset overload relays, one in each line and reverse phase relay. Provide externally mounted permanently identified junction boxes on controller cabinets for termination of communication circuits.

D. HVAC: Provide wall mounted type in each machine room to regulate temperature and relative humidity as recommended by the elevator controller manufacturer.

PART 3 - EXECUTION

3.01 PREPARATION

A. Field Measurements: Field verify all dimensions before proceeding with the work. Coordinate related work by other trades.

3.02 INSTALLATION

A. General: Install per manufacturer’s requirements, those of regulatory agencies and as specified.

B. Welded Construction: Provide welded connections for installation of elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustments, inspection, maintenance and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.

C. Sound Isolation: Mount rotating and vibrating elevator equipment and components on vibration-absorption mounts, designed to effectively prevent transmission of vibrations to structure and thereby, eliminate sources of structure-borne noise from elevator system.

D. Lubricate operating parts of systems as recommended by manufacturer.

E. Align guide rails plumb and parallel with maximum deviation of 1/16 inch. Anchorage of guide rails in pits shall not compromise waterproofing.

F. Graphics: Provide graphics visible to public as selected by Owner's Representative.

G. Manufacturer's Nameplates: Manufacturer's nameplates, trademarks or logos not permitted on surfaces visible to public.

H. Cleaning of The Installation: After the installation of the elevator has been completed and immediately prior to the carrying out of the tests, the machine room and all equipment therein, the elevator hoistway including outside of car and all ledges and similar areas, the elevator pit and equipment therein, and all door hanger runners, guides, tracks and sills shall be thoroughly cleaned down, preferably with vacuum cleaning equipment, and all dust, fluff, dirt, grit, excessive oil and grease and rubbish shall be removed from site.

I. Finish Painting After Tests: After satisfactory completion of the tests, any damage to the paint work shall be made good and the installation re-cleaned, if necessary, after which at least one final coat of gloss oil resistant or enamelized paint shall be applied by brushing or spraying in the Elevator Contractor's customary colors to all the existing and new equipment in the machine room and also to such items in the hoistway or elsewhere which have received only a primer coat.

J. Painting of Machine Room and Pit Floors: After the completion of the entire installation, the floor of each machine room area shall be thoroughly cleaned down and brush painted with two coats of traffic paint having oil resistant properties. Coordinate with waterproofing contractor as not to disturb their system and/or serviceability.

3.03 TEMPORARY ACCEPTANCE AND USE BY OWNER
A. When an elevator is near completion and declared ready for service, before completion of other elevators, Owner agrees to temporarily accept elevator and place it into automatic service.

B. The elevator must be tested and inspected by regulatory agencies and a permit to operate issued.

C. When an elevator is ready for temporary acceptance, notify and assist Owner’s Representative and Consultant in making a walk-through inspection to assure workmanship and equipment complies with contract documents.

D. The Owner agrees to sign or cause the General Contractor to sign a temporary acceptance form that is mutually agreeable to all parties.

E. During this temporary acceptance period, the Owner agrees to pay or cause the General Contractor to pay an agreed amount per day per elevator for regular maintenance. The cost for this maintenance per elevator, per day, shall be stated in the Elevator Contractor’s bid.

F. The guarantee and full maintenance period will be effective upon final acceptance of the entire installation.

3.04 FIELD QUALITY CONTROL

A. Regulatory Agencies Inspection: Upon completion of elevator, Contractor shall provide instruments, weights and personnel to conduct test required by regulatory agencies. The Contractor shall submit a complete report describing the results of the tests.

B. Examination and Testing: When installation is ready for final acceptance, notify and assist Owner’s Representative and Consultant in making a walk-through inspection of entire installation to assure workmanship and equipment complies with contract documents. Provide equipment to perform the following tests:

1. Check and verify operation of all safety features and special operations.
   a. Measure horizontal acceleration.
   b. Measure acoustical output levels in machine room, lobbies and cars.

C. Correction: Make corrections to defects or discrepancies at no cost to Owner. Should discrepancies be such that re-examination and retesting is required, all costs including those of Owner's representative fees shall be paid for by the Elevator Contractor.

D. Final Acceptance: Final acceptance of the installation will be made only after all corrections are complete, final submittals and certificates received and the Owner is satisfied and the installation is complete in all respects. Final payment will not be made until the above is completed.

3.05 INSTRUCTIONS

A. Instruct Owner's personnel in proper use of each system.

3.06 MAINTENANCE

A. General: Interim and Warranty; Provide complete continuing maintenance on entire elevator equipment during regular working hours on regular working days from award of contract, through construction and for a period of 12 months after completion and final acceptance of the last elevator.

B. Examination: Include systematic examination once monthly for adjustment, lubrication and monthly testing of fire emergency recall system of elevator equipment. Replacement of defective parts with parts of same manufacture as required for proper operation. Contractor not responsible for repairs to car enclosures, door panels, frames, sills or platform flooring resulting from normal usage or misuse, accidents and negligence for which Contractor is not responsible. Maintain an on-site log of completed tasks.
C. Performance Standards

1. Maintain the performance standard set forth in this Specification and maintain correct operation of the dispatching system.

2. Maintain smooth starting and stopping, smooth riding qualities and accurate leveling at all times.

D. Callbacks: In event of failures, provide 24-hour callback service at no additional cost to Owner.

E. Elevator Shutdowns

1. Should any elevator become inoperative, repair within 24-hours of notification of any failure. Breakdown of major components shall be completed and service restored within 72-hours.

2. Failure to comply with above, Owner may order the work done by other contractors at the Contractor's expense.

3. Devices repaired or replaced by others shall, nevertheless, become provided with maintenance by the Contractor who shall become completely responsible for correct operation of such devices for lifetime of this contract.

F. Maintenance Materials

1. Replacement Parts: Keep the following parts in a warehouse within 50 miles of the project premises.

   a. One (1) door operator motor of each type used.

   b. One (1) transformer of each type installed.

   c. Two (2) complete door interlocks.

   d. Parts for door protective devices.

   e. Such other parts as are needed to insure prompt replacement in event of elevator shutdown such as spare control boards for computer operated systems.

G. Maintenance Data: After completion, and prior to final acceptance, submit three (3) sets of complete and accurate maintenance data specific for each elevator. Final payment will not be made until received.

1. Manuals: Describe proper use and maintenance of equipment, lubrication points, the types of lubricants used and frequency of lubricant application.

2. Parts Catalogs: Complete listing of all parts of equipment and components used in the installation.

3. Wiring Diagrams: One full size rigidly laminated set mounted in machine room, three (3) black sets delivered to Owner. Wiring diagrams shall be as built, specific for this installation, and reference identification on drawings shall match points identified on terminals of controllers.

4. Maintenance Tool and Software Manuals: Provide maintenance tools and supporting software documentation required for the complete maintenance of the entire system including diagnostics and adjusting. Maintenance tool may be hand held or built into control system and shall be the type not requiring recharging or reprogramming nor of the automatic destruct type. The tool and supporting software may be programmed to operate only with this project's identification serial numbering.
H. Final Service and Inspection: Two (2) weeks before expiration of the year's maintenance, the equipment shall be lubricated, fully serviced, adjusted to the standards designated and emergency service operation devices shall be checked. A complete inspection will be made by a representative of the Owner.

I. Alternate No. 1 - Continuing Full Maintenance Contract

1. Quote cost to provide full maintenance contract for a period of five (5) years after expiration of 12 month maintenance provided with this new installation.

2. Provide examinations, replacements and call-back service as specified for maintenance under this Section.

J. Quotation: Base bid shall include cost of maintenance and materials as described above.

END OF SECTION
ELEV. NO. 2 HATCH and MACHINE ROOM PLAN

NOTE:
1. PROVIDE NEW SMOKE DETECTOR IN THE MACHINE ROOM.
2. PROVIDE VENTILATION IN THE MACHINE ROOM.
3. SPRINKLERS IN THE MACHINE ROOM Exist BUT NO HEAT DETECTOR.
   PROVIDE HEAT DETECTOR AS REQUIRED BY CODE.

HALL FIXTURES LOCATION
ELEV. NO. 2

FL. 2

6'-3"

FL. 1

3'-6"

ELEV. NO. 2

FREWDAS KEY SW.
UP HALL BUTTON
ACCESS KEY SW.

ELEV. NO. 1

NOTES:
1. PROVIDE NEW SMOKE DETECTOR IN THE MACHINE ROOM.
2. PROVIDE VENTILATION IN THE MACHINE ROOM.

REFER TO SPECIFICATION FOR ADDITIONAL INFORMATION NOT SHOWN ON THIS DRAWING
PART 1 - GENERAL

The General Provisions of the Contract, including General and Special Conditions and the requirements of Division 1, apply to the Work in this Section.

1.01 WORK INCLUDED

A. Equipment items as listed below by Equipment Identifier:
   1. 5655 Lift, axle, two post, 70,000 pound, shallow design (Ref. Part 2.01)
   2. 5656 Lift, axle, three post, 105,000 pound, shallow design (Ref. Part 2.02)
   3. 5753 Lift, parallelogram, 75,000 pound, 48 foot (Ref. Part 2.03)

B. Roughing-in, installation of equipment, and final connection of utilities, with labor, services, and incidentals necessary for complete and operational equipment installation.

C. Piping, wiring, and switching between equipment and utilities.

1.02 QUALITY ASSURANCE

A. Experience: Equipment shall be produced by a manufacturer of established reputation with a minimum of five years experience supplying specified equipment.

B. Quality standards shall meet or exceed ISO-9001 and be certified by the Automotive Lift Institute (ALI).

C. Manufacturer’s Representative:
   1. Installation: Provide a qualified manufacturer’s representative at site to supervise work related to equipment installation, check out, and start up.
   2. Training: Provide technical representative to provide training to Owner’s maintenance personnel in operation and maintenance of specified equipment.
   3. Quality standards shall meet or exceed ISO-9001.

1.03 BUY AMERICA COMPLIANCE

A. The Contractor shall comply with the applicable Buy America requirements set forth in 49 U.S.C. 5323(j) and the applicable regulations in 49 C.F.R. Part 661, as amended. If the Contractor procures any capital items with Federal funds, it is the Contractor’s responsibility to obtain the Buy America certification required under such regulations.

B. Reference Division 1 for Buy America compliance.

1.04 SUBMITTALS

A. Product Data: Submit Product Data in accordance with Division 1 of these specifications.

B. Operations and Maintenance Manual:
   1. Submit Operations and Maintenance Manuals in accordance with Division 1- General Requirements of these specifications.
2. Provide complete parts, operating, and maintenance manual covering equipment at time of installation.

3. Description of system and components.

4. Schematic diagrams of electrical, plumbing, and compressed air system.

5. Manufacturer’s printed operating instructions.

6. Printed listing of periodic preventive maintenance items and recommended frequency to validate warranties. Failure to provide maintenance information will indicate that preventive maintenance is not a condition for validation of warranties.

C. Shop Drawings:

1. Submit Shop Drawings in accordance with Division 1 - General Requirements.

2. Submit site specific installation drawings and procedures.

1.05 PRODUCT SUBSTITUTIONS

A. Follow requirements specified in Division 1 - General Requirements.

B. Additional costs resulting from substitution of products other than those specified, by model number, including drawing changes and construction, will be at the expense of the Contractor.

C. Substitution Approval: Prior to delivery or installation, submittals for each equipment item by Equipment Identifier shall be provided in accordance with Division 1 - General Requirements. Acceptance will be based on the technical requirements herein as determined by Owner and Architect.

1.06 WARRANTY

A. Warrant work specified herein for one year from substantial completion against defects in materials, functions, and workmanship.

B. Warranty shall include materials and labor necessary to correct defects.

C. Defects shall include, but not be limited to noisy, rough or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish. Defects shall not include damage due to neglect, misuse, or situations resulting from non-performance of a manufacturer’s recommended preventive maintenance schedule.

D. Submit warranties in accordance with Division 1 - General Requirements of these specifications.

E. All parts shall be readily available locally in the United States.

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in manufacturer’s containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid and/or dusty conditions.

B. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Equipment Identifier of this specification.

1.08 LABELING
A. Manufacturer shall securely attach in a prominent location, on each major item of equipment, a non-corrosive nameplate showing manufacturer’s name, address, model number, serial number, and pertinent utility or operating data.

B. Manufacturer shall securely attach the ALI label of the Automotive Lift Institute.

C. All electrical equipment and materials shall be new and shall be listed by Underwriter’s Laboratories, Inc. (UL) in categories for which standards have been set by that agency and labeled as such in the manufacturer’s plant.

PART 2 - PRODUCTS

2.01 LIFT, AXLE, TWO POST, 70,000 POUND, SHALLOW DESIGN
   Equipment Identifier: 5655
   To Be Developed

2.02 LIFT, AXLE, THREE POST, 105,000 POUND, SHALLOW DESIGN
   Equipment Identifier: 5656
   To Be Developed

2.03 LIFT, PARALLELOGRAM, 75,000 POUND, 48 FEET
   Equipment Identifier: 5753
   
   A. Manufacturer’s Reference:
      1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer’s name and model to establish minimal acceptable standards of quality, features, performance, and construction.
         
         a. Rotary Lift
         b. Madison, IN (812) 445-5438
         c. Model No.: 75/48-F with accessories

      2. Alternate manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.
         
         a. Mohawk Lifts, Amsterdam, NY (800) 833-2006
         b. Stertil-Koni, Stevensville, MD (800) 336-6637

   B. Capacities/Dimensions:
      1. Overall dimensions:
         
         | Dimensions (inches) | Length | Width | Height |
         |--------------------|--------|-------|--------|
         | a. Equipment       | 576    | 112   | 63     |
2. Lift dimensions:
   a. Platform length: 48 feet
   b. Platform width: 32 inches (maximum)
   c. Spacing between platforms: 45 inches (maximum)
   d. Overall width: 109 inches (maximum)
   e. Horizontal movement (from collapsed to fully raised position): 54 inches (approximately)
   f. Collapsed height: 16-1/2 inches (maximum)

3. Minimum lifting height of a surface mounted in a recess unit from finished floor level to bottom of tires: 63 inches, minimum. Lifting unit shall permit lifting of vehicle to any height up to its full amount with a minimum of 10 locking positions distributed throughout the lift’s travel.

4. Control console:
   a. Width: 29-3/4 inches
   b. Depth: 26-1/4 inches (33-7/8 inches including area for control conduit and piping)
   c. Height: 52 inches

5. Lift capacity: 75,000 pounds

C. Features/Performance/Construction:

1. Complete lift assembly shall consist of an electro-hydraulic lift unit, control console, and specified accessories.

2. Control console shall be connected by required lengths of steel hydraulic pipe or steel reinforced hydraulic hose, nylon compressed air line, and electrical cable permitting location 10 feet (minimum) from the connections on the lift unit including standard fittings throughout. All hydraulic hoses on lifting structure shall be of steel reinforced construction and have standard fittings throughout. All conduit from console to lift shall be located in slab.

3. Support leg joints shall be provided with hardened bushings at the cylinder to leg connection and the leg to platform connection, where stresses are at a maximum, for extended lift life and easy repair.

4. Platform:
   a. Each platform shall be constructed on 0.375 inch thick plate steel supported by 0.250 inch thick steel “I” beams.
   b. Each platform shall have two automatic swing wheel chocks constructed of 0.375-inch thick steel plate mounted to the front and rear of the lift to prevent a vehicle from rolling off the platform when raised more than 12 inches. Chocks shall not reduce the effective length of lifting platforms by more than 6 inches.
   c. Wheel chocks and wheel stays shall be interchangeable and shall automatically swing into position as the lift is raised and automatically recede when lowered.
d. Chock design shall provide for a minimum of 2 inch upward movement to prevent injury to personnel or damage to lift unit in the event of obstruction between lift unit and wheel chock.

e. The lifting platforms shall have a non-skid coating applied to their upper surface.

5. Leveling/anchoring provisions:

a. The base of each lifting member shall provide for a minimum of 1-inch vertical adjustment. The adjustment of one lifting member shall be independent of adjustment of a different lifting member to accommodate uneven slab shifting/settling.

b. The base of each lifting member shall be pre-drilled to accept anchoring bolts adequately sized for the loads imposed during lift operation.

c. There shall be no fixed obstructions between lifting platforms.

d. There shall be no floor obstructions between lifting legs. Lift unit shall be of clear floor design to eliminate trip hazards and permit free movement of personnel and rolling equipment without obstruction.

6. Hydraulic system:

a. Equipment shall comply with all applicable federal, state, and local safety regulations and codes, and OSHA, UL, AWS, NEL, and ANSI/ALI ALCTV-1998 standards.

b. Each hydraulic cylinder shall have a flow check integrally mounted to prevent collapse in the event of a major fluid lead.

c. Hydraulic cylinders shall be mounted to the underside of the lifting platforms away from sources of dirt, grime, and damage from falling objects.

d. All hydraulic hoses shall be of steel reinforced construction and have standard JIC fittings throughout.

e. The lift shall be driven by a hydraulic gear pump of U.S. manufacture, capable of supplying the appropriate PSI and GPM to operate the lift.

f. The lift shall be able to be lowered from any raised position by operation of a manual pump and valving.

7. Safety locks:

a. Steel safety locks with a safety factor of not less than 3:1 shall be mounted one set to each lifting cylinder and shall allow the lift to be locked at a minimum of 10 different levels. These locks shall ensure a minimum amount of travel in the event of a hydraulic fluid leak and shall maintain the height of the lift in that situation.

b. The safety locks shall be automatically disengaged when the lift "Lower" control is operated, and automatically re-engaged when the lift "Lower" control is released.

c. The safety locks shall be automatically engaged as the lift ascends. This will ensure positive lock engagement when raising the lift in the event of hydraulic failure.

d. The lift shall have full length continuous safety tapeswitch mounted to the lower surface of the main lifting platform. Safety tapeswitch will be located on the inside and outside of both platforms. When any of these tapeswitches are displaced horizontally or vertically, the lift will stop. Tapeswitch inside optional.
D. Controls:

1. Control console shall house an oil reservoir, suction strainer, low pressure return filter, hydraulic gear pump, manual pump, NEMA 12 rated (minimum) electrical enclosure for system disconnect, “Raise/Lower” and “Press to Lock Lift” controls, and “Power-On” and “Operator Lock-Out” pilot lamps.

2. Control system shall be able to be programmed to stop a lift at a specific height in order to load or unload any accessory jack.

3. The control system shall be operated by a Programmable Logic Control (PLC) and lock-out all operations of lift controls if an unsafe condition exists due to insufficient air pressure to operate safety locks; displaced safety tapeswitch or uneven platform heights. This lock-out shall not be able to be reset unless unsafe condition has been corrected.

4. The control system shall ensure that lifting platforms differ in height by no more than 2 inches. If platforms become uneven by a greater amount, the lift shall stop and lock-out operator.

5. The control system shall be tested and approved by a Nationally Recognized Testing Laboratory as established by OSHA to UL 508.

6. Chassis wash bays:
   a. Control console and components in chassis wash bay shall be waterproofed and suitable for use in a wet environment

E. Accessories:

1. Wash Bay Kit (eight leg)

F. Utility Requirements:

1. Electrical:
   a. Connection Requirements

   | Voltage | 460 |
   | Phase  | 3   |
   | HP     | 20  |

2. Plumbing:
   a. Compressed Air:

   | Connection (inches) | 1/2 |
   | Volume (CFM)        | 5   |
   | Capacity (PSI)      | 120 |

PART 3 - EXECUTION

3.01 INSPECTION
A. Coordinate location of rough-in work and utility stub-outs to assure match with equipment to be installed.

B. Inspect delivered equipment for damage from shipping and exposure to weather. Compare delivered equipment with packing lists and specifications to assure receipt of all equipment items and specified accessories.

C. Report in writing to the Architect, any damaged, missing or incomplete scheduled equipment and improper rough-in or utility stub-outs.

3.02 INSTALLATION

A. Perform work under direct supervision of Foreman of Construction Superintendent with authority to coordinate installation of scheduled equipment with Architect or designated representative.

B. Install equipment in accordance with plans, shop drawings, and manufacturer’s instructions:

1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level (or slight slope as required by instructions), plumb, and at right angles to adjacent work.

2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.

3. Anchorage: Attach equipment as directed by Architect or designated representative. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.

4. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.

3.03 TESTING

A. After final connections are made and prior to authorizing payment, specified equipment shall be tested for compliance with specifications in the presence of the Architect or designated representative using acceptance procedures provided by the manufacturer. Testing report shall be submitted to the Architect or designated representative.

B. Each lift shall be tested with the vehicle types operated by the Owner.

3.04 CLEANUP

A. Touch-up damage to painted finishes.

B. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.

C. Clean area around equipment installation and remove packing and installation debris from job site.

D. Notify Architect or designated representative for acceptance observation.

3.05 TRAINING

A. Direct the technical representative to provide specified hours of training to designated Owner’s maintenance personnel in operation and maintenance of the following equipment. Coordinate, with Owner, training schedule and list of personnel to be trained.

1. 5655 Lift, axle, two post, 70,000 pound, shallow design; 8 hours (minimum)

2. 5656 Lift, axle, three post, 105,000 pound, shallow design; 8 hours (minimum)
3. 5753 Lift, parallelogram, 75,000 pound, 48 foot; 8 hours (minimum)

B. Demonstrate each lift operation utilizing each of the vehicle types operated by Owner.

C. Obtain, from technical representative, a list of Owner’s personnel trained in equipment operations and maintenance.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Access doors.

B. Expansion loops.

1.2 RELATED DOCUMENTS

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

B. This Section is part of each Division 21 Section.

1.3 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.

1.4 REFERENCED 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.  ASTM - American Society for Testing and Materials

3.  CCR - California Code of Regulations

   a. Title 8 - Division of Industrial Safety, Subchapter 7; General Industry Safety Orders, Articles 31 through 36

4.  NCPWB - National Certified Pipe Welding Bureau

5.  CEC - California Electrical Code

6.  NEMA - National Electrical Manufacturers' Association

7.  NFPA - National Fire Protection Association, as amended by the CBC

8.  OSHA - Occupational Safety and Health Act

9.  UL - Underwriters' Laboratories, Inc.

1.5 DRAWINGS

A. Examine Contract Documents prior to bidding of Work and report discrepancies in writing to Architect.

B. 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.

C. 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.


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.

D. Execute work mentioned in Specifications and not shown on Drawings, or vice versa, the same as if specifically mentioned or shown in both.

1.6 REQUIREMENTS OF REGULATORY AGENCIES

A. The publications listed below form part of this Specification. Comply with provisions of these publications except as otherwise shown or specified.

2. California Electrical Code, 2013
8. California Code of Regulations, Title 24
10. CAL-OSHA
11. California State Fire Marshal, Title 19 CCR
12. National Fire Protection Association
13. Occupational Safety and Health Administration
14. Other applicable state laws

B. 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.


D. When Contract Documents differ from governing codes, furnish and install larger size or higher standards called for without extra charge.

E. No material installed as part of the Work shall contain asbestos.

1.7 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 1.
1.8 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.

1.9 SUBMITTALS

A. 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. Refer to Division 01 for complete instructions.

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.

B. 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.
C. 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.

D. 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.

E. Provide coordination drawings for fire protection systems in accordance with the requirements of Specification Section 21 10 00.

F. Furnish to Project Inspector complete installation instructions on material and equipment before starting installation.

G. 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.

H. Delegated-Design Submittal: For supports, anchorages, and seismic restraints indicated to comply with performance requirements and design criteria.

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 edition of California Building Code and NFPA 13. System shall have current OPA 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.
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 seismic restraint locations, and detailing supports, attachments and restraints, and 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.

1.10 SUBSTITUTIONS

A. Refer to Division 01 for complete instructions. Requirements given below are in addition to or are intended to amplify Division 1 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 Contractor's 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.

1.11 OPERATION AND MAINTENANCE MANUAL

A. Instruct Owner's authorized representatives in operation, adjustment, and maintenance of mechanical equipment and systems. Provide three copies of certificate signed by Owner's representatives confirming that instruction is completed.

B. 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.

1. Sets shall incorporate the following:

   a. Service telephone number, address and contact person for each category of equipment or system.
   b. Complete operating instructions for each item of fire sprinkler system.

      1) Original manual of NFPA-25 for fire sprinkler system.

   c. Copies of guarantees/warrantees for each item of equipment or systems.
   d. Test data as specified.
   e. Typewritten maintenance instructions for each item of equipment listing lubricants to be used, frequency of lubrication, inspections required, adjustment, etc.
   f. Manufacturers' bulletins with parts numbers, instructions, etc., for each item of equipment.
   g. 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.
   h. Check test and start reports for each piece of fire protection equipment provided as part of the Work.
   i. Commissioning and Preliminary Operation Tests required as part of the Work.

C. Post service telephone numbers and addresses in an appropriate place designated by Architect.
1.12 SITE CONDITIONS
A. 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.

1.13 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 and equipment modified or altered as part of this Work shall comply with the most recent applicable code requirements.

1.14 WARRANTY
A. Refer to Division 01 for warranty requirements, including effective date of warranty. Refer to specific items of equipment specified herein for warranty duration if different from that specified in Division 01.

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.

1.15 RECORD DRAWINGS
A. Refer to Division 01, Record Documents, for requirements governing Work specified herein.

B. Upon completion of the Work and as precedent to final payment, deliver to Architect the following:
   1. Originals of drawings showing the Work exactly as installed.
   2. One complete set of reproducible drawings showing the Work exactly as installed.
   3. One compact disc with complete set of drawings in PDF format showing the Work exactly as installed.
   4. Provide Contractor’s signature, verifying accuracy of record drawings.

C. Obtain signature of Project Inspector for record drawings.

1.16 DELIVERY AND STORAGE
A. Protect equipment and materials delivered to Project site from weather, humidity and temperature variations, dirt, dust and other contaminants.
1.17 COORDINATION

A. General:
1. Coordinate Work in this Section with trades covered in other Specification Sections to provide a complete and operable installation of highest quality workmanship.

B. Electrical Coordination:
1. 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:
   a. Review the Electrical Drawings and Division 26 Specifications to verify that electrical services provided are adequate and compatible with equipment requirements.
   b. 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.
   c. Prior to proceeding with installation of additional electrical work, submit detailed drawings indicating exact scope of additional electrical work.

C. Mechanical Coordination:
1. Arrange for pipe spaces, chases, slots and openings in building structure during progress of construction, to accommodate mechanical system installation.
3. 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.”

PART 2 - PRODUCTS

2.1 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.

2.2 MATERIALS
A. California Green Building Code Compliance:
   1. Fire protection equipment shall not contain CFCs.
   2. Fire protection equipment shall not contain Halons.

2.3 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.
B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

Metraflex Inc., Fireloop series.
Unisource Manufacturing, Inc., V series.

2.4 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.

PART 3 - EXECUTION

3.1 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.

3.2 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 IIIIR 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.

3.3 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
3.4 PRIMING AND PAINTING

A. Perform all priming and painting on the equipment and materials as specified herein.

B. Priming:

1. Exposed ferrous metals, including piping, which are not galvanized or factory-finished shall be primed. Black steel pipe exposed to weather shall be painted one coat of Rust-Oleum #1069 primer for black steel piping or Rust-Oleum #5260, Kelly Moore, or equal, primer for galvanized piping.

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.

C. See Painting Section for detailed requirements.

3.5 INSTALLATION OF PIPING SYSTEMS

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. 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 build-
      ings, 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 AMI Products, Adjus-to-Crete, Pipeline Seal and Insulator, or equal, pipe sleeves of suffi-
      cient 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 water-
      tight.
   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 pen-
      etrating 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 pene-
      tration or fixture opening passing through floors, walls, partitions or floor/ceiling assemblies. Pen-
      etrators 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 plugs, or equal 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 li-
      abilities in connection with the use of alternate products.

G. 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 hang-
      ers, 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.

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Rod Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>4” and Smaller</td>
<td>3/8”</td>
</tr>
<tr>
<td>5” to 6”</td>
<td>5/8”</td>
</tr>
</tbody>
</table>

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. 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.

3.6 UNIONS AND FLANGES

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.

3.7 ACCESS DOOR

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.

3.8 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.

3.9 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.

3.10 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.
3.11 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:

<table>
<thead>
<tr>
<th>System Tested</th>
<th>Test Pressure</th>
<th>Test With</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire Sprinkler Piping</td>
<td>200 PSI</td>
<td>Water</td>
</tr>
<tr>
<td>Compressed Air</td>
<td>200 PSI</td>
<td>Air &amp; Non-corrosive Leak Test Fluid</td>
</tr>
<tr>
<td>Dry Standpipes</td>
<td>300 PSI</td>
<td>Water</td>
</tr>
<tr>
<td>Wet Standpipes</td>
<td>200 PSI</td>
<td>Water</td>
</tr>
</tbody>
</table>

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.

3.12 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 21 00 50
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Sprinkler heads.
B. Pipe and Fittings.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Section 21 00 50 Basic Fire Sprinkler Materials and Methods.

1.3 REFERENCES

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:
   National Fire Protection Association (NFPA) Standard No. 13, 2013, as amended by the CBC.
   CBC Chapter 9 (as amended).
   NFPA No. 24, 2013 (as amended).
B. The work shall also be in accordance with all local or state requirements that apply.

1.4 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. Existing sprinkler heads shall be replaced throughout the facility. All existing heads shall be removed, the existing piping system flushed, and new heads installed throughout all buildings and covered exterior overhangs.
D. Furnish all labor, design drawings, calculations, materials, tools, and equipment to install the wet pipe automatic fire sprinkler system as described in this Specification Section. System shall be hydraulically calculated and designed for the building occupancy classification as determined by NFPA 13.

1. This 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.
   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.
   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 shall include areas above and below the finished ceilings, exterior exposure, canopies, stairways, rooms, areas, entry, etc, and other areas requiring sprinklers. Thoroughly examine architectural and other drawings as required to satisfy this requirement.

f. Tags, identification labels and instruction manuals for proper operation and maintenance.

E. Provide fire sprinklers to protect combustible building overhangs greater than 4 feet wide, as required by local authority.

F. Determine the static and residual pressure for the site as required for accurate determination of system requirements. Base system calculations on the lowest expected static and residual pressure for the area.

1. Test data for static and residual pressure shall be obtained from water district or local fire department; test shall be made within the last six months prior to start of work.

2. Provide calculations based on 10 percent minimum safety factor. For hydraulically calculated fire sprinkler systems the maximum velocity in the building and the fire main piping shall not exceed 15 feet per second.

1.5 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.

1.6 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: 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. Design 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 standards agencies and these Drawings and Specifications, requirements of authority having jurisdiction and recommendations of standards agencies shall govern.

2. Design and install entire system in accord with applicable codes, standards, and regulations.

3. The automatic sprinkler system shall conform to requirements of the 2007 edition of the National Fire Protection Association, Standard No. 13, as amended by the CBC. Contractor shall hydraulically calculate sprinkler system in accordance with NFPA 13.

4. Drawings are diagrammatic only to indicate rooms/areas of sprinkler protection and piping clearances when appropriate. Rerouting of pipe and addition, deletion or relocation of heads may be necessary. Submit proposed layout for approval prior to start of installation.

5. FM Compliance: Comply with Factory Mutual “Approval Guide.”

6. Supply equipment and accessories in accordance with requirements of all applicable national, state and local codes.

7. Items of a given type shall be the products of the same manufacturer.

8. Scheduled equipment performance is minimum capacity required.

9. Scheduled electrical capacity shall be considered as maximum available.
1.7 COORDINATION

A. Coordinate Work in this Section with trades covered in other Sections of Specifications to provide a complete and operable installation of highest quality workmanship.

B. 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.

C. 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.

D. 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.

E. 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.

F. Coordinate layout and installation of sprinklers with other construction penetrating ceilings, including light fixtures, HVAC equipment, and partition assemblies.

G. The Architect shall decide any differences or disputes concerning coordination, interference or extent of work, and his decision shall be final.

1.8 SUBMITTALS

A. Samples: Provide one sample of each sprinkler head type.

B. Shop Drawings: Submit in accordance with Division 01, and as follows:

1. Prepare Drawings, calculations, and product data of fire protection systems indicating pipe sized, pipe locations, fittings, shutoffs, equipment, etc. Note, in bold type, any piping which will project beyond finished surfaces of normally occupied rooms, exterior of the building or other locations which will expose the system to view.

2. Manufacturer’s data on each item of material or equipment used.

3. Layout drawings and flow calculations approved by agencies having jurisdiction.

4. Drawings and calculations shall be stamped and signed by a State of California licensed professional engineer prior to submission to the Architect. Engineer shall be qualified for this work.

C. Test Reports: As indicated in paragraph “Tests”.

1. Sprinkler pressure test.

D. Operation and Maintenance Manual:

1. Operation and Maintenance Manual in accordance with Section 21 00 50. Include an original manual of NFPA 25, California edition, in Operation and Maintenance Manual for fire sprinkler system.

2. Guarantees in accordance with Division 01.

E. Deferred Approval Documents: Do not proceed with fabrication or installation of fire sprinkler system until deferred approval documents have been approved by regulatory agencies.


3. **Agency Review:** Architect will submit documents to Agency or Authority Having Jurisdiction. Make additions, changes and corrections required by Agency / Authority at no cost to Owner and resubmit to Architect.

4. **Agency Approval:** Architect will submit documents to Agency / Authority for final approval.

### 1.9 APPLICABLE PUBLICATIONS

A. The following publications form a part of this specification:

2. ASME - American Society of Mechanical Engineers.
5. NFPA National Fire Protection Standards as amended by the CBC.
6. CFC - California Fire Code.
7. CPC - California Plumbing Code.

### 1.10 SUPERVISION

A. Keep a competent superintendent on the job that shall coordinate the activities of the crafts and maintain the progress of the work to the satisfaction of the Architect.

### 1.11 SITE CONDITIONS

A. Verify all dimensions at the building site and check existing conditions before beginning work. Make changes that are necessary to coordinate the work with other trades, after review by the Architect.

### 1.12 REGULATIONS

A. All work shall be installed in strict conformity with California Building Code (CBC), California Plumbing Code (CPC), and California Electric Codes (CEC), Industrial Safety Orders, California Mechanical Code (CMC), California Fire Code (CFC), and other laws and regulations of authorities having jurisdiction.

### 1.13 FEES AND PERMITS

A. Take out permits and pay fees and charges required in connection with the Work.

### 1.14 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.

### 1.15 EXISTING MATERIALS

A. Existing equipment, piping, construction, etc., which interferes with work of the Contract shall be removed and promptly returned to service. Damaged items shall be replaced with new material to match existing.

B. Removed materials which will not be reused and which are not claimed by the Owner shall become the property of the Contractor and shall be removed from the premises. Consult Owner before removing any material from premises. Materials claimed by Owner shall be removed carefully to prevent damage and delivered on the site where directed.

C. Existing piping not to be reused and which is concealed in the building construction may be capped and abandoned in place but such piping and wiring which is exposed in equipment rooms or occupied spaces shall become property of Contractor and shall be removed from the premises.
PART 2 - PRODUCTS

2.1 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.

2.2 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.

2.3 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 a considered visual problem by the Architect or Owner. Side wall heads shall be chrome finish.
7. 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.

2.4 PIPE AND FITTINGS

A. For Installation Aboveground: 150 PSI, Schedule 40 black steel, ASTM A-135 or A-53 with UL approved ductile or cast iron screwed fittings.

1. Schedule 10 UL approved pipe with UL approved grooved fittings and associated couplings may be used for pipe sizes 2 inches and greater. Threading of piping will not be accepted.

B. For Installation Underground to 12 inches Above Ground: Ductile cast iron AWWA C111 and C151. Outside the building, J.M. Blue Brute Class 200 UL, P.W. Pipe, or equal, C900, PVC pressure pipe, approved for fire protection use. Install in accordance with NFPA 24 and AWWA standards. Provide concrete thrust blocks at each change or
direction. Fittings shall be ductile iron, ASME B16.1, Class 125 inside building; PVC Class 200 Ring-Tite outside building. Pipe shall be approved for fire protection use.

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.

2.5 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 in ground. Provide copper plated steel bolts and nuts or brass bolts and nuts for brass flanges.

2.6 GAUGES

A. Marsh "Quality Gage", 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 midscale. Provide a three-way valve on each gauge connection.

PART 3 - EXECUTION

3.1 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 the State Fire Marshal.

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 7'-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.

3.2 HANGERS AND SUPPORTS

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 a 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
3.3 SEISMIC REQUIREMENTS

A. Comply with CBC, Volume 2, Chapter 16A and CBC Chapter 9 and NFPA 13.

B. Seismic bracing system shall be a complete pre-engineered bracing system. Pre-engineered bracing system shall include plan layout, brace selection, specification, and calculations. Complete system shall be submitted to Architect for review. See Delegated Design Submittal paragraph in article, Submittals, in Section 21 00 50.

C. Anchorage for various manufactured and fabricated items is detailed and scheduled on the drawings or specified.

   1. For proposed changes to anchorage shown, or specified, submit proposed methods of anchorage with calculations prepared by a California Registered Structural Engineer. Design of anchorage shall comply with the above regulations using minimum coefficients, CP, listed CBC Chapter 16A.

D. It is not intended that prototype or non-standard equipment or equipment frames be provided. However, 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.

E. 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.

3.4 TESTS

A. At various stages and upon completion, the system must be tested in the presence of the enforcing agency.

B. Upon completion and prior to acceptance of the installation, subject the entire new system to the tests required in NFPA 13, and shall furnish the Owner with certificates as appropriate.

3.5 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. Provide hydraulic data signage permanently attached to risers, indicating location, basis of design, water supply and pressure requirements of system.

3.6 SPRINKLER HEADS

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 pendant sprinkler heads until flushing of the 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.

3.7 PIPING JOINTS AND CONNECTIONS

A. Pipe shall be assembled in accordance with the requirements of NFPA 13.

B. Flange and spigot piece at the base of sprinkler riser shall be secured to the underground elbow at the base of riser with tie-rods which are properly coated, or stainless steel to protect against corrosion. Set-screw type flange adapters and mechanical joint retainer glands are not an acceptable substitute for tie-rods. Provide concrete thrust blocks in accordance with NFPA 24 and CBC.

3.8 DRAINS

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 the requirements of NFPA 13.

B. 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.

3.9 SLEEVES

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.

3.10 FLOOR, WALL, AND CEILING PLATES

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.

3.11 FIRESAFING

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.

3.12 UNION AND FLANGES

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.

3.13 CLEANING

A. Upon completion of tests, clean equipment, piping, etc., installed under this Section of the Specifications.
3.14 FLUSH

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 21 10 00
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electric motors.
B. Motor starters.
C. Valves and fittings.
D. Strainers.
E. Gauges.
F. Thermometers.
G. Access Doors.
H. Expansion loops.
I. Flexible joints.
J. Insulation.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. This Section is a part of each Division 22 Section.

1.3 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.

1.4 REFERENCED 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
1.5 DRAWINGS

A. Examine Contract Documents prior to bidding of work and report discrepancies in writing to Architect.

B. 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.

C. 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 Contractors' 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.

D. Execute work mentioned in Specifications and not shown on Drawings, or vice versa, the same as if specifically mentioned or shown in both.

1.6 REQUIREMENTS OF REGULATORY AGENCIES

A. The publications listed below form part of this specification; comply with provisions of these publications except as otherwise shown or specified.

2. California Electrical Code, 2013
8. California Code of Regulations, Title 24
10. CAL-OSHA
11. California State Fire Marshal, Title 19 CCR
12. National Fire Protection Association
13. Occupational Safety and Health Administration
14. Other applicable state laws

B. 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.


D. When Contract Documents differ from governing codes, furnish and install larger size or higher standards called for without extra charge.

E. No material installed as part of this Work shall contain asbestos.

1.7 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.

1.8 UTILITY CONNECTIONS

A. 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.

1.9 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.

1.10 SUBMITTALS

A. 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.

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. Refer to Division 01 for complete instructions.
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.

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 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.

E. Furnish to the Project Inspector complete installation instructions on material and equipment before starting installation.

F. 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.

G. 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.

H. 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 116875. Provide submittal information for products third-party certified by an approved laboratory as complying with California Health and Safety Code Section 116875.

I. Delegated-Design Submittal: For seismic supports, anchorages, and restraints indicated to comply with performance requirements and design criteria.

2. Supports, anchorage and restraints for piping, ductwork, and equipment shall be an OSHPD pre-approved system such as Tolco, Afcon, ISAT, Badger, 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.

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, 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 2013 California Building Code.

4. Additional Requirements: In addition to the above, conform to all state and local requirements.

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 OPERATION AND MAINTENANCE MANUAL
A. 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. Start compiling data upon approval of submittals.

1. Sets shall incorporate the following:
   a. Service telephone number, address and contact person for each category of equipment or system.
   b. Complete operating instructions for each item of plumbing equipment.
   c. Copies of guarantees/warrantees for each item of equipment or systems.
   d. Test data and system balancing reports.
   e. Typewritten maintenance instructions for each item of equipment listing lubricants to be used, frequency of lubrication, inspections required, adjustment, etc.
   f. Manufacturers' bulletins with parts numbers, instructions, etc., for each item of equipment.
   g. Control diagrams and literature.
   h. 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.
   i. Check test and start reports for each piece of plumbing equipment provided as part of the Work.
   j. 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.

1.13 SITE CONDITIONS

A. 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.

1.14 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.

1.15 WARRANTY

A. Refer to Division 01 for warranty requirements, including effective date of warranty. Refer to specific items of equipment specified herein for warranty duration if different from that specified in Division 01.

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 above warranty within a reasonable length of time after notification is given, the Architect/Owner shall have the repairs made at the Contractor’s expense.

1.16 RECORD DRAWINGS

A. Refer to Division 01, Record Documents, for requirements governing Work specified herein.

B. Upon completion of the work, deliver to Architect the following:

1. Originals of drawings showing the Work exactly as installed.
2. One complete set of reproducible drawings showing the Work exactly as installed.
3. One compact disc with complete set of drawings in PDF format showing the Work exactly as installed.

C. Provide Contractor’s signature, verifying accuracy of record drawings.

D. Obtain the signature of the Project Inspector for all record drawings.

1.17 DELIVERY AND STORAGE

A. Protect equipment and piping delivered to Project site from weather, humidity and temperature variations, dirt, dust and other contaminants.

1.18 COORDINATION

A. General:

1. Coordinate Work in this Section with trades covered in other Specifications Sections to provide a complete, operable and sanitary installation of the highest quality workmanship.

B. Electrical Coordination:

1. 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:

   a. Review the Electrical Drawings and Division 26 Specifications to verify that electrical services provided are adequate and compatible with equipment requirements.
   b. 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.
   c. Prior to proceeding with installation of additional electrical work, submit detailed drawings indicating exact scope of additional electrical work.

C. Mechanical Coordination:

1. Arrange for pipe spaces, chases, slots and openings in building structure during progress of construction, to accommodate mechanical system installation.
3. 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.”

PART 2 - PRODUCTS

2.1 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.

2.2 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, 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.

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.
   4. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

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.

2.3 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 IIIIR 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 IIIIR enclosure for starters located outdoors.

   4. Provide OSHA label indicating the device starts automatically.

2.4 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 116875.
      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 116875.
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. 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.

F. Calibrated Balancing Valves:

1. General: Calibrated orifice ball type rated for 400 psig maximum operating pressure and 250 degrees F. maximum operating pressure.
   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:
2.5 VALVES AND FITTINGS FOR NON-POTABLE WATER 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.

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. 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.

E. 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.
F. Flow Control Valve: Automatic pressure compensating flow control valves shall be Griswold, Flow Design, Inc., or equal.

G. Building Gas Shut-Off Valve:
   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.

H. 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.

I. 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 Pabco, or equal tape wrap, installed in accordance with requirements listed under “Pipe Protection”.
   2. Molded polyethylene body ball valve: 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.

J. Seismic Gas Shut-Off Valve: 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.

K. Quick Coupling Valve:
   1. Provide quick coupling valves, heavy duty brass construction with yellow thermoplastic rubber cover, stainless steel internal valve spring, one piece body.

2.6 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.
   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.

2.7 STRAINERS FOR POTABLE WATER SYSTEMS

A. Strainers: Full line size, conforming to lead-free requirements of California Health and safety Code Section 116875. "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.

2.8 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.

2.9 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.

2.10 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, condenser, chiller and heat exchanger and provide two digital electronic test thermometers for each range of fluid temperature and where shown on Drawings.

2.11 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
2.12 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.

B. Provide expansion loops listed for 4 inches of movement for use in natural or propane gas piping systems.

C. Where used in potable water systems, provide expansion loops of all stainless steel construction.

D. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

- Unisource Manufacturing, Inc., V series.

2.13 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.

2.14 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.

2.15 EQUIPMENT IDENTIFICATION

A. Identify each piece of equipment with a permanently attached engraved bakelite plate, 1/2 inch high white letters on black background.

2.16 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.

2.17 INSULATION WORK

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. Adhesives and sealants shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.

3. The term "piping" used herein includes pipe, valves, strainers and fittings.
4. 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.
5. Provide pre-formed PVC valve and fitting covers.
6. 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.
7. Urethane insulation will not be allowed above ground or on hot water piping.
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 1 inch thick 3-1/2# minimum density fiberglass with ASJ-SSL jacket for sizes up to and including 3/4 inches. For larger sizes, provide 1-1/2 inch thick 3-1/2# minimum density fiberglass insulation and ASJ-SSL jacket.
2. Insulate domestic hot water piping under slab on grade and cold water piping exposed to the weather with 3/4" thick Therma-Cel, Armaflex, or equal; seal water tight per manufacturer's directions.
3. Insulate domestic cold water piping 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 density 3-1/2# per cubic foot, with ASJ-SSL jacket.
4. 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. Verify suitability with manufacturer of insulation. Insulation with pre-applied polymer jacket may be substituted at Contractor's option.
5. Where insulated piping is exposed to the weather apply aluminum jacket secured with 1/2 inch aluminum bands on 12 inch centers. Cover fittings with glass cloth and two coats of Foster's Sealfas 30-36, Zeston 2000, or equal, PVC fitting covers. Insulation shall be vapor tight before applying metal jacket or PVC covers.

a. Pipes 10 inches diameter and smaller: Minimum .016 inch thick jacket.

PART 3 - EXECUTION

3.1 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.

3.2 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.

3.3 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.

3.4 PRIMING AND PAINTING

A. Perform all priming and painting on the equipment and materials as specified herein.

B. Priming:

1. Exposed ferrous metals, including piping, which are not galvanized or factory-finished shall be primed. Black steel pipe exposed to the weather shall be painted one coat of Rust-Oleum #1069 primer for black steel piping or Rust-Oleum #5260, Kelly Moore, or equal, primer for galvanized piping.

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 should be masked off prior to painting. When painting is completed, remove masking material.

C. See Painting Section for detailed requirements.

3.5 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 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 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.

3.6 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.

3.7 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. Silent Check Valves: Install in horizontal or vertical position between flanges.
F. Calibrated Balancing Valves: Install calibrated balancing valves per manufacturers’ recommendations, including requirements for straight pipe lengths at valve inlet and outlet.
G. Gas Shut-Off Valves:
1. Provide line size ball valve in gas line to each appliance.
H. 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.

3.8 INSTALLATION OF PIPING SYSTEMS

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. General: Support all equipment and piping so that it is firmly held in place by approved iron hangers and supports and special hangers as required. All components shall support weight of 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 all 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 all "bridging" support members as required firmly attached to building structural members in a fashion approved by the Structural Engineer.

   a. Materials, design, and type numbers per Manufacturers' Standardization Society (MSS), Standard Practice (SP)-58.

2. All hanger components shall be provided by one manufacturer B-Line, Grinnell, Uni-Strut, Badger, or equal.

3. Hanger and Support Spacing:

   a. Vertical piping support spacing: B-line #B3373 clamps attached to the pipe above each floor to rest on the floor. Provide with lead or Teflon liners on copper tubing. Provide additional support at base of cast iron risers and support at unsupported riser joints and horizontal offsets per 2007 Mason Industries Seismic Restraint Guidelines. Provide intermediate support for vertical piping, spaced at or within the following maximum limits.
<table>
<thead>
<tr>
<th>Pipe Diameter</th>
<th>Steel Fluid</th>
<th>Steel Vapor</th>
<th>Copper Fluid</th>
<th>Copper Vapor</th>
<th>CPVC &amp; PVC (Note 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 - 1&quot;</td>
<td>12</td>
<td>6</td>
<td>10</td>
<td>6</td>
<td>Base and Each Floor (Note 1)</td>
</tr>
<tr>
<td>1-1/4 - 2&quot;</td>
<td>12</td>
<td>Each Floor</td>
<td>10</td>
<td>6</td>
<td>Base and Each Floor (Note 1)</td>
</tr>
<tr>
<td>2-1/2 - 3&quot;</td>
<td>12</td>
<td>Each Floor</td>
<td>10</td>
<td>10</td>
<td>Base and Each Floor (Note 1)</td>
</tr>
<tr>
<td>Over 4&quot;</td>
<td>12</td>
<td>Each Floor</td>
<td>10</td>
<td>10</td>
<td>Base and Each Floor (Note 1)</td>
</tr>
</tbody>
</table>

Note 1: Provide mid-story guides.
Note 2: For PVC piping, provide for expansion every 30 feet per IAPMO installation standard.

b. Vertical cast iron piping support spacing: Base and each floor not to exceed 15 feet.
c. 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.

<table>
<thead>
<tr>
<th>Pipe Diameter</th>
<th>Steel Fluid</th>
<th>Steel Vapor</th>
<th>Copper Fluid</th>
<th>Copper Vapor</th>
<th>CPVC &amp; PVC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 - 1&quot;</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>1-1/4 - 2&quot;</td>
<td>7</td>
<td>10</td>
<td>6</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>2-1/2 - 3&quot;</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Over 4&quot;</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>4</td>
</tr>
</tbody>
</table>

d. Horizontal cast iron piping support spacing:
1) Support piping at every other joint for piping length of less than 4 feet.
2) For piping longer than 4 feet, provide support on each side of the coupling, within 18 inches of each joint.
3) Hanger shall not be installed on the coupling.
4) Provide support at each horizontal branch connection.
5) Provide sway brace at 40 foot maximum spacing for all suspended pipe with no-hub joints, except where a lesser spacing is indicated in the 2007 Mason Industries Seismic Restraint Guidelines. 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.

4. Individually 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.

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Rod Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot; and Smaller</td>
<td>3/8&quot;</td>
</tr>
</tbody>
</table>
2-1/2" to 3-1/2"  
4" to 5"  
6"  
1/2"  
5/8"  
3/4"

b. Provide 3/8 inch rod for support of PVC and CPVC and provide continuous support.
c. Trapeze Suspension: B-Line 1-5/8 inch width channel in accordance with manufacturer's 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; isolate copper pipe with two thicknesses of 2 inches wide 10-mil polyvinyl tape. Where used for seismic support systems, provide B-Line B2400 series 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. Support to Structure:

a. 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.

6. Rubber Neoprene Pipe Isolators:

a. 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.
b. 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.
c. Acceptable Suppliers:

1) Vertical runs: Acousto-Plumb or equal.
2) Horizontal runs: B-Line, Vibraclamp; Acousto-Plumb or equal.

7. Provide support for piping through roof, arranged to anchor piping solidly in place at the roof penetration.
8. 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.
9. Insulate copper tubing from ferrous materials and hangers with two thicknesses of 3 inch wide, 10 mil polyvinyl tape wrapped around pipe.
10. 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.
11. Suspend rods from concrete inserts with removable nuts where suspended from concrete decks. Power actuated inserts will not be allowed.

3.9 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. 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.


E. 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 clay reducers or increasers as required. Caulking of smaller pipe into thelarger without a reducer or increaser will not be permitted.

F. Clay Sewer Pipe: Joints in bell and spigot clay sewer pipe shall comply with ASTM C-425, made with an approved type of interlocking, resilient mechanical compression joint, formed on the pipe at the factory. Lubricate inside of bells and outside of spigots with a solution as recommended by the pipe manufacturer.

G. 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, Threadolets, Nibco, or equal, may be used in lieu of welding tees.

H. Polyethylene Pipe: Assemble with fusion joints in strict accordance with manufacturer's instructions.

I. Flexible Connections:

1. Furnish and install Thermo Tech., Inc. FJ/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.

3.10 UNIONS AND FLANGES

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 116875.
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 116875.

C. Locate the unions for easy removal of the equipment, tank, or valve.

3.11 ACCESS DOOR

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 Roystron Products, or equal.
   a. Field Joints and Fittings: Protecto Wrap #1170 tape as manufactured by Pipe Line Service Corporation, or Primer #200 tape by Roystron Products, or equal. Installation shall be as per manufacturer's recommendation and instructions.

2. Tape Wrap: Pressure-sensitive polyvinyl chloride tape, "Transtex #V-I0 or V-20", "Scotchwrap 50", Slipknot 100, Pabco, 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. 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. 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. Provide temporary identification of each pipe installed, at the time of installation. Temporary identification shall be removed and replaced with permanent identification as part of the work.

B. Apply the legend and flow arrow at all valve locations; at all points where the 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 the approval of the Architect. There shall be at least one marking in each room. Markings shall be located for maximum visibility from expected personnel approach.

C. Wherever two or more pipes run parallel, the markings shall be supplied in the same relative location on each.

D. Each valve on non-potable water piping shall be labeled with a metal tag stamped "DANGER -- NON-POTABLE WATER" in 1/4 inch high letters.

E. Apply markings after painting and cleaning of piping and insulation is completed.

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 TESTS AND ADJUSTMENTS

A. Test the installations in accordance with the following requirements and all applicable codes:

1. Inspector of Record should witness all tests of piping systems.
2. Notify the Architect at least seven days in advance of any test.
3. All piping shall be tested at completion of roughing-in, or at other times as directed by the Architect.
4. Furnish all necessary materials, test pumps, gases, instruments and labor required for testing.
5. Isolate from the system all equipment that may be damaged by test pressure.
6. Make connections to existing systems with flanged connection. During testing of the 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. Inspector of record shall witness final connection to system.

B. Test Schedule: No loss in pressure or visible leaks shall show after four hours at the pressures indicated.

Testing of Sanitary Sewer, Drain, Vent, Storm Drain may be done in segments in order to limit pressure to within manufacturer's recommendations. Test to 10 feet above the highest point in the system.

<table>
<thead>
<tr>
<th>System Tested</th>
<th>Test Pressure PSI</th>
<th>Test With</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sanitary Sewer, Drain, Vent</td>
<td>10 Ft. Hd.</td>
<td>Water</td>
</tr>
<tr>
<td>Storm Drain, Condensate Drains</td>
<td>10 Ft. Hd.</td>
<td>Water</td>
</tr>
<tr>
<td>Domestic Water</td>
<td>125</td>
<td>Water</td>
</tr>
<tr>
<td>Natural Gas (PE)</td>
<td>60</td>
<td>Air &amp; Non-corrosive Leak Test Fluid</td>
</tr>
<tr>
<td>Natural Gas (Steel)</td>
<td>100</td>
<td>Air &amp; Non-corrosive Leak Test Fluid</td>
</tr>
</tbody>
</table>

C. Perform operational tests under simulated or actual service conditions, including one test of complete plumbing installation with all fixtures and other appliances connected, and one test of complete installation of 48 hours each for heating and cooling with all equipment connected and operating.

D. Should any material or work fail in any of these tests, it shall be immediately removed and replaced for new material, and portion of the work replaced shall again be tested by Contractor at his own expense.

E. Lubricate each item of equipment, including motors, before operation.

3.17 TRACER WIRES

A. Provide tracer wire for non-metallic gas and water pipe in ground outside of buildings. Use AWG #12 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 ACCEPTANCE REQUIREMENTS

A. The contractor shall complete the Acceptance Requirements of the California Building Energy Efficiency Standards “Certificates of Acceptance” and submit such certificates to the authorities having jurisdiction for approval and issuance of final occupancy permit.

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 22 00 50
SECTION 22 10 00
PLUMBING PIPING SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe and fittings.
B. Water hammer arrestors.
C. Water filters.
D. Hose bibbs.
E. Wall hydrants.
F. Reduced pressure backflow preventer for potable water system.
G. Reduced pressure backflow preventer for non-potable water system.
H. Double check valve backflow preventer.
I. Potable water pressure-regulating valve.
J. Relief valves.
K. Trap primer.
L. Cleanouts.
M. Floor drains.
N. Floor sinks.
O. Area drain.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Section 22 00 50 Basic Plumbing Materials and Methods.

1.3 ADDITIONAL REQUIREMENTS

A. Furnish and install any incidental work not shown or specified which is necessary to provide a complete and workable system.
B. Coordinate all of work in this Section with all of the trades covered in other Sections of the Specifications to provide a complete, operable and sanitary installation of the highest quality workmanship.
C. All plumbing work required in the course of this contract shall be performed in strict accordance with all codes and regulations. Plumbing work done under this contract shall not adversely affect the operation of the existing plumbing systems. All materials shall be new and shall match existing.

1.4 DESCRIPTION OF WORK

A. Furnish and install all plumbing work indicated on the drawings and described herein.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of plumbing piping 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 piping systems work similar to that required for project.

C. Requirements of Regulatory Agencies: The publications listed below form a part of this specification; comply with provisions of these publications except as otherwise shown or specified.

1. Plumbing Code Compliance: Comply with applicable portions of California Plumbing Code pertaining to selection and installation of plumbing materials and products.
   a. NSF Compliance:
      1) Pipe, tube, and fittings used in potable water systems intended to supply drinking water shall meet the requirements of NSF-61 2010a, “Drinking Water System Components – Health Effects.”
      2) Plastic potable water-service piping shall meet the requirements of NSF 14 2010, “Plastic Piping Components and Related Materials.”

2. 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 116875.


4. Utility Compliance: Fabricate and install natural gas systems in accordance with local gas utility company requirements.

5. CPC Compliance: Fabricate and install natural gas systems in accordance with California Plumbing Code.

6. Provide certified gas welder as defined in California Plumbing Code to weld all joints in welded gas piping.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for plumbing piping systems materials and products.

B. Provide welding certificate for all gas pipe welders.

C. Record Drawings: At project closeout, submit Record Drawings of installed piping systems, in accordance with requirements of Division 01.

D. Maintenance Data: Submit maintenance data and parts lists for plumbing piping systems materials and products. Include this data, product data, shop drawings, and record drawings in Operation and Maintenance Manual; in accordance with requirements of Division 01.
E. 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 116875. Provide submittal information for products third-party certified by an approved laboratory as complying with California Health and Safety Code Section 116875.

1.7 JOB CONDITIONS

A. Cooperation with other trades: Coordinate Work of this Section with that of other Sections to ensure that Work is carried out in an orderly fashion.

B. Coordinate with other trades all 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 all other trades as required for a completely coordinated project.

PART 2 - PRODUCTS

2.1 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.

2.2 PIPE AND FITTINGS INSIDE BUILDINGS AND BELOW COVERED WALKS AND CORRIDORS

A. 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 copper 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).

   a. Joints located over critical areas including food preparation, food storage, food serving, and eating areas shall be ANACO-Husky SD 4000, Clamp-All 125, or equal, meeting the requirements of FM 1680, SD Class I and ASTM C1540.

B. 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.

C. 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.

2. 2-1/2 inch and smaller: 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.

D. 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.

E. 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.

F. 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.

G. Gas Pipe: Schedule 40 black steel conforming to ASTM A53, with malleable iron screwed 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 fuel connectors, as defined in 1203 of the CPC, are not acceptable for connection of equipment, except where specifically indicated on the Contract Documents.

2. Where Drawings indicate installation of mechanical equipment on spring isolation rails or spring mounted curbs, provide flexible connection, Metraflex, Metraloop, Unisource Mfg. Co. "V" connector, or equal, CSA listed for 4 inches of movement.

   a. Provide CSA certification for gas connections.

3. Flexible Gas Connection System for Movable Gas-Fire 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.

4. Provide gas tight Schedule 40 conduit to vent gas piping installed below covered walks and where noted on drawings (per CPC 1211).

H. 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 or spring mounted curbs, provide threaded metal connector at mechanical equipment, Metraflex Model SST or BST, Unisource Mfg. Co. "V" connector, or equal, CSA listed for 4 inches of movement. Arrange flexible connection to insure drainage of condensate under all installation conditions, and arrange for support of flexible connection at each end of the connector, to insure alignment at all times.
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.

2.3 PIPING AND FITTINGS OUTSIDE BUILDINGS AND BEYOND COVERED WALKS

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. 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:
   - J.M. Eagle
   - P.W. Pipe
   - Ipex Series Pipe

C. Water Service Piping Above Grade:

1. Sizes 2 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/WWA 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 1-1/2 inches and smaller: Type L copper tubing, hard temper, with brazed wrought copper fittings.


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.

E. 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.
F. 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.

2.4 FIRE PROTECTION PIPING

A. Refer to specification Section 21 10 00 “Fire Protection.”

2.5 WATER HAMMER ARRESTORS

A. Provide water hammer arrestors conforming to lead-free requirements of California Health and Safety Code Section 116875, 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.

B. Water hammer arrestors shall be certified under P.D.I. Standard WH201 and by ASSE Standard 1010.

C. 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.

D. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

Josam Company, series 75000
Smith (Jay R.) Mfg. Co., Hydrotrol 5005-5050
Mifab, series WHB

2.6 WATER FILTERS

A. 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 116875, in locations indicated on Drawings.

1. 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.

2. Provide one spare cartridge for each unit provided.

2.7 HOSE BIBBS

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:

   Acorn Engineering Co.
   Woodford Manufacturing Co.

2.8 WALL HYDRANTS

A. 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:

   Acorn Engineering Co.
   Woodford Manufacturing Co.
2.9 REDUCED PRESSURE BACKFLOW PREVENTER FOR POTABLE WATER SYSTEMS

A. Provide reduced pressure principle backflow preventer conforming to lead free requirements of California Health and Safety Code Section 116875.

1. 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.

2. 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. 2 inches and smaller: Wilkins 975XL2, Febco LF825YRP, Watts LF919, or equal.
   b. 2-1/2 thru 10 inches: Wilkins 475AXL, Febco LF860RP, or equal.
   c. 2-1/2 and 3 inches: Watts LF009

B. 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.

C. Provide substantial padlock and chain to lock valves in open position, and turn key over 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 lineal feet. Chain shall be hot galvanized.

D. Provide capped connections at each test cock. Install in accordance with requirements of Authority Having Jurisdiction.

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 two concrete filled, 6-inch diameter pipe bollards to protect all exposed piping from motor vehicle damage.

2.10 REDUCED PRESSURE BACKFLOW PREVENTER FOR NON-POTABLE WATER SYSTEMS

A. 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.

B. 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.

C. Provide substantial padlock and chain to lock valves in open position, and turn key over 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 lineal feet. Chain shall be hot galvanized.

D. Provide capped connections at each test cock. Install in accordance with requirements of Authority Having Jurisdiction.
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 two concrete filled, 6-inch diameter pipe bollards to protect all exposed piping from motor vehicle damage.

G. 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:

   Ames
   Febco Sales, Inc.
   Watts Regulator Company
   Clow

2.11 DOUBLE CHECK 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 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.

C. Provide substantial padlock and chain to lock valves in open position and turn key over 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 lineal feet. Chain shall be hot galvanized.

D. Provide capped connections at each test cock. Install in accordance with requirements of Authority Having Jurisdiction.

E. Provide two concrete filled, 6 inch diameter pipe bollards to protect all exposed piping from motor vehicle damage.

F. 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.

G. 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:

   Ames
   Febco Sales, Inc.
   Watts Regulator Company
   Clow

2.12 POTABLE WATER PRESSURE-REGULATING VALVE

A. 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 116875. Size for maximum flow rate and inlet and outlet pressure indicated on Drawings.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

   Cla-Val Company
   Watts Regulator Company
2.13 RELIEF VALVES

A. 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.

B. 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.

C. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

- Watts Regulator Company
- Cash (A.W.) Valve Manufacturing Corporation
- Zurn Industries, Inc.; Wilkins-Regulator Division

2.14 TRAP PRIMER

A. 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:

- MiFab, Inc.
- Precision Plumbing Products
- Sioux Chief Manufacturing Company

2.15 CLEANOUTS

A. 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 where required for satisfactory use.

1. Provide cleanouts in waste drop from each sink and urinal.
2. 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.

B. 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.

C. Cleanouts in composition floors: Zurn ZN-1400-X-DX, or equal (nickel bronze top).

D. Cleanouts in concealed, aboveground cast-iron soil or waste lines: Zurn Z-1440A, or equal, with ABS plastic plug.

E. 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 1/2 inch of front face of finished wall.

1. Where space does not permit the above installation, provide Zurn Z-1446, or equal, with stainless steel access cover, and vandal resistant screw.
2. Install face of cleanout plug within 1/2 inch of front face of finished wall.

F. Cleanouts in drive areas: Zurn -1400-HD-KC, or equal, with heavy-duty top and ABS plastic plug.
G. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

Zurn
J.R. Smith
Josam

2.16 FLOOR DRAINS 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:

Zurn
J.R. Smith
Josam

2.17 FLOOR SINKS

A. 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.

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, or equal:

Zurn
J.R. Smith
Josam

2.18 AREA DRAIN

A. 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:

Zurn
J.R. Smith
Christy
Brooks
Santa Rosa Precast

PART 3 - EXECUTION

3.1 INSPECTION

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.
3.2 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 arresters 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.

3.3 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. 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.

F. Grade all vent piping so as to free itself quickly of any water condensation.

G. 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.

H. Hubless Cast Iron Joints: Comply with coupling manufacturer’s installation instructions.
3.4 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.

3.5 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 Contractors 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.

3.6 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.

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.

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.

3.7 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. Appliance fuel connectors, as defined in 1203 of the CPC, are not acceptable for connection of equipment, except where specifically indicated on the Contract Documents.
   2. Route gas vent and gas relief to outside.
   3. 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.

3.8 INSTALLATION OF BACKFLOW PREVENTERS

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.

3.9 INSTALLATION OF TRAP PRIMERS

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 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.

3.10 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.

3.11 SPARE PARTS

A. Furnish to Owner, with receipt, one valve key for each key operated hydrant, bibb, or faucet installed.

3.12 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.

3.13 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.

3.14 OPERATION TEST

A. Test each piece of equipment to show that it will operate in accordance with indicated requirements.

3.15 TESTING AND BALANCING

A. See Section 23 05 93 of these specifications for testing and balancing requirements.

3.16 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 22 10 00
SECTION 22 40 00
PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES
   A. Water supplies and stops.
   B. Plumbing fixture hangers and supports.

1.2 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
   B. Section 22 00 50 Basic Plumbing Materials and Methods.

1.3 ADDITIONAL REQUIREMENTS
   A. Furnish and install any incidental work not shown or specified which is necessary to provide a complete and workable system.
   B. Coordinate all of work in this Section with all of the Trades covered in other Sections of the Specifications to provide a complete, operable and sanitary installation of the highest quality workmanship.

1.4 DESCRIPTION OF WORK
   A. Furnish and install all plumbing work indicated on the Drawings and described herein.

1.5 QUALITY ASSURANCE
   A. Manufacturers: Firms regularly engaged in manufacture of plumbing fixtures of the type, style and configuration required. All companies providing products with warranties must have been engaged in manufacturing of such products for as long as the warranty states.
   B. Plumbing Fixture Standards: Comply with applicable portions of the following codes and requirements for all work in this section:
      - California Building Code – CBC
      - California Plumbing Code – CPC
      - California Health and Safety Code
      - American National Standards Institute - ANSI
      - Federal Standards - F.S.
      - National Sanitary Foundation – NSF International
   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 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 116875.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer's specifications for plumbing fixtures and trim, including catalog cut of each fixture type and trim item furnished.

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.

C. 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 116875. Provide submittal information for products third-party certified by an approved laboratory as complying with California Health and Safety Code Section 116875.

1.7 QUALITY ASSURANCE

A. California Green Building Standards Code Requirements:

PART 2 - PRODUCTS

2.1 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.

2.2 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.

2.3 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.

2.4 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:

   American Standard, U.S. Plumbing Products
   Crane Plumbing
   Eljer Plumbingware Div., Wallace-Murray Corp.
   Kohler Co.
   VitrA

2. Plumbing Trim:

   McGuire Manufacturing Co., Inc.
   Delta Commercial
   Chicago Faucet Co.
   T&S Brass and Bronze Works, Inc.

3. Flush Valves:

   Sloan Valve Co.
   Zurn Industries, Hydromechanics Div.
Toto USA, Inc.

4. Faucets:
   Chicago Faucet Co.
   Symmons Scott
   T&S Brass and Bronze Works, Inc.
   Delta Commercial

5. Fixture Seats:
   Church Seat Co.
   Bemis Mfg. Co.
   Beneke Corp.

6. Water Coolers and Drinking Fountains:
   Haws Corporation
   Halsey Taylor Mfg. Co.
   Elkay Mfg. Co.
   Acorn Aqua

7. Service Sinks:
   American Standard
   Kohler Co.
   Williams Serviceptor
   Florestone
   Acorn

8. Stainless Steel Sinks:
   Elkay Mfg. Co.
   Just Mfg. Co.
   Haws Corporation

9. Showers:
   Acorn
   Bradley
   Symmons
   Powers

10. Emergency Equipment:
    Haws Corporation
    Gardian
    Symmons
    Bradley
    Encon

11. Fixture Carriers:
    Josam Mfg. Co.
    J. R. Smith
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 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. All flush valve solenoids and sensors shall be UL listed.

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:

   Dearborn Brass, Commercial series with brass nuts
   Delta Commercial
   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:

   Orion
   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.

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 116875, 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 IPS inlets and lock shield-loose key handles. Provide combination fixtures with compression stop and IPS 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:

- BrassCraft Manufacturing model SR37XC stop with 3-1/2AC riser and 647 escutcheon.
- McGuire Manufacturing Company, Inc. model LFH2167LK.
- Watts model LF890 203LK.

2.8 PLUMBING FIXTURE HANGERS AND SUPPORTS

A. Residential type fixture supports are not acceptable.

B. Install wall mounted water closets with combination support and waste fittings, with feet of support securely anchored to floor.

C. 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.

D. 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.

2.9 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.

PART 3 - EXECUTION

3.1 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.

3.2 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.

3.3 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.

3.4 INSTALLATION OF FAUCETS

A. Provide 85 percent IPS red brass pipe, conforming to lead-free requirements of California Health and Safety Code Section 116875, 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.

3.5 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.

3.6 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.

3.7 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 22 40 00
PART 1 - GENERAL

1.1 SECTION INCLUDES
   A. Commercial electric water heaters.
   B. Instantaneous electric water heaters.

1.2 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
   B. Section 22 00 50 Basic Plumbing Materials and Methods.

1.3 ADDITIONAL REQUIREMENTS
   A. Furnish and install any incidental work not shown or specified which is necessary to provide a complete and workable system.
   B. Coordinate all of work in this Section with all of the Trades covered in other Sections of the Specifications to provide a complete, operable and sanitary installation of the highest quality workmanship.

1.4 DESCRIPTION OF WORK
   A. Furnish and install all plumbing work indicated on the Drawings and described herein.

1.5 QUALITY ASSURANCE
   A. Manufacturers: Firms regularly engaged in manufacture of plumbing equipment of type and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
   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. 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.
   F. ASME Relief Valve Stamps: Provide water heaters with safety relief valves bearing ASME valve markings.
   G. 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.
H. California Energy Commission Compliance: Provide written confirmation of listing of all water heaters in the "Appliance Efficiency Database."

I. 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 116875.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer's plumbing equipment specifications, installation and start-up instructions, capacity and ratings, with selection points clearly indicated.

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.

C. 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 116875. Provide submittal information for products third-party certified by an approved laboratory as complying with California Health and Safety Code Section 116875.

PART 2 - PRODUCTS

2.1 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).

2.2 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. Warranty: Furnish three-year minimum warranty on tank leakage.

G. Provide the following accessories:

1. Brass drain valve
2. 3/4 inch temperature and pressure relief valve
3. Thermometer

H. Provide equal flow manifold for piping entering and leaving the water heaters. Manifold shall be provided as a standard option for the heaters proposed.
I. Controls: Adjustable immersion thermostat or surface mounted therm-o-disc; power circuit fusing.

J. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

- Bradford White Corporation
- Lochinvar Corporation
- PVI Industries, LLC
- Rheem Manufacturing Company
- Smith, A.O. Water Products Co.; a division of A.O. Smith Corporation

2.3 INSTANTANEOUS ELECTRIC WATER HEATERS

A. General: Cabinet mounted stainless steel electric heating style. Flow switch activated, UL listed, 150 PSI rated.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

- Chronomite Laboratories, Inc.
- Eemax, Inc.

PART 3 - EXECUTION

3.1 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.

3.2 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.

3.3 INSTALLATION OF ELECTRIC WATER HEATERS

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.

3.4 TRAINING

A. Provide a minimum of 4 hours of training and orientation of Owners staff in proper care and operation of Plumbing Equipment.
3.5 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.

3.6 OPERATION TEST

A. Test each piece of equipment to show that it will operate in accordance with indicated requirements.

3.7 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 22 50 00
SECTION 23 00 50
BASIC HVAC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Electric motors.
B. Motor starters.
C. Access Doors.
D. Expansion loops.
E. Flexible joints.
F. Insulation.

1.2 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. This Section is a part of each Division 23 Section.

1.3 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.

1.4 REFERENCED 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
1.5 DRAWINGS

A. Examine Drawings prior to bidding of work and report discrepancies in writing to Architect.

B. 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.

C. 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 Contactors' 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.

D. 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.

1.6 REQUIREMENTS OF REGULATORY AGENCIES

A. The publications listed below form part of this Specification; comply with provisions of these publications except as otherwise shown or specified.

2. California Electrical Code, 2013
8. California Code of Regulations, Title 24
10. CAL-OSHA
11. California State Fire Marshal, Title 19 CCR
12. National Fire Protection Association
13. Occupational Safety and Health Administration
14. Other applicable state laws
B. 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.


D. When Contract Documents differ from governing codes, furnish and install larger size or higher standards called for without extra charge.

E. FEES AND PERMITS

F. 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.

G. Arrange for utility connections and pay charges incurred, including excess service charges.

1.7 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.

1.8 SUBMITTALS

A. 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.

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. Refer to Division 01 for complete instructions.

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.

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 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.

E. Provide coordinated layouts for HVAC Ductwork systems, in accordance with Specification Section 23 80 00.

F. Furnish to the Project Inspector complete installation instructions on material and equipment before starting installation.

G. Have fire damper and fire smoke damper installation instructions available at Project site during construction for use by Project Inspector.

H. 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.

I. 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.

J. 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.

K. Delegated-Design Submittal: For seismic supports, anchorages, and restraints indicated to comply with performance requirements and design criteria.


2. Supports, anchorage and restraints for piping, ductwork, and equipment shall be an OSHPD pre-approved system such as Tolco, Afcon, ISAT, Badger, 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.

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, 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 2013 California Building Code.

4. Additional Requirements: In addition to the above, conform to all state and local requirements.

1.9 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.

1.10 OPERATION AND MAINTENANCE MANUAL

A. 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. Start compiling data upon approval of submittals.

1. Sets shall incorporate the following:

a. Service telephone number, address and contact person for each category of equipment or system.

b. Complete operating instructions for each item of heating, ventilating and air conditioning equipment.

c. Copies of guarantees/warrantees for each item of equipment or systems.
d. Test data and system balancing reports.
e. Typewritten maintenance instructions for each item of equipment listing lubricants to be used, frequency of lubrication, inspections required, adjustment, etc.
f. Manufacturers' bulletins with parts numbers, instructions, etc., for each item of equipment.
g. Temperature control diagrams and literature.
h. Check test and start reports for each piece of mechanical equipment provided as part of the Work.
i. 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.

1.11 SITE CONDITIONS

A. 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.

1.12 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.

1.13 WARRANTY

A. Refer to Division 01 for warranty requirements, including effective date of warranty. Refer to specific items of equipment specified herein for warranty duration if different from that specified in Division 01.

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.

1.14 RECORD DRAWINGS

A. Refer to Division 01, Record Documents, for requirements governing Work specified herein.

B. Upon completion of the Work, deliver to Architect the following:

1. Originals of drawings showing the Work exactly as installed.
2. One complete set of reproducible drawings showing the Work exactly as installed.
3. One compact disc with complete set of drawings in PDF format showing the Work exactly as installed.
4. Provide Contractor's signature, verifying accuracy of record drawings.
C. Obtain the signature of the Inspector of Record for all Record Drawings.

1.15 DELIVERY AND STORAGE

A. Protect equipment and materials delivered to Project site from weather, humidity and temperature variations, dirt, dust and other contaminants.

1.16 COORDINATION

A. General:

1. Coordinate Work in this Section with trades covered in other Specifications Sections to provide a complete, operable and sanitary installation of the highest quality workmanship.

B. Electrical Coordination:

1. 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:

   a. Review the Electrical Drawings and Division 26 Specifications to verify that electrical services provided are adequate and compatible with equipment requirements.
   b. 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.
   c. Prior to proceeding with installation of additional electrical work, submit detailed drawings indicating exact scope of additional electrical work.

C. Mechanical Coordination:

1. Arrange for pipe spaces, chases, slots and openings in building structure during progress of construction, to accommodate mechanical system installation.
3. 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.”

PART 2 - PRODUCTS

2.1 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.

2.2 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.

2.3 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, 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.

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 2013 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.


6. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.


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.

2.4 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.

2.5 JOINING MATERIALS
A. Refer to Division 22 and 23 piping sections for special joining materials not listed below.

B. Brazing Filler Metals:
   1. 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.

2.6 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.

2.7 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.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
   Metraflex Inc., Metraloop series.
   Unisource Manufacturing, Inc., V series.
2.8 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.

2.9 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.

2.10 EQUIPMENT IDENTIFICATION

A. Identify each piece of equipment with a permanently attached engraved bakelite plate, 1/2 inch high white letters on black background.

2.11 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 legend and flow arrow shall conform to ASME A13.1.

2.12 INSULATION WORK

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. Adhesives and sealants shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.

3. The term "piping" used herein includes pipe, air separators, valves, strainers and fittings.

4. 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.

5. Provide pre-formed PVC valve and fitting covers for indoor piping.

6. Provide factory-fabricated aluminum valve and fitting covers for outdoor piping.

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. Urethane insulation will not be allowed above ground or on hot water piping.

9. 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.

10. Clean thoroughly, test and have approved, all piping and equipment before installing insulation and/or covering.

11. Repair all damage to existing pipe and duct 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. 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. Verify suitability with manufacturer of insulation. Insulation with pre-applied polymer jacket may be substituted at Contractor's option.

2. Insulate refrigerant suction piping, including fittings, with 3-1/2 pound per cubic foot minimum density fiberglass with factory-applied ASJ-SSL jacket. Insulate valves and irregular surfaces to match adjacent insulation and cover with two layers of Glasfab saturated in Foster Sealfas 30-36, 3M, or equal, carried 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. Insulation thicknesses per application follow:

   a. Indoor refrigerant suction piping 3/4 inch diameter and smaller: 1 inch thick.
   b. Indoor refrigerant suction piping 1 inch diameter and larger: 1-1/2 inches thick.
   c. Outdoor refrigerant suction piping; all sizes: 2 inches thick.

3. In lieu of the above, refrigerant suction piping, including fittings, may be insulated with Armacell LLC; Armaflex, or equal. Seal all joints with Armaflex 520 BLV adhesive, or equal. Apply insulation in strict accordance with manufacturer's recommendations. Insulation thicknesses follow:

   a. Indoor refrigerant suction piping 3/4 inch diameter and smaller: 1/2 inch thick.
   b. Indoor refrigerant piping 1 inch diameter and larger: 1 inch thick.
   c. Outdoor refrigerant piping; all sizes: 2 inches thick.

4. When equipment manufacturers' instructions indicate that refrigerant liquid and hot-gas gas piping be insulated, insulation thickness shall be equal to, and applied as described herein for refrigerant suction piping.

5. 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.

   a. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
   b. Tee covers.
   c. Flange and union covers.
   d. End caps.
   e. Beveled collars.
   f. Valve covers.
   g. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

6. Jacket thickness:

   a. Pipes 10 inches diameter and smaller: Minimum .016 inch thick jacket with smooth finish.

C. Duct Insulation:

1. All duct insulation shall meet minimum R-value of R-8 at 3 inch thickness 3/4 pound per cubic foot density for ductwork installed outside the building insulation envelope. For ductwork installed within the building insulation envelope, duct insulation shall have a minimum R-value of R-4.2 at 2 inch thickness, 3/4 pound per cubic foot density.

2. General: 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.

3. Wrap 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.

4. On all supply and return ductwork exposed to weather and not internally lined, field apply minimum 2" thick mineral-fiber board thermal insulation, glass fibers bonded with thermosetting resin. Comply with ASTM C612, type IB without facing and with all service jacket with factory applied FRK-25 foil reinforced kraft paper. Aluminum jacket, 0.024 inch thickness sheets manufactured from aluminum alloy complying with ASTM B209, stucco embossed finish and having an integrally bonded moisture barrier over entire surface in contract with insulation.

5. Provide internal duct lining in accordance with specification section 23 80 00.

PART 3 - EXECUTION

3.1 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.

3.2 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 IIIR 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.

3.3 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.

3.4 PRIMING AND PAINTING

A. Perform all priming and painting on the equipment and materials as specified herein.

B. Priming:

1. Exposed ferrous metals, including piping, which are not galvanized or factory-finished shall be primed. Black steel pipe exposed to the weather shall be painted one coat of Rust-Oleum #1069 primer for black steel piping or Rust-Oleum #5260, Kelly Moore, or equal, primer for galvanized piping.

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 should be masked off prior to painting. When painting is completed, remove masking material.

C. See Painting Section for detailed requirements.

3.5 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 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 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.
3.6 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.

3.7 INSTALLATION OF PIPING AND DUCT SYSTEMS

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, conduit, or 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.

5. Horizontal runs of pipes, conduits, or 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.

6. Close ends of pipe immediately after installation. Leave closure in place until removal is necessary for completion of installation.

7. At the time of rough installation, or during storage on the construction site and until final startup of the heating and cooling equipment, all duct and other related air distribution component opening shall be covered with tape, plastic, sheet metal, or other methods acceptable to the enforcing agency.

8. Each piping system shall be thoroughly flushed and proved clean before connection to equipment.

9. Pipe the discharge of each relief valve, air vent, backflow preventer, and similar device to floor sink or drain.

10. Install exposed polished or enameled connections with special care showing no tool marks or threads at fittings.

11. Install horizontal valves with valve stem above horizontal.

12. Use reducing fittings; bushings shall not be allowed. Use eccentric reducing fittings wherever necessary to provide free drainage of lines and passage of air.

13. Verify final equipment locations for roughing-in.

14. 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.

15. 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.

B. 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.

C. 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 caulkng. Wrap pipes through slabs on grade with 1 inch thick fiberglass insulation to completely isolate the pipe from the concrete.

D. 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.

E. Firestopping:

1. Pack the annular space between the pipe sleeves and the pipe and between duct openings and ducts 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 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 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.

F. Flashing:

1. Flashing for penetrations of metal or membrane roof for mechanical items such as flues, ducts, 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. Elmdor/Stoneman Model 1540.
2. Flues and ducts shall have 24 gauge galvanized sheet metal storm collar securely clamped to the flue above the flashing.

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.

G. Hangers and Supports:

1. General: Support all ductwork, equipment and piping so that it is firmly held in place by approved iron hangers and supports, and special hangers as required. All 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 all hanger material before installation. Do not support piping or ductwork with plumbers' tape, wire rope, wood, or other makeshift devices. Where building structural members do not match piping and ductwork support spacing, provide all “bridging” support members as required firmly attached to building structural members in a fashion approved by the Structural Engineer.

   a. Materials, design, and type numbers for support of piping per Manufacturers' Standardization Society (MSS), Standard Practice (SP)-58.
   b. Materials and design for ductwork support shall be per SMACNA “HVAC Duct Construction Standards, Metal and Flexible.”

2. All hanger components shall be provided by one manufacturer: B-Line, Grinnell, Uni-Strut, Badger, or equal.

2. Pipe Hanger and Support Spacing:

   a. Vertical piping support spacing: B-line #B3373 clamps attached to the pipe above each floor to rest on the floor. Provide with lead or Teflon liners on copper tubing. Provide additional support at base of cast iron risers and support at unsupported riser joints and horizontal offsets per 2007 Mason Industries Seismic Restraint Guidelines. Provide intermediate support for vertical piping, spaced at or within the following maximum limits.

<table>
<thead>
<tr>
<th>Pipe Diameter</th>
<th>Steel Fluid</th>
<th>Steel Vapor</th>
<th>Copper Fluid</th>
<th>Copper Vapor</th>
<th>CPVC &amp; PVC (Note 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 - 1”</td>
<td>12</td>
<td>6</td>
<td>10</td>
<td>6</td>
<td>Base and Each Floor (Note 1)</td>
</tr>
<tr>
<td>1-1/4 - 2”</td>
<td>12</td>
<td>Each Floor</td>
<td>10</td>
<td>6</td>
<td>Base and Each Floor (Note 1)</td>
</tr>
</tbody>
</table>

   Note 1: Provide mid-story guides.

   b. 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.

<table>
<thead>
<tr>
<th>Pipe Diameter</th>
<th>Steel Fluid</th>
<th>Steel Vapor</th>
<th>Copper Fluid</th>
<th>Copper Vapor</th>
<th>CPVC &amp; PVC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 - 1”</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>1-1/4 - 2”</td>
<td>7</td>
<td>10</td>
<td>6</td>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Rod Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot; and Smaller</td>
<td>3/8&quot;</td>
</tr>
</tbody>
</table>

   b. Trapeze Suspension: B-Line 1-5/8 inch width channel in accordance with manufacturers’ published load ratings. No deflection to exceed 1/160 of a span.

   c. Trapeze Supporting Rods: Shall have a safety factor of five; securely anchor to building structure.

   d. Pipe Clamps and Straps: B-Line B2000, B2400; isolate copper pipe with two thicknesses of 2 inches wide 10-mil polyvinyl tape. Where used for seismic support systems, provide B-Line B2400 series pipe straps.

   e. 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.

   f. Steel Connectors: Beam clamps with retainers.

5. Duct Hanger and Support Spacing: Conform to Requirements of CMC and SMACNA “HVAC Duct Construction Standards, Metal and Flexible.”

6. Support to Structure:
   a. 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.

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 tubing from ferrous materials and hangers with two thicknesses 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.

11. On chilled or combination hot and chilled water or refrigerant pipes, install the hangers on the outside of the pipe covering and not in contact with the pipe. 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.

3.8 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. 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.

C. Flexible Connections:
   1. Flexible connections in refrigerant lines; Flexonic, Anaconda or equal, metal hose, full size.
   2. Anchor piping securely on the system side of each flexible connection.
3.9 ACCESS DOOR

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.

3.10 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.

3.11 PIPE IDENTIFICATION

A. Provide temporary identification of each pipe installed, at the time of installation. Temporary identification shall be removed and replaced with permanent identification as part of the work.

B. Apply the legend and flow arrow at all valve locations; at all points where the 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 the approval of the Architect. There shall be at least one marking in each room. Markings shall be located for maximum visibility from expected personnel approach.

C. Wherever two or more pipes run parallel, the markings shall be supplied in the same relative location on each.

D. Apply the markings after painting and cleaning of piping and insulation is completed.

3.12 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.

3.13 TESTS AND ADJUSTMENTS
A. Test the installations in accordance with the following requirements and all applicable codes:

1. Notify the Architect at least seven days in advance of any test.
2. Inspector of Record should witness all tests of piping systems.
3. All piping shall be tested at completion of rough-in, or at other times as directed by the Architect.
4. Furnish all necessary materials, test pumps, gases, instruments and labor required for testing.
5. Isolate from the system all equipment that may be damaged by test pressure.
6. Make connections to existing systems with flanged connection. During testing of the 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. Inspector of record shall witness final connection to system.

B. 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.

3.14 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.

3.15 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.

3.16 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.

3.17 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.
A. The contractor shall complete the Acceptance Requirements of the California Building Energy Efficiency Standards, including but not limited to Air Distribution Systems, Outside Air systems, Packaged HVAC Systems, VFD Systems, Hydronic System Controls, Space Conditioning Controls, Demand Control Ventilation and Air Economizers. Contractor shall perform required acceptance tests and shall complete the appropriate “Certificates of Acceptance” and submit such certificates to the authorities having jurisdiction for approval and issuance of final occupancy permit.

3.19 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 23 00 50
SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Balancing Air Systems:
      a. Constant-volume air systems.
      b. Variable-air-volume systems.

1.3 REFERENCES
A. Associated Air Balance Council (AABC)
B. National Environmental Balancing Bureau (NEBB)

1.4 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:

<table>
<thead>
<tr>
<th>Similar Terms</th>
<th>Contract Term</th>
<th>AABC Term</th>
<th>NEBB Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAB Specialist</td>
<td>TAB Specialist</td>
<td>TAB Agency</td>
<td>NEBB Certified Firm</td>
</tr>
<tr>
<td>--------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>TAB Field Supervisor</td>
<td>Test and Balance Engineer</td>
<td>Test and Balance Supervisor</td>
<td></td>
</tr>
</tbody>
</table>


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.

1.5 INFORMATIONAL SUBMITTALS

A. 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.


1. Submit examinations report with qualifications data.


D. 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.

E. Certified TAB reports.
1. Provide three printed copies of final TAB report. Provide one electronic file copy in PDF format.

F. Sample report forms.

G. 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.

1.6 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
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.

1. Agenda Items:
   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.


K. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.7 PROJECT CONDITIONS

1.8 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.

1.9 COORDINATION

A. Notice: Provide 7 days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.
C. Coordinate TAB work with work of other trades.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 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 heat-transfer coils for correct piping connections and for clean and straight fins.

L. Examine operating safety interlocks and controls on HVAC equipment.

M. Report conditions requiring correction discovered before and during performance of TAB procedures.
Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. 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. 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. Automatic temperature-control systems are operational.
3. Equipment and duct access doors are securely closed.
4. Balance, smoke, and fire dampers are open.
5. Isolating and balancing valves are open and control valves are operational.
6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
7. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

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 230713 "Duct Insulation," Section 238000 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.
3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer’s outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. 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 233113 "Metal Ducts." Section 238000 “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.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

   1. Measure 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.

3.6 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.
3.7 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.
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.

3.8 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.9 PROCEDURES FOR HEAT-TRANSFER COILS

A. 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.

3.10 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.

3.11 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: Plus 10 percent and minus 0 percent.
2. Air Outlets and Inlets: Plus 5 percent and minus 5 percent.
3. Multiple outlets within single room: Plus 5 percent and minus 0 percent for total airflow within room. Tolerance for individual outlets within a single room having multiple outlets shall be as for “Air Outlets and Inlets”.
   a. Room shall be balanced to create pressure relationship (positive, negative, or neutral) with adjacent spaces as indicated on Drawings. Maintain airflow differentials between supply, return, and exhaust indicated on Drawings.

3.12 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.

3.13 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. Fan curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. 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.
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. Fan drive settings including settings and percentage of maximum pitch diameter.
   e. Settings for supply-air, static-pressure controller.
   f. Other system operating conditions that affect performance.

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. Duct, outlet, and inlet sizes.
3. Pipe and valve sizes and locations.
4. Terminal units.

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. Outdoor airflow in cfm.
   g. Return airflow in cfm.
   h. Relief airflow in cfm.
   i. Outdoor-air damper position, normal and economizer, power exhaust, or power exhaust economizer modes, as applicable to installed equipment.

H. 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 airflow 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.

I. 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.

J. 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.

K. 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.

L. Instrument Calibration Reports:

1. Report Data:
   
   a. Instrument type and make.
   b. Serial number.
   c. Application.
   d. Dates of use.
   e. Dates of calibration.

3.14 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 room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
   c. Verify that balancing devices are marked with final balance position.
   d. 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.

3.15 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.
SECTION 23 80 00
HEATING, VENTILATING AND AIR CONDITIONING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Roof mounted air conditioning units.
B. Split system heat pump units.
C. Split system air conditioning units.
D. Air cooled condensing units.
E. Wall-Mounted Heat Pump Unit
F. Refrigeration piping and fittings.
G. Air inlets and outlets.
H. Terminal Units.
I. Filters.
J. Dampers.
K. Ductwork.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Section 23 00 50, Basic HVAC Materials and Methods.
C. 23 05 93, Testing, Adjusting, and Balancing for HVAC.

1.3 ADDITIONAL REQUIREMENTS

A. Furnish and install any incidental work not shown or specified which is necessary to provide a complete and workable system.
B. Coordinate all of work in this Section with all of the Trades covered in other Sections of the Specifications to provide a complete, operable and sanitary installation of the highest quality workmanship.

1.4 DESCRIPTION OF WORK
A. Work of this section includes, but is not necessarily limited to Heating, Ventilating and Air Conditioning work indicated on the drawings and described herein.

1.5 QUALITY ASSURANCE

A. Design Criteria:

1. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture. All gas-fired equipment shall be UL, ETL or CSA listed.
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.
6. Scheduled gas BTU input shall be considered as maximum available.

1.6 SUBMITTALS

A. 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. 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 2013 Building Energy Efficiency Standards. Provide evidence of certification.

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.

E. 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.

F. Record Drawings: At project close-out, submit Record Drawings of installed ductwork, duct accessories, and outlets and inlets in accordance with requirements of Division 01.

G. 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.

1.7 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 coordination drawings showing plan and pertinent section or elevation views of all piping, ductwork and electrical systems. Drawings shall be on vellum or sepia mylar, reproducible and the work represented shall be fully coordinated with the structure, other disciplines, and with all finishes. Drawings shall all be presented on a single size sheet. Contractor may use either size D (24 inch x 36 inch) or E (36 inch x 42 inch). Drawings graphics shall fully comply with A.I.A. Architectural Graphic Standards and ANSI Y14. Drawings may be hand drawn or computer generated using AutoCad or "Quick Pen". All drawings shall have title block, key plan, north arrow and sufficient grid lines to provide cross-reference to the 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 coordination 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.
   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 "finding" changes or deviations to 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.

E. It shall be responsibility of the General Contractor to ensure that the Heating, Ventilating and Air Conditioning Contractor coordinates all of his work with all other trades, including mechanical and electrical trades, so that complete job is neat and in conformity with plans and specifications.

1.8 REFERENCES

A. AABC - Associated Air Balance Council

B. AFBMA - Anti Friction Bearing Manufacturer's Association

C. CSA – Canadian Standards Association International

D. AMCA - Air Moving and Control Association Inc.

1. Standard 210 - Laboratory Methods of Testing Fans

E. ANSI - American National Standards Institute

F. ARI - Air-Conditioning and Refrigeration Institute

G. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers

H. ASME - American Society of Mechanical Engineers
I. ASTM - American Society of Testing and Materials
J. CCR - California Code of Regulations
K. CSFM - California State Fire Marshal
L. NIST - National Institute of Standards and Technology
M. NEMA - National Electrical Manufacturer's Association
N. NFPA - National Fire Protection Association
O. OSHA - Occupational Safety and Health Act
P. SMACNA - Duct Manuals
Q. CBC - California Building Code
R. UL - Underwriters' Laboratories, Inc.
S. CMC - California Mechanical Code
T. CPC - California Plumbing Code
U. CEC - California Electrical Code

PART 2 - PRODUCTS

2.1 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).

2.2 GAS FIRED EQUIPMENT

A. All gas-fired equipment shall be listed for use as a gas appliance.

B. All units shall comply with the emissions requirements of the Air Quality Management District (AQMD) in which they are to be installed.

2.3 AIR CONDITIONING UNIT, ROOF-MOUNTED – DUAL COMPRESSOR

A. Provide factory assembled single packaged outdoor rooftop mounted, electrically controlled gas heating and electric cooling unit, rated in accordance with ARI Standards 210 or 360, and 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. UL or ETL tested and certified.

C. Unit shall be rated in accordance with ARI sound standards 270 or 370.

D. Unit shall be UL tested and certified in accordance with ANSI Z21.47 Standards as a total package.

E. Roof curb shall be designed to conform to NRCA Standards.

F. Unit shall be manufactured in a facility registered to ISO 9001:2000.

G. Unit shall be Energy Star qualified.

H. 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 foil-faced 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 and heat section areas. Each panel shall have multiple latches and handles. Each major external hinged access panel shall be double-wall construction and permanently attached to the rooftop unit.
4. Return air filters shall be accessible through a dedicated hinged 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 a minimum 3/4 inch-14 NPT connection, 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. Furnish unit with kit for field conversion if required by manufacturer for the scheduled unit size. See Drawings for air discharge configuration.

I. Fans:

1. Centrifugal supply air blower (evaporator fan) shall have rubber-isolated, cartridge type ball 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.
4. Induced-draft blower shall be of the direct-driven, single inlet, forward-curved, centrifugal type. It shall be made from aluminized steel with a corrosion-resistant finish and shall be dynamically balanced.

J. Compressor:

1. Fully hermetic, scroll type with crank case heaters, 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.
4. Provide with dual electrically and mechanically independent refrigerant circuits.
5. Compressor shall have a five year warranty.

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.
   a. When supplied as standard equipment for unit size as scheduled on Drawings, condenser coils may consist of corrosion resistant coated aluminum alloy fins, tubes and manifolds.
2. Units shall have face-split type evaporator coil.
3. 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 Drawings.
4. Coils shall be leak tested at minimum 170 psig and pressure tested at minimum 450 psig.

L. Heating Section:

1. Induced-draft combustion type with energy saving 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 a minimum of 20 gage corrosion resistant steel. Standard heat exchanger shall have a ten year warranty.
   b. The optional stainless steel heat exchanger shall be of the tubular-section type, constructed of a minimum of 20 gage, type 409 stainless steel, including stainless steel tubes, vestibule plate, and collector box. Stainless steel heat exchanger shall have a fifteen year warranty.
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.

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 2 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. See Section 15900, if included, and equipment schedule, sequence of operation and control diagram on Drawings for additional requirements.
2. Provide electro-mechanical controls with 24V thermostat interface when third party direct digital controls with an Energy Management System will be provided.
3. Provide electro-mechanical controls with 24V thermostat interface or provide microprocessor controls for stand-alone thermostat operation.
4. Provide microprocessor controls for single zone VAV units for stand-alone operation. Units shall have factory mounted supply fan variable frequency drives.
5. Provide microprocessor controls with BACnet or LON interface for single zone VAV units when third party direct digital controls with an Energy Management System will be provided. 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 25°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. Automatic compressor redundancy.
   e. Service run test capability.
   f. Shall accept input from a CO2 sensor (indoor).
   g. Configurable alarm light shall be provided which activates when certain types of alarms occur.
   h. Provide compressor minimum run time (3 minutes) and minimum off time (5 minutes).
   i. Service diagnostic mode.
   j. Economizer control.
   k. Unit shall have 0°F low ambient cooling operation.
   l. 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.
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” 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.

Q. Operating Characteristics:
   1. Unit shall be capable of starting and running at 125° F outdoor ambient temperature per maximum load criteria of ARI Standards 210 or 360.
   2. Unit with factory controls will operate in cooling down to an outdoor ambient temperature of 0° F. Electromechanical controls shall operate down to 25° 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 — standard side or alternate bottom. See Drawing Schedule for thru-the-bottom power wiring requirement.

S. 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. All evaporator fan motors 5 hp and larger shall meet the minimum efficiency requirements as established by the Energy Policy Act of 1992 (EPACT), effective October 24, 1997.
   4. Totally enclosed condenser-fan motor shall have permanently lubricated, sealed bearings, and inherent automatic-reset thermal overload protection.
   5. Induced-draft motor shall have permanently lubricated sealed bearings and inherent automatic-reset thermal overload protection.

T. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
   Carrier Corporation.
   Trane Inc.
   Johnson Controls, Inc.
U. Provide the following additional features and equipment:

1. Roof Curb: Formed 14 gauge 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 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.
   b. Provide hinged cabinet access doors and include latches to provide a tool-less entry for servicing.
   c. Provide door lock on the power exhaust cabinet to meet ETL safety requirements.
   d. 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.
   e. Provide belt driven exhaust blowers, double inlet, forward-curved centrifugal type. Provide gravity backdraft damper at fan outlet.
   f. 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.

V. Flue Extensions:

1. Provide at all locations where gas flue outlet will be within 10 feet of an adjacent building or unit air intake and locations where adjacent vertical surfaces within 3 feet extend more than 2 feet above the top of the unit, provide manufacturer’s listed flue extension.
2. Arrange flue extension to terminate 3 feet above top of adjacent air intake or adjacent vertical surface.

W. Replenish for a period of one year without cost to the Owner all refrigerant and oil required to maintain the proper levels.

X. 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.

2.4 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: Horizontal ducted fan coil unit, as indicated on Drawings.
   1. Cabinet: Pre-painted galvanized steel cabinet including R-4.2 insulation with vapor barrier. Tested for 2% cabinet leakage at 1.0 inches w.c.
   2. Fans: Double inlet, forward curved, statically and dynamically balanced.
   3. Fan Motor: High Efficiency ECM motor, size as indicated 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. Evaporator Coil: Aluminum fins mechanically bonded to grooved copper tubes. Coils shall be pressure leak tested.
   5. 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.
      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.

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.

L. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
   Mitsubishi Electric Corporation.
   Carrier Corporation
   Sanyo Electric Co., Ltd.

M. Owner Training: Manufacturer shall provide one on-site 2-hour training session for Owners’ maintenance personnel.

2.5 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 or horizontal suspended, as indicated on Drawings.
   1. Cabinet:
      a. Wall mounted: Molded white high strength plastic.
         1) Provide wall mounted unit with factory mounting plate.
      b. Horizontal ducted: Pre-painted galvanized steel cabinet including R-4.2 insulation with vapor barrier. Tested for 2% cabinet leakage at 1.0 inches w.c.
   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.

   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.

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.

L. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

AC Transit
HEATING, VENTILATING AND AIR CONDITIONING
D3 Richmond Yard Reactivation P2095
Mitsubishi Electric Corporation.
Carrier Corporation
Sanyo Electric Co., Ltd.

2.6 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:

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.
3. Provide unit with 5 year limited compressor warranty.

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.

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:

   Carrier Corporation
   Trane Inc.

O. Owner Training: Manufacturer shall provide one on-site 1-hour training sessions for Owners’ maintenance personnel.

2.7 WALL MOUNTED HEAT PUMP UNIT

A. Provide factory assembled, pre-charged electric cooling and heating unit, certified in accordance with ARI Standard 390-2003, and UL listed and labeled. Provide refrigerant charge R-410A and all internal wiring, piping, controls and special features required prior to field startup. Design unit to conform to the following:

   1. ASHRAE 90.1.
   2. Insulation, adhesive, and all materials exposed to the air stream shall meet NFPA 90A requirements for flame spread and smoke generation.
   3. Unit casing and wall sleeve shall be capable of withstanding 1000-hour salt spray exposure per ASTM B117-03.

B. Performance: Total cooling capacity of the heat pump unit shall be as scheduled on Drawings.

C. Cabinet:
   1. 20 gauge pre-painted zinc coated galvanized steel with baked enamel finish. Unit base shall be 20 gauge pre-painted zinc coated galvanized steel with baked enamel finish.
   2. Unit shall include hinged, lockable front panel for filter service and access to primary electrical controls. Provide with tamper resistant fasteners for access panels.
   3. Cabinet shall be fully insulated with foil covered, high density fiberglass insulation with sealed edge treatment and sound deadening insulation material in the compressor section.
   4. Condensate drain pans for evaporator and condenser shall be of stainless steel construction.
   5. Unit shall have sloped top and rain flashing.
D. Wall Sleeve:
   1. Factory supplied wall sleeve shall be constructed of 16 gauge galvanized steel, coated with an epoxy primer and a baked enamel finish.

E. Fans:
   1. Shall be twin centrifugal type.

F. Motors:
   1. Evaporator fan motor shall be continuous operation, variable-speed ECM type.
   2. Condenser Fan Motor shall be totally enclosed permanent split capacitor type, with sleeve bearings.

G. Compressor:
   1. 2-stage scroll compressor mounted on isolation rails. Provide with the following:
      a. 5 year compressor warranty.
      b. Factory installed TXV.
      c. Crankcase heater.

H. Coils:
   1. Evaporator and condenser coils shall have aluminum fins mechanically bonded to seamless internally grooved copper tubes with all joints brazed.

I. Supplemental Electric Heaters:
   1. Provide as scheduled on Drawings. Factory or field installed supplemental electric heaters shall be provided with the following:
      a. Line break automatic reset limit switch.
      b. Redundant safety controls.

J. Controls and Safeties:
   1. Provide factory controls and safeties that include the following:
      a. The unit shall include a diagnostic light to indicate when service is required.
      b. 24 VAC internal control circuit with transformer.
      c. Current sensing relay.
      d. Compressor high and low pressure lockout with automatic reset.
      e. Phase-reverse rotation protection.
      f. Solid state electronic heat pump control shall include the following:
         1) 30, 60 or 90 minute defrost cycle.
         2) Ten minute defrost override.
         3) Five minute compressor short cycle protection.
         4) Thermistor sensor, speed up terminal for service.

K. Electrical Components:
   1. Provide circuit breaker or toggle disconnect, accessible through hinged lockable access cover.
L. Additional Features and Equipment:

1. See Schedule on Drawings for additional factory or field installed options.

2.8 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.

B. 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.

2.9 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 gases, universal color for other refrigerant gases. 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.

2.10 AIR INLETS AND OUTLETS

A. Except as otherwise indicated, provide manufacturer's standard outlets and inlets 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 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.

2.11 AIR TERMINAL UNITS

A. Shutoff, Single-Duct Air Terminal Units:


2. Casing: 0.034-inch-thick galvanized steel, single wall.

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. Adhesive VOC Content: 80 g/L or less.

a) 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.

b. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.

c. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.


a. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at 3-inch wg 6-inch wg inlet static pressure.

4. Controls:

a. Electronic Damper Actuator: 24 V, powered open, spring closed.

b. Terminal Unit Controller: Pressure-independent, variable-air-volume (VAV) 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:

   1) Occupied and unoccupied operating mode.
   2) Remote reset of airflow or temperature set points.
   3) Adjusting and monitoring with portable terminal.
   4) Communication with temperature-control system.

c. Room Sensor: Wall mounted, with the following features:

   1) Digital display of sensed temperature.
   2) Local temperature setpoint adjustment. Capable of manual override through control system operator.
   3) Local override to turn HVAC on. Capable of manual override through control system operator.
   4) Access for connection of portable operator terminal.

5. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

    Price Limited.
    Titus.
    Johnson Controls, Inc.

2.12 AIR FILTERS
A. Provide MERV 8 or 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:

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: 2” 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:

   Camfil Farr, Inc., model 30/30.
   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) and leave the remaining filters in location designated by the Owner. Provide units designed to accommodate washable, permanent filters with one washable, permanent filter.

2.13 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 damper. 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. 3 hour dynamic fire dampers shall be Ruskin DIBD230, Pottorff.
      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 or equal by Pottorff.
      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, equal by Pottorff.
      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 EZ reset “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 easy 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 devise for connection to poser. 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 2-gauge minimum galvanized 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” minimum length and factory “roll formed” one-piece angles with pre-punched holes for easy installation. Dampers shall be Ruskin FSDR25 or equal by Pottorff.

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 or equal by Pottorff.

i. 3-hour rated combination fire smoke dampers shall be Ruskin model FSD60-3 or equal by Pottorff.

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 or equal by Pottorff.

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 or equal by Pottorff.

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 or equal by Pottorff.

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, or equal by Pottorff.
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.

2.14 DUCTWORK

A. Construct and install all 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.


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.


C. Fabricate all ductwork with sheet metal. Fiberglass ductwork will not be accepted for use on this project.

D. Duct sizes indicated are external sizes.

E. 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.
F. **LDuct Sealing:**

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. 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. 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

G. **Provide sheet metal angle frame at all duct penetrations to wall, floor, roof, or ceiling.**

H. **Duct Support Materials:** Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, straps, trim, and angles for support of ductwork.

I. **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:

<table>
<thead>
<tr>
<th>Duct Dimension</th>
<th>Minimum Gauge</th>
<th>Joint Reinforcement Per CMC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Through 12&quot;</td>
<td>26</td>
<td>Not Required</td>
</tr>
<tr>
<td>13&quot; through 18&quot;</td>
<td>24</td>
<td>Not Required</td>
</tr>
<tr>
<td>19&quot; through 30&quot;</td>
<td>24</td>
<td>C/4</td>
</tr>
<tr>
<td>31&quot; through 42&quot;</td>
<td>22</td>
<td>E/4</td>
</tr>
<tr>
<td>43&quot; through 54&quot;</td>
<td>22</td>
<td>F/2</td>
</tr>
<tr>
<td>55&quot; through 60&quot;</td>
<td>20</td>
<td>G/4</td>
</tr>
<tr>
<td>61&quot; through 84&quot;</td>
<td>20</td>
<td>I/2</td>
</tr>
<tr>
<td>85&quot; through 96&quot;</td>
<td>20</td>
<td>J/2</td>
</tr>
<tr>
<td>Over 96&quot;</td>
<td>18</td>
<td>K/2</td>
</tr>
</tbody>
</table>

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.

J. 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:

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Johns Manville</td>
<td>Duct Liner PM</td>
</tr>
<tr>
<td>CertainTeed Corporation</td>
<td>ToughGard</td>
</tr>
<tr>
<td>Fosters Adhesive</td>
<td>85-62</td>
</tr>
<tr>
<td>Swifts Adhesive</td>
<td>7336</td>
</tr>
</tbody>
</table>

K. 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.

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Minimum Gauge</th>
<th>Method of Manufacture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 14”</td>
<td>26</td>
<td>Spiral Lockseam</td>
</tr>
<tr>
<td>15” to 23”</td>
<td>24</td>
<td>Spiral Lockseam</td>
</tr>
<tr>
<td>24” to 36”</td>
<td>22</td>
<td>Spiral Lockseam</td>
</tr>
<tr>
<td>37” to 50”</td>
<td>20</td>
<td>Spiral Lockseam</td>
</tr>
<tr>
<td>51” to 60”</td>
<td>18</td>
<td>Spiral Lockseam</td>
</tr>
<tr>
<td>Over 60”</td>
<td>14</td>
<td>Longitudinal Seam</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Minimum Gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td>3” to 36”</td>
<td>20</td>
</tr>
<tr>
<td>38” to 50”</td>
<td>18</td>
</tr>
<tr>
<td>Over 50”</td>
<td>16</td>
</tr>
</tbody>
</table>

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.

L. 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.
M. 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:

      C.A. Schroeder, Inc., Cal Flex model 2PMJ
      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 8 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.

5. 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.

N. Provide Vention, or equal, flexible connections on inlet and outlet of AC Unit, air handler and exhaust fans. Provide galvanized weather hood over flexible connections exposed to the weather.

PART 3 - EXECUTION

3.1 ROOF MOUNTED EQUIPMENT

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 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.
F. 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.

G. Connect supply and return air ducts to horizontal discharge roof mounted equipment with flexible duct connectors specified elsewhere in these Specifications.

H. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.

3.2 INSTALLATION OF SPLIT SYSTEM AC, HEAT PUMP, AND VRF SYSTEMS

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.

3.3 INSTALLATION OF WALL MOUNTED HEAT PUMP UNIT

A. Install unit per manufacturers written instructions.

B. Install unit level and plumb.

C. Anchor unit to structure as detailed on Drawings.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Route condensate drain to nearest approved place of disposal, or as shown on Drawings.

F. Provide condensate pump where condensate will not drain by gravity.

3.4 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. Refer to Article, Insulation Work, in Section 23 00 50, Basic HVAC Materials and Methods.

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. 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.

3.5 AIR INLETS AND OUTLETS
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 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.
C. Ceiling-mounted air terminals or 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. Terminals or 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 terminals or 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 #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.

3.6 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.

3.7 FILTERS

A. Mount filters in airtight frames furnished by the filter manufacturer, and install in accordance with manufacturer's recommendations.

B. Air filters shall be accessible for cleaning or replacement.

C. Identify each filter access door with 1/2 inch high minimum stenciled letters.

D. Provide temporary filters for all fans that are operated during construction; after all 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.

3.8 DAMPERS

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.

3.9 INSTALLATION OF DUCTWORK

A. 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.

B. Duct Joints: Install duct sealers, pop rivets or sheet metal screws at each fitting and joint. Duct sealer shall be fire retardant. Sheet metal screw for joints shall be minimum #10 size galvanized.

C. Applicable Leakage Classes:

<table>
<thead>
<tr>
<th>Pressure Class</th>
<th>Round Duct</th>
<th>Rectangular Duct</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot;W.G. or less</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>4&quot;W.G. or greater</td>
<td>3</td>
<td>6</td>
</tr>
</tbody>
</table>

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. 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.

H. 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.

I. 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. Make bends to maintain R/W-1.5.
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.

3.10 DUCTWORK SEALING AND LEAK TESTING

A. Retrofit Construction, including alterations to existing duct system or space conditioning equipment: All duct systems (supply, return, outside air intake and exhaust), except those exposed in the conditioned space, shall be sealed and leak tested in strict conformance with the requirements of the 2013 California Building Energy Efficiency Standards. See drawings for extent of this work and leakage rate requirements. The leakage rate shall be confirmed through field verification and diagnostic testing in accordance with the procedures set forth in the 2013 California Building Energy Efficiency Standards Reference Appendices. Contractor shall also complete the Acceptance Requirements in the standards for duct sealing/leak testing. Refer to Section 23 00 50 for additional information on Acceptance Requirements.

3.11 TEMPERATURE CONTROL SYSTEM

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.

3.12 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.

3.13 TESTING AND BALANCING

A. For testing and balancing requirements, refer to Section 23 05 93, Testing and Balancing for HVAC.

3.14 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.

3.15 DUCT CLEANING

A. Clean all existing duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.
   1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer.
   2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
   3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:
   1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
   2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:
   1. Air outlets and inlets (registers, grilles, and diffusers).
   2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
   3. Coils and related components.
   4. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
   5. Supply-air ducts, dampers, actuators, and turning vanes.
   6. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:
   1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
   2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
   3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
   4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
   5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
   6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.16 ACCEPTANCE REQUIREMENTS

A. In addition to the testing and balancing requirements specified in Section 23 05 93, the Contractor shall also be responsible to complete the Acceptance Requirements of the 2013 California Building Energy Efficiency Standards. Refer to Section 23 00 50 for additional information on Acceptance Requirements.

3.17 EQUIPMENT MOUNTING

A. Mount and anchor equipment in strict compliance with Drawings details. Alternate anchorage methods will not be considered for roof mounted equipment.

3.18 MODULATING POWER EXHAUST START UP

A. Pre Start Up

1. Once the power exhaust economizer is installed, remove the access doors on the exhaust cabinet.
   a. Route the 1/8” pressure tubing (provided with the economizer) from the high pressure port on the transmitter to the occupied building space. Terminate the pressure tubing in the conditioned space at a port (field provided) shielded from drafts.
   b. Route line voltage cable from the VFD to the disconnect or unit power distribution point as required.

2. Note
   a. Check local code requirements prior to installing the line voltage through ac package unit. A separate disconnect may be required. See power exhaust name plate for electrical ratings.

B. Start Up

1. Use the MODULATION POWER EXHAUST START-UP REPORT (included at the end of this section) to record unit information and verification of start up checks.
   a. The power exhaust will be energized when the exhaust control contacts are closed. The contacts will not be closed until the outside air dampers start to open. Once the contacts are closed the run signal at the VFD will be enabled. Motor speed will be dependent upon the building pressure signal from the pressure transmitter.

2. Check the power exhaust installation is complete, power exhaust is level and all seams are tight.
3. Check the set screws on the blower wheel hub. Be sure they are tight and the wheel does not rub the housing.
4. Check the motor and blower pulleys. Be sure they are tight and aligned.
5. Check the belt tension. Assure there is not more than 1/2” of belt deflection.
6. Check all line and low voltage connections for loose or un-connected wires.
   a. WARNING: Hazard of Electrical Shock! Capacitors in the VFD retain their charge after the power is removed. Disconnect incoming power and wait until the voltage between terminals b+ & b- is 0 vdc before servicing the drive.
7. Verify correct voltage to the disconnect before turning on power to the power exhaust.

   a. To check out the blower, temporarily disconnect the jumper from terminals 13a to 2 on the VFD terminal strip.
   b. This will place the VFD in keypad/frequency operation.
   c. Use the arrow keys on the keypad to increase the speed to 60 Hz.
   d. If the blower is rotating the wrong direction, switch the t1 & t2 motor leads at the VFD to t2 & t1.
   e. Adjust the motor sheave for the desired blower CFM output at full speed.
   f. When the blower check-out is complete, run the speed back down to 20 Hz and re-connect the jumper between terminals 13a and 2.

8. Adjust the setpoint per job requirements. The VFD will display the pressure control set point in hundredths of an inch w.g. (Example: 3.0 = .03” w.g.)

   a. Note: The initial setting at first power up will be 3.0. To adjust the set point, press the up or down arrow, pic will flash in the display then the set point will display with a dot in the upper left corner of the window. Use the up or down arrow to adjust the set point now. After 5 seconds of inactivity the VFD will revert to display mode. Use the following chart for reference.

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>INCHES WATER GAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.0</td>
<td>0.10”</td>
</tr>
<tr>
<td>9.0</td>
<td>0.09”</td>
</tr>
<tr>
<td>8.0</td>
<td>0.08”</td>
</tr>
<tr>
<td>7.0</td>
<td>0.07”</td>
</tr>
<tr>
<td>6.0</td>
<td>0.06”</td>
</tr>
<tr>
<td>5.0</td>
<td>0.05”</td>
</tr>
<tr>
<td>4.0</td>
<td>0.04”</td>
</tr>
<tr>
<td>3.0</td>
<td>0.03”</td>
</tr>
<tr>
<td>2.0</td>
<td>0.02”</td>
</tr>
<tr>
<td>1.0</td>
<td>0.01”</td>
</tr>
<tr>
<td>0.0</td>
<td>0.00”</td>
</tr>
</tbody>
</table>

   b. To see the frequency output: press mode twice, p50 will display, press the up arrow until p71 is displayed, press mode. The display now shows the frequency output. Press mode to return to the set point display.
   c. To see the transmitter output: press mode twice, p50 will display, press the up arrow until p69 is displayed, press mode. The display now shows the transmitter output signal level. 0.0=0vdc, 10.0=10vdc. Press mode to return to the set point display.
   d. For more advanced features and settings, refer to the VFD manual.
   e. Note: to change the OEM settings, parameter p48 must be set to 01 (user settings). The VFD must be in a stopped state with “---” in the display to change this parameter.

9. Notes:

   a. Power supply, provide disconnect means and circuit protection as required. See power exhaust name plate for electrical ratings. If local codes allow connecting to the HVAC unit power make sure
the disconnect and incoming wiring are sized to handle the load of both the HVAC unit and the power exhaust.

b. The exhaust contacts (ec) initiate the run/stop signal for the VFD. When the outside air dampers are fully closed the VFD is in stop mode. When the dampers start to open the VFD will go into run mode. The exhaust contacts will be either integral to the economizer controller or actuator or be a separate end switch mounted on the damper frame.

c. The VFD is factory pre-programmed to accept the 0-10 vdc signal from the differential pressure transmitter. For custom programming, first change parameter 48 to user settings. See instructions in the VFD hand book to set parameters.
d. MODULATION POWER EXHAUST START-UP REPORT

PROJECT _______________________________ UNIT TAG __________________
AC UNIT MODEL ______________________ UNIT TAG __________________
POWER EXHAUST MODEL _______________________________ _______________
POWER EXHAUST SERIAL NUMBER _______________________________
DATE ___________________ TECHNICIAN ___________________
____ POWER EXHAUST CABINET IS INSTALLED IN AC UNIT (SEAMS ARE TIGHT, POWER
EXHAUST IS LEVEL, NO GAPS)
____ ELECTRICAL CONNECTIONS ARE TIGHT
____ VERIFY BLOWER ROTATES FREELY AND WHEEL DOES NOT RUB
____ MOTOR SHEAVE, BLOWER SHEAVE AND BLOWER WHEEL SET SCREWS ARE TIGHT.
____ VERIFY PRESSURE TUBING IS RUN TO OCCUPIED SPACE
____ LOW VOLTAGE WIRING IS CONNECTED
____ LINE VOLTAGE WIRING IS CONNECTED
____ VERIFY VOLTAGE ______ L1-L2 ______ L2- L3 ______ L1-L3
______ L1-N ______ L2-N ______ L3-N
____ VERIFY BLOWER ROTATION
____ BLOWER & VFD DATA AT 60HZ ______ CFM ______ RPM
VFD ______ L1 AMPS ______ L2 AMPS ______ L3 AMPS
MOTOR ______ T1 AMPS ______ T2 AMPS ______ T3 AMPS
MOTOR ______ BHP
____ VERIFY VFD IS OPERATING IN PI MODE
____ PRESSURE SET POINT FOR OCCUPIED SPACE

SAMPLE BLOWER SET UP LABEL TO BE PLACED ON DRIVE SIDE OF BLOWER

MOTOR SHEAVE: 1VL34X.625
BLOWER SHEAVE: AK41H
BLOWER BUSHING: HX.75
BELT: A37
MOTOR SHEAVE ADJUSTMENT
2 TURNS OPEN BLOWER RPM=1167
4 TURNS OPEN BLOWER RPM=987

END OF SECTION 23 80 00
PART 1 - GENERAL

1.01 SUMMARY

A. Table of Contents, Division 26 - Electrical:

<table>
<thead>
<tr>
<th>SECTION NO.</th>
<th>SECTION TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>26 00 10</td>
<td>BASIC ELECTRICAL REQUIREMENTS</td>
</tr>
<tr>
<td>26 00 60</td>
<td>POWER SYSTEM STUDY</td>
</tr>
<tr>
<td>26 00 90</td>
<td>ELECTRICAL DEMOLITION</td>
</tr>
<tr>
<td>26 05 19</td>
<td>BUILDING WIRE AND CABLE</td>
</tr>
<tr>
<td>26 05 26</td>
<td>GROUNDING AND BONDING</td>
</tr>
<tr>
<td>26 05 29</td>
<td>ELECTRICAL HANGERS AND SUPPORTS</td>
</tr>
<tr>
<td>26 05 31</td>
<td>CONDUIT</td>
</tr>
<tr>
<td>26 05 33</td>
<td>BOXES</td>
</tr>
<tr>
<td>26 05 53</td>
<td>ELECTRICAL IDENTIFICATION</td>
</tr>
<tr>
<td>26 22 13</td>
<td>DRY TYPE TRANSFORMERS</td>
</tr>
<tr>
<td>26 24 16</td>
<td>PANELBOARDS</td>
</tr>
<tr>
<td>26 27 16</td>
<td>CABINETS AND ENCLOSURES</td>
</tr>
<tr>
<td>26 27 26</td>
<td>WIRING DEVICES</td>
</tr>
<tr>
<td>26 28 16</td>
<td>OVERCURRENT PROTECTIVE DEVICES</td>
</tr>
<tr>
<td>26 28 19</td>
<td>DISCONNECT SWITCHES</td>
</tr>
<tr>
<td>26 29 00</td>
<td>MOTOR CONTROLS</td>
</tr>
<tr>
<td>26 32 13</td>
<td>PACKAGED ENGINE GENERATOR SYSTEM</td>
</tr>
<tr>
<td>26 36 23</td>
<td>TRANSFER SWITCHES</td>
</tr>
<tr>
<td>26 51 00</td>
<td>LIGHTING</td>
</tr>
<tr>
<td>26 61 13</td>
<td>FIRE ALARM SYSTEM</td>
</tr>
</tbody>
</table>

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.
4. Coordination.
5. Record documents.
6. Operation and maintenance manuals.
7. Excavation.
8. Rough-in.
10. Cutting, patching, painting and sealing.
11. Field quality control.
12. Cleaning.

13. 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, lighting fixtures, 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 vaportight. 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. Lighting fixture supports: Provide slack fixture support wire for lighting fixtures 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. Temperature control panel(s). (Line voltage only)
6. Irrigation controller(s). (Line voltage only)
7. Electric signage.
9. Variable frequency drive units.
10. Motorized roll down/sliding doors and grills.

E. Items furnished under this Division, but installed and connected under another Division includes but is not limited to:
   1. Diesel generator day tank. (Division 22)
   2. Generator daytank fuel strainer, manual fuel pump, check valve and any other specified accessories. (Division 22)

F. 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:

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
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 NEC 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 neatly bound in an 8-1/2” x 11” folder or binder 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. 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 2013 California Building Code (CBC) and ASCE 7-05. 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 Ip=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. 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.

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) system for
submission by the Contractor. The Engineer in either Autocad Release 14 or DXF file format can provide
files of the electrical Contract Documents to the Contractor.

1. Fire alarm system, Section 266113.

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.

2. Design-Build systems approach: The Drawings do not fully represent the entire installation for the systems indicated below. The Contractor is required to complete the design for these systems as specified herein and as indicated on the Drawings. CAD Shop Drawings shall be submitted for review prior to installation:
   a. Fire alarm system: Drawings indicate the location of all control panel components, initiating devices, annunciating devices, communication system components, auxiliary equipment control and conduit between buildings. Conduits, wire and cabling between all system equipment, devices, etc. are not indicated.
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 fixture schedule listing Manufacturers and products actually 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. A set of CAD files of the electrical documents will be provided to the Contractor in either Autocad Release 14 or DXF file format.

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. Fire alarm system.

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. PDF and CAD files of Drawings.

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 utilizing the electronic files provided by the Engineer.

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 EXCAVATION

A. General: Cutting and digging shall be under the direct supervision of the General Contractor and included as necessary for the Work of this Section.
B. Excavation for underground vaults and 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 drip-line 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 side 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: Place soil materials in layers to required subgrade elevations for each area classification, using materials and methods specified in Division 31, Earthwork.

   1. Under building slabs, use drainage fill materials.

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 particular 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. 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.

8. Install systems, materials and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

9. 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.

10. Coordinate electrical systems, equipment and materials installations with other building components.

11. 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.

12. Install systems, materials and equipment giving right-of-way priority to other systems that are required to maintain a specified slope.

13. Conform to the National Electrical Contractor's 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 in 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 122 volts for 120 volt 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 month 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: At the time of completion, a period of not less than 24 hours shall be allotted by the Contractor for instruction of building operating and maintenance personnel in the use of all systems. This 24 hours training is in addition to any instruction time called out in the Specifications for specific systems, i.e., Fire Alarm, Generator, etc. 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.

B. Special tools: Provide one of each tool 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
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 evaluation study.

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.

   NFPA 70E; Electrical Safety Requirements for Employee Workplaces.

1.03 SUBMITTALS

A. Submit in accordance with the requirements of Section 26 00 10: 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. Tabulations of arc flash evaluation study results and commentary regarding results.

g. Sample arc flash warning label.

3. Contractor shall also provide an electronic copy of the report as part of the Record Document process.

B. The study shall be submitted to the Engineer 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 208 VAC 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, automatic 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 the largest rated device in the 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, including the ground fault system 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. 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 Engineer's attention.

3.04 ARC FLASH EVALUATION STUDY

A. An arc flash evaluation study shall be performed to identify the shock hazard and appropriate personnel protective equipment (PPE) required at each switchboard, distribution board, panelboard, etc. in accordance with the referenced standards.

B. The arc flash evaluation study shall include all voltage classes of equipment from the service entrance down to and including the panelboards.

C. The company performing the arc flash evaluation study shall provide arc flash and shock hazard warning labels for all equipment evaluated. Labeling shall be as follows:

1. Label type:
   a. 4" x 6" for Hazard Class 1 or less.
   b. 5" x 7" for Hazard Class greater than 1.
   c. White vinyl or polyester with orange warning symbol and black text.
   d. Industrial grade self-adhesive backing.
   e. Printed information shall be from the evaluation study results.
   f. Labeling shall be by Created with Brady “PowerMark” Sign, Label Maker or approved equal.
2. Hazard Class 1 label information:
   a. Equipment name.
   b. Available short circuit current.
   c. Flash protection boundary.
   d. Incident energy at 18 inches expressed in cal/cm².
   e. PPE required.

3. Hazard Class greater than 1 label information:
   a. Equipment name.
   b. Available short circuit current.
   c. Flash protection boundary.
   d. Incident energy at 18 inches expressed in cal/cm².
   e. PPE required.
   f. Voltage shock hazard.
   g. Limited shock approach boundary.
   h. Restricted shock approach boundary.
   i. Prohibited shock approach boundary.

D. Labels shall be affixed to all equipment covered under the evaluation study.

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
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. Selective Electrical demolition

1.02 SYSTEM DESCRIPTION

A. Disconnection, removal and relocation of all wiring, light fixtures, 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, light fixtures, 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, fixtures, 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 lighting fixtures, 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 LIGHT FIXTURES
   A. Disconnect and remove abandoned light fixtures. 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. Removed 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.
   
   B. Fire alarm system: Maintain the existing system in service. Disable system only to make temporary connections to maintain service in areas adjacent to Work area(s). Notify Owner and Fire Supervisory Service at least 24 hours before partially or completely disabling the system.
   
   C. Telephone system: Maintain the existing system in service throughout construction. Disable system only to make temporary connections where necessary to maintain service in areas adjacent to Work area(s). Notify Owner and Telephone Utility at least 24 work week hours before partially or completely disabling the system.

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. Luminaries: 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
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. 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. Federal Specifications (FS):
   
   FS J-C-30A; Cable and Wire, Electrical (Power, Fixed Installation).
   
   FS W-S-610C; Splice Conductor.
   
   FS HH-I-595C; Insulation Tape, Electrical, Pressure-Sensitive Adhesive, Plastic.

2. Underwriters Laboratories, Inc. (UL):

   UL 44; Thermoset-Insulated Wires and Cables.
   
   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.
3. National Electrical Manufacturer Association (NEMA):

   NEMA WC-5; Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

   NEMA WC-7; Cross-Linked Thermosetting Polyethylene Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

4. Institute of Electrical and Electronic Engineers (IEEE):

   IEEE 82; Test Procedure for Impulse Voltage Tests on Insulated Conductors.

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. 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. Copper wire AWG #8 and larger shall be stranded, unless otherwise indicated.
   3. Copper wire AWG #10 and smaller may be solid or stranded as best suited for the installation.

B. Insulation material:
   1. All insulated wire, conductor and cable shall be 600 volt rated unless otherwise noted on the Drawings.
   2. Thermoplastic-insulated building wire: NEMA WC 5.
   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. Service Entrance: Type RHW or THWN.
   7. Control Circuits: Type THW or dual rated THHN/THWN.
   8. Identify system conductors as to voltage and phase connections by means of color-impregnated insulation.

2.03 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-stripping pigtail and tap U-contact connectors shall not be used.
C. Push-in wire connectors:
   1. Multi-port push-in wire connectors for a maximum of 8-wires, as required for specific application. Connectors are manufactured to accommodate a wide range of sizes with either solid or stranded conductors, up to a maximum wire size of #10 AWG. Low insertion force required for ease of installation.
   2. Housing shall be 105 degrees C and transparent for visual connection verification.
   3. 600 volt maximum rating with copper contacts.
   4. UL Listed to 486C and UL 467 Listed for grounding and bonding applications.

D. 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.

E. Splicing and insulating tape: Provide black, ultraviolet proof, self-extinguishing, 7 mil thick vinyl general purpose electrical tape with a dielectric strength of 10,000 volts suitable for temperatures from minus 18 degrees C to 105 degrees C. Federal Spec. HH-I-595, Scotch 33+ or equal minimum.

F. 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 570-volts/mil minimum.

G. 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.

H. 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 particular system.

I. 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.

J. 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.

K. 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.

L. 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 - 125 amps
      b. 5/16" bolt - 175 amps
      c. 3/8" bolt - 225 amps
      d. 1/2" bolt - 300 amps
      e. 5/8" bolt - 375 amps
      f. 3/4" bolt - 450 amps

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. 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.

E. Color coding:
   1. For 120/208 volt, 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 277/480 volt, 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. 20 amp power and lighting branch circuit containing no more than four (4) current carrying conductors (phases and neutrals). Use #10 AWG conductor for 120/208 volt circuits located outside a 75 foot radius of panel source and for 277 volt branch circuits located outside a 200 foot radius of panel source, unless otherwise noted.
F. 20 amp power and lighting branch circuits containing no more than eight (8) current carrying conductors (phases and neutrals). Use #10 AWG conductors for 120/208 volt circuits located outside a 65 foot radius of panel source and for 277/480 volt circuits located outside a 150 foot radius of panel source.

G. Provide #10 AWG pig tails on all 20A and 30A 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 NEC 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, 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 Manufacturer's published installation instructions.

3.04 WIRING INSTALLATION IN RACEWAYS

A. Install wire in raceway 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 AWG #1.

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.

F. Install and test all cables in accordance with Manufacturer's instructions and warranty.
3.05 WIRE SPLICES, JOINTS AND TERMINATION

A. Join and terminate wire, conductors and cables in accordance with UL 486A, C, NEC 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 additional 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, pullboxes 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 six (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, 600 volt, 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 Manufacturer’s packaging shall be strictly complied with.

L. Feeder circuits: (#6 to 750 MCM)

1. Join or tap conductors from #6 AWG to 750 MCM 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 MCM 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 MCM 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 recommendation 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.
   e. 5/8" - 11 bolt at 55-foot pounds torque.
   f. 3/4" - 10 bolt at 158-foot pounds torque.

3.06 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.

D. Provide all terminal strips with each individual terminal identified using specified vinyl markers.

E. In manholes, pullboxes and handholes, provide tags of the embossed brass type and also show the cable type and voltage rating. Attach the tags to the cables with slip-free plastic cable lacing units.

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 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:
      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, make an inspection 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 100 amp rated and above.

2) 50% of all feeders smaller than 100 amps.

3) 10% of all branch circuits at each individual panelboard.

b. Perform insulation-resistance test using megohm meter with applied potential of 1000V 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
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.
4. Safety ground grid and/or mat.

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. Division 05: Building Steel.
2. 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.

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. Provide a safety ground grid and/or mat beneath emergency generator. Grid/mat shall be poured in the concrete floor slab and constructed as specified herein.

D. Except as otherwise indicated, the complete electrical installation including the neutral conductor, metallic conduits and raceways, 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.
E. 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 NEC/CEC.

C. Bare conductors in direct contact with earth or encased in concrete: #2/0 AWG copper minimum, U.O.N.

D. Bonding pigtail: 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 NEC/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 SAFETY GROUND GRID AND/OR MAT

A. Provide prefabricated or field constructed wire mesh consisting of #6 AWG bare copper conductors forming a 24” x 24” grid. Prefabricated wire mesh shall be constructed with silver brazing at all cross intersections. Field constructed wire mesh shall utilize either exothermic welds or high pressure compression connectors at all cross intersections.

B. Provide #1/0 AWG bare copper conductor installed in the center of grid and run parallel the length of the mesh, leaving 8 foot pigtales at both ends for bonding with generator.
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. Supplementary grounding electrode (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 #4 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 NEC/CEC Article 250, whichever is greater.

C. Separately derived electrical system grounding:

1. Ground each separately derived system per requirements in NEC/CEC Article 250 as a minimum, unless greater requirements are required elsewhere in the Contract Documents.

2. Transformers: Provide a dual rated four or six-barrel grounding lug with a 5/8"-11 threaded hole. Drill enclosure with 11/16" bit and attach lug to enclosure utilizing a torque bolt and a dragon tooth transition washer or equal. Connect the following when present:

   a. Grounding electrode conductor from supplemental ground rods.
   b. Building steel.
   c. Cold water pipe.
   d. Primary feeder ground.
   e. Secondary feeder ground.
   f. Main bond jumper.
   g. Isolated ground conductor.

D. Equipment bonding/grounding:

1. Provide a NEC/CEC sized insulated copper ground conductor in all 120VAC through 600 VAC 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 35 volts 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.

6. Provide external ground wire wrapped around flexible conduit and terminate to connectors designed for the purpose.

E. Site lighting grounding: Bond all metallic light poles and bollards. Provide ground rods where indicated on the Drawings.

F. Generators:

1. Provide a safety grid and/or mat encased in the middle of the concrete pad or floor beneath the equipment with bare copper conductor pigtails extending up through slab at both ends of switchgear/equipment, within footprint of gear.

2. The grid/mat shall extend a minimum of 48" beyond the footprint of the equipment on both ends and at the back side of switchgear.

3. The grid/mat shall extend a minimum of 72" beyond the footprint on the equipment on the front side of switchgear.

4. Terminate the safety grid/mat #1/0 AWG bare copper conductor pigtails to the electrical equipment ground bus within sections at each end of equipment lineup.

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.
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. Division 03: Cast-in-place concrete. Concrete equipment pads.
2. Division 05: Miscellaneous metals. Hangers for electrical equipment.
3. Division 09: Ceiling suspension systems. Slack fixture 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 1-1/2 inch by 1-1/2 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
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. Rigid non-metallic conduit and fittings.
6. Flexible metallic conduit and fittings.
7. Liquidtight flexible metallic conduit and fittings.
8. 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. Division 01: Cutting and patching.
2. Division 31: Earthwork. Excavation and backfill for conduit and utilities on Project site.
4. Division 07: Sheet metal flashing and trim.

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 WW-C-563; Electrical Metallic Tubing.
   FS WW-C-566; Specification for Flexible Metal Conduit.
   FS WW-C-581; Specification for Galvanized Rigid Conduit.
   FS W-C-1094A; Conduit and Conduit Fittings Plastic, Rigid.
2. American National Standards Institute, Inc. (ANSI):
   ANSI C80.1; Rigid Steel Conduit, Zinc-Coated.
ANSI C80.3; Electrical Metallic Tubing, Zinc Coated.

3. 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 651; Schedule 40 and 80 Rigid PVC Conduit.
   UL 797; Electrical Metallic Tubing - Steel.
   UL 1242; Intermediate Metal Conduit - Steel.

4. 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.

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. Occidental Coating Co. (OCAL).
   f. Alflex Corp.
   g. American Flexible Metal Conduit Co.
   h. Anaconda.

2. Nonmetallic conduit:
   a. Prime Conduit.
   b. JM Eagle.
   c. Cantex.

3. Fittings:
   a. Appleton Electric Co.
   b. OZ/Gedney.
   c. Thomas & Betts Corp.
   d. Spring City Electrical Manufacturing Co.
   e. Occidental Coating Co. (OCAL).
   f. Carlon.

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.

C. Three piece couplings: Electroplated, 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 NEC 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: Electroplated, steel or cast malleable iron, 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: Electroplated steel or cast malleable iron 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: Electroplate steel or cast malleable iron; UL listed raintight and concrete tight, using gland and ring compression type construction.

E. Raintight connectors: Electroplated steel or cast malleable iron, UL listed raintight and concrete tight, with insulated throat, using gland and ring compression type construction.

2.06 RIGID NON-METALLIC CONDUIT (PVC)

A. Conduit:

1. Rigid polyvinyl chloride, Schedule 40 or 80 conforming to NEMA TC1 and UL 651, latest edition. 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. Fittings: Couplings, adaptors, transition fittings, etc., shall be molded PVC, slip on, solvent weld type conforming to NEMA TC3 for Schedule 40 or 80.

2.07 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 fixture connection in suspended ceilings and cut-in outlet boxes within existing furred walls.
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.

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 .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) shall 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 NEC and local Codes.

2. For feeders and branch circuits concealed in concrete floors and walls when not in contact with earth.

B. PVC insulated galvanized rigid steel conduit shall 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): Shall be used for the same application as galvanized rigid steel conduit as specified herein, except for hazardous locations prohibited by CEC, NEC or Local Codes.

D. Electrical metallic tubing (EMT): Shall 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 6 feet above the finish floor except within electrical, communication or signal rooms or closets.

E. Rigid non-metallic conduit (PVC): Shall be used in the following applications:

1. Schedule 40 or 80 for feeders and branch circuits run beneath ground floor slab except that bends and penetrations through the floor must be PVC coated galvanized rigid steel.

2. Schedule 40 or 80 for exterior branch circuits directly buried in earth, 18" minimum below grade. PVC may be used below exterior slabs not subject to vehicular traffic.

3. PVC may be used below exterior slab subjects to vehicular traffic when encased in a minimum of 2 inches of concrete.

4. Only schedule 80 PVC may be used for above ground conduit extensions on utility poles.

5. PVC elbows shall be radius sweep type schedule 40 for bends 45° or less and large radius sweep type schedule 80 for bends 46° or greater.

6. In general, PVC may not be run exposed in concrete walls or in floor slabs unless expressly indicated on the Drawings.
F. Flexible metallic conduit (FMC): Shall 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 lighting fixtures installed in suspended ceilings, minimum sizes shall be 3/8" for lighting fixtures and control wiring and 1/2" for motor and transformer connections.

G. Liquidtight flexible metallic conduit (LFMC): Shall 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. Minimum sizes shall be 1/2".

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. 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.

F. 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.

G. 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.

H. 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.

I. Connect recessed lighting fixtures 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 1/2" for interior applications and 3/4" for exterior and underground applications.

C. 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.
D. In general, all conduit work shall be concealed where possible. Exceptions shall be electrical, communication and mechanical rooms, exposed ceiling areas, and parking garages.

E. Conduit connections to motors and surface cabinets shall be concealed, with the exception of electrical, communication and mechanical rooms, or unless exposed Work is clearly called for on the Drawings.

F. Install conduits in complete runs before pulling in cables or wires.

G. Install conduit free from dented, bruises or deformations. Remove and replace any damaged conduits with new undamaged material.

H. Conduits shall be well protected and tightly covered during construction using metallic bushings and bushing "pennies" to seal open ends.

I. 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.

J. Clean any conduit in which moisture or any foreign matter has collected before pulling in conductors. Paint all field-threaded joints to prevent corrosion.

K. 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.

L. 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.

M. Metallic conduit shall not be in contact with other dissimilar metal pipes (i.e. plumbing).

N. 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.

O. A run of conduit between terminations at wire pulling points shall not contain more than the equivalent of four quarter bends (360 degrees, total).

P. Emergency power raceway system: Install entirely independent of other raceway systems, except where specifically allowed by NEC 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 UNDERGROUND INSTALLATION

A. Perform trenching, backfilling and compaction operations as specified in Division 31: Trenching.

B. Install service utility company underground conduits in strict conformance to each utility company’s requirements. Obtain a copy of each utility company’s installation guidelines prior to commencing Work.

C. Tops of conduits shall be as follows unless otherwise noted:

D. Not less than 18 inches below finished grade.

E. Not less than 24 inches below roadways, paved parking lots, driveways or any surface subject to vehicular traffic.

F. Not less than 4 inches below building floor slab for branch circuits. Major feeders and large signal conduits (2” and greater) at not less than 18 inches.

G. Depth of service utility conduits shall conform to utility company requirements.

H. Furnish and install specified underground conduit marker 12” above conduits in trenches with all buried conduits.

3.08 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. 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 copper green ground-bonding jumper installed. For concrete embedded conduit, use expansion and deflection couplings as specified above for three inches and larger conduits.

H. 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.

3.09 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 lighting fixtures, switches, receptacles and as required by the NEC.

3.10 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 NEC.

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 ⅜ inch bolt size and not less than 1-1/8 inch 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
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. 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. Raco, Inc.

2. Cast boxes:
   a. Appleton Electric Co.
   b. Crouse-Hinds.

3. Floor boxes:
   a. Hubbell Inc.
   b. Walker.
   c. Raceway Components, Inc.

4. Pullboxes:
   a. Circle AW Products.

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, knockout type box of size and configuration best suited to the application indicated on the Drawings.

2. 4-inch square by 1-1/2 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 four 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 Cadmium plated cast iron alloy, 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. **Cast metal pull and junction box:** Provide standard cast malleable iron outlet or device boxes wherever possible; otherwise use cadmium plated, cast malleable iron boxes with bolt-on, interchangeable conduit hub plates with neoprene gaskets.

C. **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 lighting fixtures.

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. Provide precast concrete boxes in exterior planting areas, walkways, roads etc.

H. Provide an access panel in permanent ceiling or wall where boxes are installed and will be inaccessible.

I. For boxes mounted in exterior walls, make sure that there is insulation behind outlet boxes to prevent condensation in boxes.

J. 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.

K. 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.

L. Add additional sheet rock as necessary to maintain original fire rating of walls where boxes are installed.

M. 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 lighting fixtures are to be installed from the box.

E. Support boxes, mounted above suspended acoustical tile ceilings, directly from the structure above.

END OF SECTION
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.
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. 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).

2.06 WIRE AND TERMINAL MARKERS

A. Provide self-adhering, pre-printed, machine printable or write-on, self-laminating vinyl wrap around strips. 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) Power source:
            a) Normal - __
            b) Emergency – E
            c) UPS – U
         2) Equipment description:
            a) Main switchboard – MS
            b) 277/480 volt distribution board – HD
            c) 277/480 volt panelboard – H
            d) 120/208 volt distribution board – LD
e) 120/208 volt panelboard – L
f) Transformer – TX

3) Floor number where equipment is located – 3
4) Equipment designation – B

b. Example: EHD2A
   1) Emergency source.
   2) 277/480 volt distribution board.
   3) 2nd floor.
   4) 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: EHD2A; 1200A; 277/480V, 3PH, 4W; Served from: ATS1A
   b. Transformers: ETX2A; 150KVA; 480V pri. - 120/208V, 3PH, 4W sec.; Served from: 06EHD2A; Load Served: 06EL2A
   c. Disconnects or Individual Motor Starters: EF-1; 20HP; 480V,3PH,3W; Served from MCC1A
   d. Signal: STB3C; Public Address System; Served from STB2C

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 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 1/2 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 (400 AMP 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 NEC, where indicated or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.
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 ½" below the top edge of the coverplate.
   4. Inscription shall be centered and square with coverplate.

B. Application:
   1. Provide inscribed coverplates for devices as outlined below:
      a. Receptacles.
      b. Outlets in surface raceways.
      c. Multi-ganged (four or more) switch arrangement.
      d. Special purpose switches, i.e. projection screens, shades, exhaust fans, etc.
   2. Type-on-tape inscriptions shall be provided for the following devices:
      a. Receptacles.
   3. Engraved inscriptions shall be provided for the following devices:
      a. Special purpose switches.
   4. 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
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.


2. 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.

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. Furnish structural calculations for equipment anchorage as described in Section 260010: Basic Electrical Requirements.

5. Submit Manufacturer's installation instructions.

6. Final test results.

7. 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.

2. General Electric.
3. Siemens/I-T-E.
4. Square D.

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: 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 1/2 percent full capacity taps above normal (FCAN) and four 2 1/2 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; 0 db
   b. 10 to 50 kVA; 45 db
   c. 51 to 150 kVA; 50 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. Three phase transformers:

      1) 15 kVA: 6.4Z
      2) 25 kVA: 5.8Z
      3) 30 kVA: 5.2Z
F. Basic impulse level (BIL): 10 kV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.

G. Energy efficiency: Transformers rated 15 kVA and larger shall be energy efficient designs and NEMA TP-1 compliant. The energy efficient transformers shall be specifically designed to meet the energy efficiency standards set forth in NEMA Standards publication, TP-1, 2002.

H. Grounding: Ground core and coil assembly to enclosure by means of a visible flexible copper strap.

I. Enclosures:


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, convection air-cooled, dry type transformers with NEMA Type 1 enclosure unless otherwise noted.

2. Transformers shall have been tested to UL standards and constructed to NEMA standards.

B. Insulation:

1. Insulation system and average winding temperature rise for kVA as follows unless otherwise indicated:

<table>
<thead>
<tr>
<th>KVA RATING</th>
<th>CLASS H</th>
<th>RISE IN DEGREES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 15</td>
<td>220c</td>
<td>115c</td>
</tr>
<tr>
<td>16 - 500</td>
<td>220c</td>
<td>115c</td>
</tr>
</tbody>
</table>

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 liquidtight 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 transformer with a dual rated four-barrel solderless grounding lug with a 5/8"-11 threaded hole. Drill transformer enclosure with 11/16" bit and attach lug to enclosure utilizing a torque bolt and Dragon Tooth transition washer. Connect the following:

1. Primary feeder ground.
2. Secondary feeder ground.
3. Grounding electrode.
4. Main bond jumper to neutral (when present).

3.06 IDENTIFICATION

A. Provide transformer nameplate as described in Section 260533: 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. Calculate polarization index.
      c. Perform power-factor or dissipation-factor tests in accordance with test equipment Manufacturer's instructions.
      d. Perform turn-ratio test on tap connections. Verify winding polarities are in accordance with nameplate.
      e. Perform an excitation-current test on each phase.
      f. Measure resistance of each winding at each tap.
      g. Verify core is solidly grounded. If core is insulated and removable core ground strap is available, perform core insulation-resistance test at 500V DC.
      h. Verify correct secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.
      i. Perform over-potential test on all high and low voltage windings-to-ground.
   
   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 1000 VDC.

c. Polarization index should be compared to Manufacturer’s factory test results. If Manufacturer’s data is not available, acceptance test results will serve as baseline data.

d. Turn-ratio test results should not deviate more than 0.5% from either adjacent coils or calculated ratio.

e. Dissipation-factor/power-factor values should be 5% or less.

f. If winding-resistance test results vary more than 1% from adjacent windings, consult Manufacturer.

g. Typical excitation current test data pattern for three-legged core transformer is two similar current readings and one lower current reading.

h. If core insulation resistance is less than one megohm at 500 VDC, consult Manufacturer.

i. AC over-potential test shall not exceed 75% of factory test voltage for one minute duration. DC over-potential test shall not exceed 100% of factory RMS test voltage for one minute duration. Insulation shall withstand over-potential test voltage applied.

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
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 (400 amps to 800 amps).

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-375; Circuit Breakers, Molded Case, Branch Circuit and Service.
   FS W-P-115; Power Distribution Panel.

2. National Electrical Manufacturers Association (NEMA):
   NEMA AB 1; Molded Case Circuit Breakers.
   NEMA PB 1; Panelboards.
   NEMA PB 1.1; Instructions for safety instruction, operation and maintenance of panelboard rated 600 volts or less.

3. 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 260010: 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.
   2. General Electric.
   3. Siemens/I-T-E.
   4. Square D.
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.
   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 120/208 volt panelboards and 25,000 AIC for 277/480 volt panelboards. Unless otherwise noted.
7. Provide full sized bussing in all sections of multi-section panelboards.
8. No panelboard section shall have greater than 42 poles.
10. 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, i.e. Section 1 (circuit numbers 1-42), Section 2 (circuit numbers 43-84), Section 3 (circuit numbers 85-126). 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 262816: 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 handle ties for single pole circuit breakers that share a neutral conductor.
F. 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 PS 1 and FS W-P-115.

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 and FS W-P-115.

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 100-ampere branch circuit cross connectors and mounting hardware. For future device spaces larger than 100 amps, 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.

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. Visually inspect panelboard for rust and corrosion. If signs of rust and corrosion are present, restore or replace panelboard to new condition.

K. In damp and wet locations, mount panelboards with a minimum one inch of air space between cabinet and the wall or other support material.

L. Provide close up plugs in all unused openings in the cabinet.

M. Field install handle ties on single pole circuit breakers that share a neutral conductor.

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: 1000 volt DC tests for one minute on all 600 volt 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
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. Hinged cover enclosures.
2. Cabinets.

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 Manufacturer's 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 (UL):
   UL 50; Enclosures for Electrical Equipment.
   UL 65; Standards for Wired Cabinets.
   UL 1059; Terminal Blocks.
   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. Describe Project construction, material, finish and any specific features of each component.

3. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.

4. Submit Manufacturer's installation instructions.
5. Furnish structural calculations for equipment anchorage as described in Section 260010: Basic Electrical Requirements.

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.


2. Circle AW Products.

B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

2.02 CABINETS AND ENCLOSURES

A. Construction: Shall be code gauge galvanized steel with standard concentric knockouts for conduit terminations. Size shall be as indicated on Drawings. Cabinet shall be NEMA 250 Type 1 or 3R.

B. Finish: Manufacturer's standard gray baked enamel finish.

C. Covers: Continuous hinged steel door, lockable and keyed to match panelboard locks.

D. Mounting:

1. Flush cabinets shall be furnished with concealed trim clamps and shall be not less than 4 inches deep.

2. Surface cabinets shall be furnished with screw cover trim, flush hinged door and shall not be less than 6 inches deep.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Contractor shall thoroughly examine Project site conditions for acceptance of cabinets and enclosures installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.02 INSTALLATION

A. Set cabinets and enclosures plumb and symmetrical with building lines. Furnish and install all construction channel bolts, angles, etc. required to mount all equipment furnished under this Section of the Specifications.

B. Cabinets and enclosures shall be anchored and braced to withstand seismic forces calculated in accordance with that referenced in Section 260010: Basic Electrical Requirement.

C. "Train" interior wiring, bundle and clamp using specified plastic wire wraps.
D. Replace doors or trim exhibiting dents, bends, warps or poor fit that may impede ready access, security or integrity.

E. Terminate conduit in cabinet with lock nut and grounding bushing.

F. Terminate wiring on terminal blocks and identify each with heat shrink tags.

3.03 CLEANING

A. Touch-up paint any marks, blemishes or other finish damage suffered during installation.

B. Vacuum clean cabinet on completion of installation.

END OF SECTION
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. Wall dimmer switches.
3. Occupancy sensor 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.

1.02 REFERENCES

A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified.

1. Federal Specification (FS):
   - FS W-P-455A; Plate, Wall Electrical.
   - FS W-C-596; Electrical Power Connector, Plug, Receptacle and Cable Outlet.
   - FS W-S-896; Switch, Toggle.

2. National Electrical Manufacturer's Association (NEMA):
   - NEMA WD-1; General-Purpose Wiring Devices.
   - NEMA WD-5; Specific-Purpose Wiring Devices.

3. 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.
AC Transit

WIRING DEVICES

D3 Richmond Yard Reactivation P2095

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 one 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. Hubbell.

   b. Pass & Seymour.

   c. Leviton.

2. Wall dimmer switches:

   a. Lutron NOVA 'T' Vareo style.

3. Occupancy sensors switches:

   a. Cooper Controls “Greengate”

   b. WattStopper
c. Leviton

d. SensorSwitch, Inc.

e. Hubbell Building Automation, Inc.

4. Floor mounted service boxes:
    a. Hubbell.
    b. Walker.

B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

2.02 WALL SWITCHES

A. Standards: Provide general-purpose 120/277 VAC switches that conform to NEMA WD-1 Specifications.

B. Color: Device color shall be white, unless otherwise noted.

C. Wall switches:
   1. Provide twenty ampere, 120/277 volt, Specification grade, toggle handle style, 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. Double pole, single throw switches: Hubbell #1222 series, Pass & Seymour #20AC2 series or Leviton #1222 series.
   4. Three way switches: Hubbell #1223 series, Pass & Seymour #20AC3 series or Leviton #1223 series.

2.03 WALL DIMMER SWITCHES

A. Standards: Provide dimmer switches 120 VAC that conforms to NEMA WD-2 and UL 20.

B. Color: Device color shall be white, unless otherwise noted.

C. Dimmers:
   1. Linear slide type dimmer with smooth and continuous square law dimming curve.
   2. Separate control of intensity and on/off.
   3. Dimmers shall have power failure memory to bring lights back on at same level prior to power interruption.
   4. Dimmers shall incorporate air-gap switch accessible by removing coverplate.
   5. Furnish dimmer switches in ratings of 600 watts, 1000 watts and 1500 watts to accommodate lighting loads indicated connected to each switch on Drawings. Incorporate Manufacturer’s derating where dimmers are ganged together.
6. Where dimmers are indicated ganged with non-dimmed lighting switches provide Lutron ‘Tapswitch’ series switch for up to 1000 watt load. Provide 277 VAC relays (as recommended by Manufacturer) to interface 120 VAC switches to switch 277 VAC loads.

7. Provide switches with single and multi-gang coverplate of high impact ABS plastic. Coverplate shall be snap-on type with no visible attachments or fins.

2.04 OCCUPANCY SENSOR SWITCHES

A. 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. Occupancy sensors shall be dual-technology type infrared/ultrasonic as specified herein with voltage and wattage rating equal to the lights being controlled.
   3. All sensors shall have an adjustable time delay for turning off lights and a sensitivity adjustment.
   4. Ceiling mounted sensors shall operate on low voltage as supplied by control unit. Control unit shall contain power supply and relays for switching loads.
   5. Units shall be furnished to cover the areas being controlled. No allowance shall be given for providing sensors improperly sized for the square footage of the controlled area.

B. Color: Device color shall be white, unless otherwise noted.

C. Wall mounted single level control sensors:
   1. Sensor shall be dual-technology infrared/ultrasonic type with single level switching capability and coverage up to 900 square feet.
   2. Operation shall be manual “ON” and manual or automatic ”OFF”.
   3. Time delay adjustment from 30 seconds to 30 minutes. Set adjustment at 4 minutes.
   4. Load capacity of 0 to 1800 watts at connected voltage.
   5. For use in small utility closets where dual level switching is not indicated.

D. Wall mounted dual level control sensors:
   1. Sensor shall be dual-technology infrared/ultrasonic type with dual level switching capability and coverage up to 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 30 minutes. Set adjustment at 10 minutes. Set sensitivity adjustment at maximum.
   4. Load capacity of 50 to 1000 watts at connected voltages.
   5. Integral photocell, 2 circuit, compatible with electronic bi-level switching ballast. Provide with ambient light control adjustment.
   6. For use in offices where dual level switching is indicated.
E. Ceiling mounted single-directional sensors:
   1. Sensor shall be dual-technology infrared/ultrasonic type single-directional with coverage up to 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 30 minutes. Set adjustment at 10 minutes. Set sensitivity adjustment at maximum.
   4. Load capacity of 20 amps per power or slave pack at connected voltage.
   5. Power pack consisting of Class 2, 24V 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 areas.

F. Ceiling mounted omnidirectional sensors:
   1. Sensor shall be dual-technology infrared/ultrasonic type omnidirectional with coverage up to 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 15 minutes. Set adjustment at 10 minutes. Set sensitivity adjustment at maximum.
   4. Load capacity of 15 amps per power or slave pack at connected voltage.
   5. Power pack consisting of Class 2, 24V output transformer and relay in single housing, capable of powering up to 2 sensors and mounted inside standard 4-inch square box.

2.05 RECEPTACLES

A. Standards:
   1. Provide general purpose 20 ampere, 125/250 VAC 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, 20 amp, 125 VAC, 2 pole, 3 wire grounding type receptacles.
   3. Receptacles shall be the standard conventional style device.

B. Color:
   1. Device color shall be white, 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 20 amp, 125 VAC, 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.

F. 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. Poke-through floor fitting:
1. Flush style fire rated poke-through device for installation in a 4" cured hole through a concrete floor. Provide with finish ring housing, receptacle, cable access, box, etc. or any other accessories to facilitate the installation indicated on Drawings.
2. Use raceway components #RC4 series for flush installations.

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 style, throughout the Project unless otherwise specified.

B. Color: Coverplate color shall be white, 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. Non-public areas:
   a. Provide horizontal mounted, weatherproof in-use coverplate for one duplex or one GFCI receptacle. Provide gasketed, spring loaded, vertically self-closing covers suitable for use in damp and wet locations as described in UL 514 and NEC 406. Covers shall allow the use of the device with the cover closed.
   b. Furnish base plates, covers, hinge pins, spring and screws of corrosion resistant type 302 stainless steel.
2. Public area receptacles:
   a. Provide horizontal mounted weatherproof in-use coverplate for one duplex or one GFCI receptacle. Provide gasketed, spring loaded, lockable, vertically self-closing covers suitable for use in damp and wet locations as described in UL 514 and NEC 406. Covers shall allow the use of the device with the cover closed.
   b. Furnish base plates, covers, hinge pins, spring and screws of corrosion resistant type 302 stainless steel.
   c. Provide two (2) keys for each locking type coverplate.

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 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.
   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 maintenance/service areas.

3.04 OCCUPANCY SENSOR SWITCHES

A. Set time delays in sensors in accordance with Owner's directions.

B. Where substituted occupancy sensors are used, it shall be the responsibility of the Contractor to place sensors in the proper place and with proper alignment to cover to all the area intended in the Contract Documents.

C. Provide one power pack with each ceiling mounted occupancy sensor, whether indicated or not on plans, unless wiring details or plans indicate otherwise.

D. Where Drawings indicate ceiling mounted slave units, provide 3 #14 in 1/2" conduit from power pack to slave unit and connect so that input from either master or slave sensor will turn lights on.

E. 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 and Structural Engineer.

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. 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
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.  

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 Specification (FS):  
FS W-C-375; Circuit Breakers, Molded Case, Branch Circuit and Service.

2. 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.

3. 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. Submit Manufacturer's installation instructions.
7. Complete bill of material listing all components.
8. 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:
   b. General Electric.
   c. Siemens/I-T-E.
   d. Square D.

B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

2.02 FUSES

A. General: All power fuses shall be time-delay, high interrupting (300 K 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 ratios. Types of fuses shall be as follows:

   1. 0 - 600 amperes: 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.

   2. Motor branch circuit fuses (0-600 amperes): UL Class J dual element, time delay type fuse. Motor branch circuit fuses shall be sized for Type 2 coordination for the motor controller and back-up motor overload protection and shall be coordinated with motor starter overload relay heaters. See Section 262900: Motor Controls.

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.

C. Fuses for installation in current limiting circuit breakers or motor circuit protectors shall meet the specific requirements of the Manufacturers of that equipment to ensure compatibility.

2.03 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 25,000 RMS symmetrical amps for 480 volt systems and 10,000 RMS symmetrical amps for 208 volt 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. 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.

G. All terminals shall be rated for aluminum or copper wire.
H. Circuit breakers with trip ratings 100 amp 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 100 amps shall be installed in distribution type panels.

I. Circuit breakers with trip ratings 101 amps through 400 amps 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.

J. Circuit breakers with trip ratings 401 amps through 1200 amps shall have electronic trips with the following characteristics:
   1. Electronic true RMS sensing trip, adjustable via current plug.
   2. Adjustable long time setting and delay.
   3. Adjustable short time pick-up and delay.
   4. Adjustable instantaneous pick-up.
   5. Mechanical targets on overload, ground fault and short circuit.

K. Accessories: Provide accessories as noted on the Drawings, i.e. shunt-trip, auxiliary contacts, undervoltage trip, alarm switch, etc.

L. 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.

M. Series rated breakers are not acceptable unless specifically noted on the Drawings.

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 NEC and NEMA standards for installation.

D. Circuit breakers serving "Fire Alarm Control Panel(s)" shall be red in color.
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 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 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. Determine that circuit breaker will trip under overcurrent condition, with tripping time in conformance with NEMA AB 1 requirements.
   c. Test all circuit breakers with frame size 225 amps and larger and 10 percent of all circuit breakers with frame sizes less than 225 amps in each panelboard, distribution board, switchboard, etc. unless otherwise noted.

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.

3.04 ADJUSTING

A. Adjust circuit breaker trip settings for coordination with other overcurrent protective devices in system.

B. Adjust circuit breaker trip settings for adequate protection from overcurrent and fault currents.

3.05 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.

3.06 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
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. Federal Specifications (FS):
   FS W-F-870; Fuseholders (for plug and enclosed cartridge fuses).
   FS W-S-865; Switch, Box (enclosed), Surface-Mounted.

2. National Electrical Manufacturer Association (NEMA):
   NEMA KS 1; Enclosed Switches.

3. 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).
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.


2. General Electric.

3. Siemens/I-T-E.

4. Square D.

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 600 VAC 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 200,000 amperes RMS symmetrical. Furnish with provisions for RK-1 fuses for switches up to 600 amps. 800 amp 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 NEC 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
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:


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. 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. Federal Specifications (FS):
   FS W-F-870; Fuseholders (for plug and enclosed cartridge fuses).
   FS W-S-865; Switch, Box, (Enclosed) Surface-Mounted.

2. Underwriters Laboratories, Inc. (UL):
   UL 198; Fuses (applicable subsections).
   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 508; Industrial Control Equipment.
   UL 508A; Industrial Control Panels.

3. National Electrical Manufacturer Association (NEMA):
   NEMA ICS 2; Industrial Control Devices, Controllers and Assemblies.
   NEMA ICS 6; Enclosures for Industrial Controls and Systems.
   NEMA KS 1; Enclosed Switches.

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 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. Include detailed control wiring diagrams for each starter.

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. 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: Motor 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.

1.07 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.

2. General Electric.
3. Siemens/I-T-E.
4. Square D.

B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

2.02 MANUAL MOTOR STARTERS

A. Manual motor starter: AC general purpose Class A manually operated non-reversing full-voltage controller for induction motors rated in horsepower, with overload relay, red pilot light, auxiliary contacts when indicated on Drawings and pushbutton operator. Starter size and number of poles shall be as required for connections indicated on Drawings. Furnish in conformance with NEMA ICS 2.

B. Fractional horsepower manual starters: AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit and toggle operator. Starter size and number of poles shall be as required for connections indicated on Drawings. Furnish in conformance with NEMA ICS 2.

C. Enclosure: NEMA ICS 6; Type 1.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Contractor shall thoroughly examine Project site conditions for acceptance of motor control installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.02 GENERAL

A. Install motor control equipment in accordance with Manufacturer's instructions, as indicated on the Drawings and as specified herein.

B. Install equipment where indicated on the Drawings.

3.03 MOUNTING

A. Include construction channel and mounting hardware as required to support motor control equipment.

B. Coordinate locations of control equipment in the field to provide code clearances in front of devices.

3.04 IDENTIFICATION

A. Provide engraved, machine screw-retained type 'NP' nameplate on each motor control device. Refer to Section 260553: Electrical Identification.

B. Installation:

1. Handling, storage, installation and energize of MCC’s shall be carried out in accordance with Manufacturer's instructions.

2. Provide mounting hardware brackets, bus bar drilling and filler pieces for all unused spaces.

3. "Train" interior wiring; bundle and clamp, using specified plastic wire wraps specified under Section 260519: Building Wire and Cable.
4. Replace any panel pieces, doors or trims having dents, bends, warps or poor fit that may impede ready access, security or integrity.

5. Conduits terminating in concentric, eccentric or oversized knockouts at MCC’s shall have ground bushings and bonding jumpers installed interconnecting all such conduits and the switchboards.

6. Check and tighten all bolts and connections with a torque wrench using Manufacturer's recommended values.

3.05 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 motor controls 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 to overcurrent protective devices.

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 control and power connections.
   e. Check that all covers, barriers and doors are secure.
   f. Verify that motor controls meet specified requirements.
3. Electrical tests:
   a. Insulation resistance: 1000 volt DC tests for one minute on all 600 volt 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.

3.06 CLEANING

A. Prior to energizing of motor controls 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 motor controls 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 TRAINING

A. Factory authorized service representative shall conduct a 2 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
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. Packaged engine generator set.
2. Engine mounted radiator.
3. Dual-containment skid mounted fuel tank with fuel fittings.
4. Exhaust silencer and fittings.
5. Starting batteries and battery charger.
6. Control panel.
7. 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.


1.02 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 C37.17; Trip devices.
2. Federal Specification (FS):
   FS W-C-375; Circuit Breakers, Molded Case, Branch Circuit and Service.
3. Institute of Electrical and Electronic Engineers (IEEE):
   IEEE 43; Testing Insulation Resistance of Rotating Machinery
4. National Electrical Manufacturer Association (NEMA):
   NEMA MG1; Motors and Generators.
   NEMA MG2; Safety Standards for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators.
   NEMA AB1; Molded Case Circuit Breakers.
NEMA ICS1; General Standards for Industrial Control and Systems.
NEMA ICS4; Terminal Blocks.
NEMA ICS6; Enclosures for Industrial Controls and Systems.
NEMA II; Electrical Indicating Instrument - Relay.
NEMA SG5; Power Switchgear Assemblies.

5. Underwriters Laboratories, Inc. (UL):

UL 50; Cabinets and Boxes.
UL 467; Grounding and Bonding Equipment.
UL 489; Molded Case Circuit Breakers and Circuit Breaker Enclosures.
UL 508; Electric Industrial Control Equipment.
UL 891; Dead-Front Electrical Switchboards.
UL 1004; Electric Motors.
UL 1004B; Electric Motors and Generators.
UL 1236; Battery Chargers for Charging Engine-Starter Batteries.
UL 2200; Stationary Engine Generator Assemblies.


NFPA 37; Stationary Combustion Engines and Gas Turbines
NFPA 110; Emergency and Standby Power Systems

1.03 SYSTEM DESCRIPTION

A. It is the intent and purpose of these Specifications to provide an emergency standby diesel engine generator system of the latest commercial type and design that includes all controls, protection, wiring and accessories for unattended operation for the duration of a normal power outage.

B. The engine generator set shall automatically start, attain rated speed and voltage, accept load and be able to supply continuous electrical service within 10 seconds after the beginning of an interruption of the normal power.

C. Generator Air Quality must meet all federal and local applicable standards and time tables.

D. Generator must meet Air Quality requirements as allowed by Bay Area Air Quality Management District at the time of permitting. Completion of permitting through the Bay Area Air Quality Management District is required.
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 to include:
   a. Front, plan and side elevations with overall dimensions.
   b. Conduit entrance locations and requirements.
   c. Electrical schematic and interconnection wiring diagrams for all equipment to be supplied. Clearly mark all termination points and indicate quantity/size of all field-installed wiring.
   d. Battery rack size and elevations.
   e. Control panel with front elevation indicating all devices and instruments.
   f. Nameplate legend.
   g. Connection and support including weight.
   h. Electrical characteristics including KW/KVA, voltage, number of phases, RPM’s, overcurrent device ratings. Provide Manufacturers published transient response data of the complete engine generator set upon 50%, 75% and 100% block loads at .9 pf. Data shall include maximum voltage dips, frequency dips and recovery time periods.
   i. Make and model of output circuit breaker(s).
   j. Skid mounted fuel tank showing all specified options and pipe connection locations.
   k. Provide kilowatt output curve, fuel consumption curve and airflow requirements for combustion, ventilating and radiator cooling air.
   l. Remote annunciator panel elevation and dimensions with nameplate information for each indicating light.

5. Furnish structural calculations for equipment anchorage as described in Section 260010: Basic Electrical Requirements.

6. Outdoor weatherproof equipment enclosures and accessories.

7. The manufacturer shall provide the forms required by the Bay Area Air Quality Management District ‘BAAQMD,’ as part of the submittal process, and completely filled out with all information pertaining to the generator being furnished for this project. These forms shall be included as part of the submittal requirements. Additional site specific information required on the forms shall be obtained by the electrical contractor, to complete the requirements, and then shall be submitted to BAAQMD. The electrical contractor is responsible for gaining final approvals and permitting from BAAQMD for the installation of the generator.
8. Certified test data stating that the complete unit was factory tested at the rated full load and power factor with ambient, altitude and fuel grade recorded.

9. Submit Manufacturer's installation instructions.

10. Complete bill of material listing all components.

11. Final test results.

12. Warranty.

B. Dimensions and configurations of engine generator(s) and accessories 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.

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. Detailed instructions for repair of the engine generator set and other major components specified in this Section.

4. Pictorial parts list and part numbers.

5. Pictorial and schematic Electrical Drawings of wiring systems, including operating and safety devices, control panels, instrumentation and annunciators.

6. Telephone numbers for the authorized parts and service distributors.

7. Include all service bulletins and torque Specifications for all terminations.

8. 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. Independent Testing Agency qualifications: Refer to Section 260010: Basic Electrical Requirements.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery: Engine generator 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.

1.08 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.

1.09 SYSTEM START-UP
A. Upon completion of installation, initial start-up of the engine generator shall be performed by a factory trained dealer service representative sufficient time shall be allowed to properly check the system out and perform required minor adjustments before the Engineer's witnessed test shall begin.

1.10 MAINTENANCE
A. Extra material:

1. Special tools: Provide to the Owner the special tools and testing devices required for routine maintenance.

2. Provide one spray can of matching finish paint for touching up damaged surfaces after installation.

B. Maintenance Service:

1. Provide a 2 year Manufacturer's maintenance contract of the engine generator system. The 2 year period shall begin from the date of Engineer's acceptance on a total no-charge basis. During this period, Manufacturer's maintenance staff shall visit the installation not less than 8 times for routine inspection and preventive maintenance. The maintenance visits shall be scheduled at 3 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 manufacturers shall submit a preventative maintenance schedule outlining in detail the following:

   a. Time when services are to be performed.

   b. Work to be performed.

   c. Shutdowns required for service.

   d. Company or Contractor support services required.

2. The contract shall include, but not be limited to, the following:

   a. Engine Generator Manufacturer's recommended procedures for weekly inspection and maintenance to be done by user.

   b. Quarterly inspections by the Supplier personnel to review the weekly maintenance record being kept by user and train any new Owner operating personnel.
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. Packaged engine generators:
   a. Caterpillar.
   b. Detroit Diesel.
   c. Kohler.
   d. Onan - Cummins.

B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

2.02 GENERAL REQUIREMENTS

A. Packaged engine generator system shall be in accordance with Specifications and as indicated on the Drawings.

B. Engine generator set shall be of single-shaft type mounted and aligned on a common frame.

C. Engine generator set shall start and be up to full speed and capable of accepting full load in less than 10 seconds.

D. Engine generator set shall be capable of producing the KW/KVA rating as indicated on the Drawings continuously at 500 feet above sea level, 104 degrees Fahrenheit ambient temperature (120° F. max., 40° F min.) and with 100% rated load.

E. Provide signs on all doors to the engine generator room "WARNING: THIS EQUIPMENT MAY START AUTOMATICALLY."

F. Provide anti-corrosive and anti-rust coatings on all areas subject to corrosion or rust.

G. Engine generator emissions shall meet or exceed local air quality standards as specified by any agency requiring such standards. It is the responsibility of the Engine Generator Manufacturer to verify these requirements.

2.03 ENGINE

A. Type: Liquid-cooled inline or V-type, four stroke cycle, compression ignition diesel internal combustion engine. Engine shall be naturally aspirated, turbo-charged or turbo-charged-inter-cooled, as required. Turbocharger shall be of the turbine type driven by engine exhaust gases and direct connected to a blower supplying engine combustion air.

B. Rating: Standby power of sufficient horsepower to operate all engine generator accessories under load. The horsepower rating shall take into account any generator efficiency losses.

C. Engine speed: 1800 rpm.

D. Fuel: No. 2 diesel fuel oil. The Engine Manufacturer shall recommend and supply an engine with the proper compression ratio for the specified fuel.
E. Electronic governor: Automatic frequency regulation adjustable electric isochronous type governor, Woodward model #2301/EG-3P or approved equal, with the following characteristics:

1. Stability: +/- 0.25% of rated frequency at any constant load from no load to full load.
2. Droop: 0% (isochronous) to 10% (adjustable).
3. Recovery time: 6 seconds upon application or removal of full load.
4. Frequency: Modulation shall not exceed one cycle per second.
5. Protection: Include Protection from voltage spikes and reverse polarity.

F. Jacket water heater: Thermal circulation type water heater sized to maintain the engine jacket water at 90 degrees F in an ambient temperature of 40 degrees F. Heater shall be controlled by an integral adjustable thermostat, which shall be automatically deactivated while engine generator is running.

G. Cylinder liners: Provide removable wet type cylinder liners of close-grained alloy iron.

H. Engine accessories: Provide crankcase fumes disposal breather, lube oil filter, lube oil cooler, secondary fuel and lube oil filters, intake air cleaner (dry type), flexible fuel lines, gear-driven water pump, fuel priming pump with Racor type primary fuel filter, fuel transfer pump, lube oil pump, fuel/water separator.

2.04 GENERATOR

A. General: Generator shall be of the engine-driven, synchronous, brushless, drip-proof, random wound, tropicalized construction type with amortisseur windings in the pole faces of the rotating field. Generator shall not provide greater than 5% total harmonic distortion. Generator shall be capable of sustaining a three phase load of 300% rated current for 10 seconds and sustain 150% of continuous load current for two minutes with field set for normal rated load excitation.

B. Rating: KW/KVA rating as noted on Drawings, at 0.8 power factor, 3 phase, 4 wire, wye connected, 277/480 volts, 60 Hz at 1800 rpm.

C. Stator insulation:

1. All insulation materials used in the stator shall have a minimum temperature rating of Class 155 degrees C (Class F) per IEEE Std. 1. The coils shall be of a random wound coil construction using a magnet wire meeting NEMA MW36-C Specifications.

2. Turn-to-turn testing shall be performed on all stator windings per IEEE Std. AA 522 prior to impregnation. A high-potential test shall be conducted on the stator prior to impregnation per IEEE Std 115.

D. Rotor construction:

1. The rotor shall be of the fully laminated, salient pole type.

2. Low resistance amortisseur bars shall be inserted through slots in the field poles and brazed/welded to a continuous shorting ring to complete the damping circuit.

3. Cooling fans shall be an integral part of the rotor assembly.

4. The rotor shall have accessible provisions for bolt-on balancing weights.

5. All insulation materials used in the rotor shall have a minimum temperature rating of Class 155 Degrees C (Class F) per IEEE Std. 1. The poles shall be of a layer wound construction using a magnet wire meeting NEMA MW35-C or MW36-C Specifications.
6. A high-potential test shall be conducted on the rotor prior to impregnation per IEEE Std. 115.

E. Brushless exciter system:

1. The exciter shall be a high frequency, direct connected, rotating brushless type, three phase, full wave rectified, surge protected and shall be matched with the generator rotor and control system.

2. The rotating part of the exciter, including the rectifier assembly, shall rotate together with the alternator rotor as a complete assembly on one shaft.

3. Both the armature and field windings shall be Vacuum Pressure Impregnated (VPI) with Epoxy resin.

4. The brushless exciter shall be compatible with the voltage regulator.

5. The automatic voltage regulator shall be supplied with the alternator, a complete solid-state type.

F. Overspeed: The system shall be free of injurious torsional and bending vibrations within a speed range from 10% below to 10% above synchronous speed. The rotor assembly shall demonstrate 125% overspeed capability at 170°C for 2 hours. Rotor dynamic, two-plane balance shall not exceed 0.002-inch peak-to-peak amplitude at operating speed. All rotating components shall be secured with SAE Grade 8 hardware.

G. Drive configuration: The generator shall be of the single bearing design type. It shall have an adapter and disc type coupling suitable for direct connection to the standard SAE flywheel and bell housing of the engine.

H. Bearings: The bearing shall be of a re-greasable, single row, ball bearing design.

I. Voltage regulator:

1. The generator shall be equipped with a volts-per-hertz type voltage regulator that shall be by same Manufacturer as the engine generator set. The regulator shall sense line-to-line for three phases of generator output voltage and exhibit the following characteristics:

   a. Generator output voltage maintained within +/- 1% of rated value for any load variation between no load and full load at 0.8 to 1.0 pf.

   b. Generator output voltage drift no more than +/- 1/2% of rated value at constant temperature.

   c. Generator output voltage drift no more than +/- 1% of rated value over ambient temperature range of -40°C to 70°C.

   d. Transient overvoltage shall not exceed 25% upon removal of 80% of full load at .8 pf. with recovery in less than 2 seconds.

   e. Telephone Influence Factor (TIF) of less than 50.

   f. Electronic Interference/Radio Frequency Interference (EMI/RFI) suppressed to commercial standards.

   g. The regulator shall include the following features:

      1) Voltage level rheostat shall provide generator output voltage adjustment of -10% to +10% of nominal.

      2) Automatic gain adjustment shall provide output voltage compensation for changes in load or frequency.
3) At full throttle engine starting, output voltage shall not overshoot more than 5% of its rated value, with respect to the volts/Hz curve.

4) Response time shall be less than seventeen milliseconds.

h. Protection shall be provided against loss of voltage sensing and long-term overcurrent conditions. The overcurrent protection function shall automatically reset when the regulator is de-energized. The regulator shall not be damaged or result in unsafe operation when subjected to open or shorted input due to sensing loss or in short to ground or adjacent conductor. Fast blow fuses shall be included in two of the sensing leads to fully protect the regulator. The regulator shall also include internal protection for under frequency, over voltage and over excitation.

i. The regulator module shall be sealed in a waterproof and air-proof shock resistant plastic housing and shall withstand:

1) Temperatures between -20° to 70°C.

2) Vibration of 4.5 G's (peak) between frequencies of 18 to 2000 Hz in three perpendicular planes and mechanical shock of 20 G's in all three planes.

3) Salt spray as described by MIL-STD - 810C, Method 509.1 and ASTM-B117.

j. If SCR's are used within the regulator, isolating circuits shall be included to prevent the harmonic distortion from building load SCR's interfering with the triggering of the regulator SCR's.

2. The voltage regulator "burned-in" period shall be a minimum of 24 hours.

J. Generator set with proposed engine shall be rated for a maximum of 25% voltage dip upon application of any size load, up to 60 percent of full load. The voltage shall recover to and remain within the steady state band in not more than 5.0 seconds.

K. Generator accessories:

1. The generator shall contain a series boost circuit that shall sustain generator output at 300% rated current for a minimum of 10 seconds and maximum of 16 seconds before automatically removing power to the exciter field.

2.05 COOLING SYSTEM

A. General: The engine shall be furnished with a cooling system having sufficient capacity for cooling the engine when delivering full rated load at the ambient temperature and altitude specified herein.

B. Radiator: Engine mounted radiator with an engine-driven blower type fan and centrifugal type pump for circulating coolant through system. Air shall draw from engine side and exhaust through radiator core with no more than .5 inches of water external restriction in addition to core restriction.

C. Cooling system treatment: Provide protection against internal corrosion of cooling system. Installations where units will be exposed to subfreezing temperatures, a solution of 50% ethylene glycol shall be added. Supplier shall provide all required coolant and anti-freeze.

D. Guards: Provide suitable guards on all moving parts of cooling system to meet safety requirements.
A. General:

1. Fuel: Diesel No. 2 fuel oil having 35 degree API (16°C or 60°F) specific gravity.
2. Provide fuel pressure gauge and hand-operated auxiliary priming pump.
3. Engine shall be equipped with all pumps, filters, lines, etc., necessary to supply fuel to the engine. The engine fuel pump shall have adequate capacity to lift fuel at least 96”. Individual fuel injectors shall be provided for each cylinder.
4. Provide a fuel/water separator to protect the fuel system from water damage.
5. Provide oversize heavy-duty fuel filter.
6. The fuel transfer pump, injection pumps, rack and pinion assembly and timing mechanism shall be maintenance free for the life of equipment.
7. Flexible fuel lines shall be installed between the engine and the fuel supply to isolate vibration.
8. Provide fuel oil cooler for fuel returning to tank in order to maintain temperature within acceptable limits to allow engine to operate at full rated horsepower.

B. Fuel tank:

1. Skid mounted fuel tank, 600 gallons, completely prewired, pre-plumbed, pre-assembled, U.L. labeled. Tank size shall include additional capacity, over and above that indicated, for sediment sump. Tank shall be factory pre-piped to engine.
2. Fuel tank shall be constructed of heavy gauge steel. Epoxy coated inside, rust proofed and finish painted outside. Construction shall meet earthquake resistance requirements as indicated in Section 260010: Basic Electrical Requirements. Furnish with dual containment or rupture basin type design to fit within skid beneath generators.
3. Fuel tank shall have NPT threaded pipe connections of required size for fill, drain, vent, overflow, engine suction, engine fuel return, etc. Coordinate with Division 22 for exact size, location and quantity required for plumbing pipe connections.
4. Fuel tank accessories:
   a. Fuel gauge: Fuel level monitor gauge complete with probes to indicate fuel level. Mount gauge such that it is visible from fuel tank filling inlet.
   b. Critical low level and engine generator shutdown: Separate float switch for engine generator shutdown. This switch shall shutdown the engine generator before the fuel tank is sucked dry to prevent "air locking" the fuel injectors. Set activation level for just above the fuel supply intake line to the engine. Provide local red indicating light and separate auxiliary DPDT dry contacts from connection to remote alarms. Terminate contacts on a labeled terminal strip.
   c. Low level alarm: Separate low fuel level float switch alarm with local red indicating light and separate auxiliary DPDT dry contacts for connection to remote alarms. Terminate contacts on a labeled terminal strip. Set low-level alarm at tanks half full level.
   d. Provide tank with a gasketed inspection port.
   e. 2” manual fill port with threaded lockable cap.
f. Rupture basin leak detection: Separate float switch in dual containment basin to sense presence of fuel due to leak or rupture of inner tank. Provide with local red indicating light and separate auxiliary DPDT dry contacts for connection to remote alarms. Terminate contacts on a labeled terminal strip.

g. Provide position-indicating handball valve with plumbing to permit draining of rupture basin back into main fuel tank.

h. Provide back-up fuel supply line with a float valve located in the tank and gasketed inspection cover.

C. Fuel tank shall be fully filled with specified fuel upon acceptance of system and prior to turning Project over to Owner.

2.07 EXHAUST SYSTEM

A. A critical grade horizontally mounted exhaust silencer and flexible exhaust connection shall be provided by the Engine Generator Supplier. The equipment shall be of a size as recommended by the Manufacturer in order to keep exhaust backpressure and noise levels within limits required by the Engine Manufacturer.

B. The exhaust silencer shall be mounted on the roof of the engine generator set weatherproof housing. Coordinate to maintain a minimum height requirement above roof. The exhaust piping shall discharge in the vertical direction with a rain cap.

C. The silencer shall be supported by means of supports provided on the weatherproof housing. These supports shall not interfere with access doors or routine maintenance procedures.

D. Discharge: The termination point for the exhaust discharge into the atmosphere shall be according to the latest building code requirements, but not less than ten feet above the adjacent grade.

E. Post-fabrication treatment: The exhaust silencer, piping, support system and hardware shall be spray paint black color with a silicone-based, heat-resistant to 1200 degrees F, anti-corrosive, VOC compliant, water-soluble. All components shall be coated and heat cured in accordance with Manufacturer's directions prior delivery to the Project site and field assembly. Touch-up paint marred surfaces immediately after assembly. Manufacture: Aremco Corr-Paint #CP4000, SermaGard or approved equal.

F. Silencers shall be maxim series M51, Nelson Level 400 or approved equal. Provide one silencer for each engine generator set.

2.08 STARTING SYSTEM

A. The engine shall be equipped with an electric starting system rated 24 volts D.C. and shall include two means of automatic starter cutout upon starting. The starter shall crank the engine for three, 15 second on - 15 second off, periods (45 seconds of cranking) before activating the overcrank lock-out device.

B. Batteries:

1. Shall be Lead-Acid sized to allow continuous cranking of the engine for six 15 second on - 15 second off periods (90 seconds of cranking) in a 40° F. ambient temperature and maintain a minimum cell end voltage of 1.75 volts per cell.

2. Batteries shall be SAB Nife, ALCAD, Delco, Trogan or approved equal.

3. They shall be installed to comply with the seismic requirements as describe in Section 260010: Basic Electrical Requirements and rack mounted on the engine generator set frame. The rack shall be as manufactured by Battery Manufacturers.
4. Provide all interconnecting bars and extra-flexible locomotive cables with the batteries and high compression, circumferentially crimp type lugs.

5. Locate batteries as close as possible to the starter.

6. Fill Lead-acid batteries with electrolyte at the Project site.

C. Battery charger:

1. Furnish a 24V DC output, 120V AC, solid state, input transistor controlled, constant voltage, battery charger suitable for the Lead-Acid batteries specified. The output current shall be current limited to 120% of maximum and shall not require a cranking disconnect relay.

2. Provide 5% accurate DC ammeter and 5% accurate DC voltmeter to indicate rate of charge on front door of unit.

3. Input and output shall be fused.

4. Unit shall not discharge battery when AC power fails.

5. Unit shall operate and be capable of fully charging the starting batteries while the engine generator set is running and shall be capable of returning to the fully discharged battery 100 percent of its ampere-hour rating within 24 hours.

6. The charger shall float the batteries at 2.17 to 2.20 volts per cell and equalize them at 2.33 to 2.35 volts per cell.

7. Unit shall be sized to accommodate all control panel loads, such as meters and indicating lights, in addition to battery charging requirements.

8. Unit shall be Sens model #CC-FS-24V, sizes as required (min. 10 amp) or approved equal.

9. The following accessories shall be included:

   a. Low DC battery voltage alarm relay. Contacts, 120 VAC, 10 amperes. Alarm shall be locked out during engine cranking.

   b. High DC battery voltage alarm relay. Contacts, 120 VAC, 10 amperes.

   c. AC input power failure alarm relay contacts, 120 VAC, 10 amperes.

   d. DC current failure alarm relay contacts, 120 VAC, 10 amperes.

   e. Ground Fault Alarm relay contacts, 120 VAC, 10 amperes.

   f. Hermetically sealed semiconductors and integrated circuits.

   g. Ambient Temperature Compensation circuit.

   h. Green power on indicator light.

D. Wire alarm relays #1 and #2 above together in parallel so that any one or both will remotely annunciate as "High or Low Battery Voltage".

E. Wire alarm relays #3, #4 and #5 above together in parallel so that any one or both will remotely annunciate as "Battery Charger Malfunction".

F. Ether-type starting aids shall not be permitted.
ENGINE GENERATOR CONTROL PANEL

A. General: The control panel shall be mounted on the engine generator set.

1. The 24 VDC starting batteries shall power all indicating lights and shutdown controls.

2. The controls must maintain accuracy and be capable of operating at the reduced voltage levels during cranking and at the higher voltage levels imposed by the battery charger and temperature extremes of 40°F to 125°F.

3. All control relays shall be industrial control grade with gold flashed contacts rated for low voltage DC circuits.

4. True RMS sensing meters shall employ non-linear converting circuits and shall be capable of at least a 5:1 peak to RMS ratio to ensure accuracy.

5. Current and potential transformers, where used shall be 0.3% accuracy class and selected and coordinated to cause meter deflections in the top 25% of meter scale for nominal and rated values.

B. The control panel shall consist of the following indicators and equipment mounted logically and symmetrically on the face of the panel:

1. True RMS sensing AC voltmeter. Digital or switchboard type with 1% accuracy, 4.5 inch, 250° scale.

2. True RMS sensing AC ammeter. Digital or switchboard type with 1% accuracy, 4.5 inch, 250° scale.

3. Combination ammeter and line to line voltmeter four position phase selector switch: Phase A, Phase B, Phase C and off.

4. Frequency Meter: 2% accuracy based on 10% waveform distortion from non-linear loads. (55 to 65 Hz with 1/10 Hz divisions).

5. Voltage Adjusting Rheostat (+/- 5%)

6. Indicating lights as follows:

<table>
<thead>
<tr>
<th>ALARM/STATUS</th>
<th>LAMP COLOR</th>
<th>HORN ALARM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Low Oil Pressure:</td>
<td>Amber</td>
<td>Yes</td>
</tr>
<tr>
<td>Low Oil Pressure:</td>
<td>Red</td>
<td>Yes</td>
</tr>
<tr>
<td>Pre-high Jacket Water Temperature:</td>
<td>Amber</td>
<td>Yes</td>
</tr>
<tr>
<td>High Jacket Water Temperature:</td>
<td>Red</td>
<td>Yes</td>
</tr>
<tr>
<td>Low Jacket Water Temperature (&lt;70°F)</td>
<td>Amber</td>
<td>Yes</td>
</tr>
<tr>
<td>Overspeed:</td>
<td>Red</td>
<td>Yes</td>
</tr>
<tr>
<td>Overcrank:</td>
<td>Red</td>
<td>Yes</td>
</tr>
<tr>
<td>Emergency Stop:</td>
<td>Red</td>
<td>Yes</td>
</tr>
<tr>
<td>Low Fuel Level (Day tank):</td>
<td>Amber</td>
<td>Yes</td>
</tr>
<tr>
<td>Battery Charger Malfunction:</td>
<td>Amber</td>
<td>Yes</td>
</tr>
<tr>
<td>System Ready:</td>
<td>Green</td>
<td>No</td>
</tr>
<tr>
<td>Not-In-Auto:</td>
<td>Red/Flash</td>
<td>Yes</td>
</tr>
<tr>
<td>Low or high DC Battery Voltage:</td>
<td>Red</td>
<td>Yes</td>
</tr>
<tr>
<td>Low Coolant Level:</td>
<td>Yellow</td>
<td>Yes</td>
</tr>
</tbody>
</table>

7. Single pushbutton for testing all indicating lamps.

8. Elapsed hour meter. (non-resettable, 5 digit)
9. The control panel shall also contain the following items:
   a. Fuel pressure gauge.
   b. Engine oil pressure gauge.
   c. Engine water temperature gauge.
   d. Two Form C dry contacts for engine running.
      1) One for remote annunciation.
      2) One spare.
   e. Two Form C dry contacts for common failure.
   f. Engine shutdown relays for low oil pressure, high water temperature, overspeed,
      overcrank and emergency stop.
   g. Three position function switch, "AUTO," "OFF/RESET," and "RUN."
   h. All required fuses, current and potential transformers.
   i. Emergency "STOP" red mushroom-head pushbutton. Provide one additional, identical
      "stop" pushbutton with plastic safety guard and all required interface provisions for
      remote mounting. Provide engraved nameplate "Generator Emergency Off." Mounting,
      conduit and wire to the remote pushbutton will be provided under this contract.
      Operation of emergency off pushbutton shall be annunciated at control panel and remote
      annunciator panel(s).
   j. A fault-reset function shall be provided to clear fault indications and allow restarting of the
      engine after the shut-down faults has been corrected. The control design shall be such
      that the fault indication shall remain until reset. The fault-reset function shall operate only
      when the function switch is in the "OFF/RESET" position.
   k. Alarm horn with silencing button. After silencing, alarm shall automatically sound again if
      another alarm condition develops. "ON/OFF" switch is not acceptable.

10. Furnish full width steel step to allow easy viewing of control panel. Bolt to engine generator set
    frame.

2.10 ACCESSORIES

A. Main terminal box:

1. Engine generator set load termination junction box shall be mounted with bottom of box at 30" AFF,
   to allow easy installation of underground power conduits and conductors.

2. Construction shall comply with IP44 for protection against solid bodies greater that 1 mm and water
   splashing.

3. It shall include three rigidly mounted bus-bar of tin-plated copper with terminals and one isolated
   neutral bus-bar, all suitable for the termination of the generator output feeder, size and quantity as
   noted on the Drawings.
4. The bus bars shall be drilled for terminating high compression circumference crimped type lugs having two holes on each lug. Provide adequate space for ease in training cables. Provide extension box as required, taking care to maintain code clearances. Belleville washers shall be used.

B. Connection box:

1. A suitable connection box (separate from the main terminal box) shall be furnished for space heater leads. This connection box should be located adjacent to the main terminal box, readily accessible.

2. The following protection elements shall be wired to this connection box:
   a. Generator winding space heaters.
   b. Control panel space heaters.

C. Anti-condensation heater: Provide 120 VAC generator stator winding and control panel anti-condensation heaters with factory set, adjustable thermostat and lube oil or similar positive cutoff when the generator is operating. Heaters are to be easily replaceable in the field.

D. Vibration isolators:

1. Engine generator set(s) shall be installed on spring type vibration isolators rated for the seismic zone as indicated in Section 260010: Basic Electrical Requirements. They shall have a minimum rated deflection of 1” and shall be selected based on the actual load at each mounting point of the unit ultimately installed. Springs shall have a minimum additional travel of 50% of rated deflection and shall have a seismic withstand capability of 1.0 "G" acceleration in all directions. Furnish unit complete with non-skid neoprene acoustical isolation pad, pre-drilled anchor bolt holes and mounting nuts. Supplier shall submit earthquake mounting design data.

2. Vibration isolators shall be Mason Industries, Inc. or approved equal.

E. Wiring and conduit:

1. Engine generator control wiring shall be multi-strand, plastic insulated cable resistant to heat, abrasion, oil, water, antifreeze and diesel fuel. Each cable shall be heat stamped throughout the entire length to identify the cable’s origin and termination. Cables shall be enclosed in nylon flexible conduit that is slotted to allow easy access and moisture to escape. Reusable bulkhead fittings shall be used to attach the conduit to generator mounted junction boxes.

2. Provide all termination with spade or ring crimp type terminals. All termination points on terminal blocks shall be permanently and neatly labeled.

F. Grounding:

1. Provide factory installed, code sized grounding conductor from the generator ground pads to the engine generator frame and to a grounding lug in the load termination junction box sized to accept the number of ground conductors in the feeder conduits as indicated on the Drawings. Provide factory installed grounding lug, adjacent to the load termination junction box and a code sized grounding conductor from the generator neutral. The lug shall be used for field connection to the grounding electrode conductor as indicated on Drawings.

2. Two none-corrosive stainless steel grounding pads shall be welded to each alternator. The pads shall be located diagonally opposite one another.

G. Nameplates: The alternator shall have a non-corrosive stainless steel nameplate with not less than the minimum information called for in NEMA publication number MG1.
H. Main circuit breaker: Provide a molded case, thermal-magnetic, output circuit breaker, size as indicated on Drawings. Mount in a code sized junction box with sufficient room for incoming cables. Provide high-pressure crimp type cable lugs and Belleville washers on studs for feeder termination. Provide one, form C, auxiliary contact rated 120 VAC, 10 amps to annunciate as “NOT-IN-AUTO” at the control panel and at the remote annunciator panel when the breaker is in the open or tripped position.

I. Remote annunciator panel:

1. General: surface mounted remote annunciator panel conforming with NFPA 110 and consisting of the following components:
   - Buzzer with silence button. After silencing, buzzer shall automatically sound again if another alarm condition develops.
   - Momentary contact lamp test pushbutton.
   - Summary alarm contact (Form C) to provide contact closure upon activation of alarm buzzer. This contact shall remain closed until all systems are reset. Contact shall be tied into the security system for time/date documentation.
   - Alarm/status LED indicator lights with inscriptions as outlined herein. Provide silk-screened lettering conforming to Specification Section 260553: Electrical Identification.
   - Power for remote annunciation panel shall be obtained from the engine generator 24VDC starting batteries. Panel shall operate on a signal level ranging from 9 VDC to 30 VDC.
   - Panel shall not be larger than 20” wide 20” tall 6” deep.
   - Faceplate shall be brushed stainless steel with flush hex-head fasteners.

2. The following alarm/status LED indicator lights shall be provided:

<table>
<thead>
<tr>
<th>ALARM/STATUS</th>
<th>LED LAMP COLOR</th>
<th>HORN ALARM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Power (contact in ATS):</td>
<td>Green</td>
<td>No</td>
</tr>
<tr>
<td>Generator Power (contact in ATS):</td>
<td>Amber</td>
<td>No</td>
</tr>
<tr>
<td>Generator Running:</td>
<td>Green</td>
<td>No</td>
</tr>
<tr>
<td>Not-in-Auto (Output breaker open or tripped):</td>
<td>Red/Flash</td>
<td>Yes</td>
</tr>
<tr>
<td>Fuel Tank Leak:</td>
<td>Red</td>
<td>Yes</td>
</tr>
<tr>
<td>Low Water Temperature (&lt;70°F):</td>
<td>Amber</td>
<td>Yes</td>
</tr>
<tr>
<td>Low DC Battery Voltage:</td>
<td>Red</td>
<td>Yes</td>
</tr>
<tr>
<td>Battery Charger Malfunction:</td>
<td>Amber</td>
<td>Yes</td>
</tr>
<tr>
<td>Ground Fault:</td>
<td>Red</td>
<td>Yes</td>
</tr>
<tr>
<td>Low Coolant Level:</td>
<td>Red</td>
<td>Yes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PRE-SHUTDOWN ALARMS</th>
<th>LED LAMP COLOR</th>
<th>HORN ALARM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Fuel Level:</td>
<td>Amber</td>
<td>Yes</td>
</tr>
<tr>
<td>Pre-High Water Temperature:</td>
<td>Amber</td>
<td>Yes</td>
</tr>
<tr>
<td>Pre-Low Oil Pressure:</td>
<td>Amber</td>
<td>Yes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SHUTDOWN ALARMS</th>
<th>LED LAMP COLOR</th>
<th>HORN ALARM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overspeed:</td>
<td>Red</td>
<td>Yes</td>
</tr>
<tr>
<td>Overcrank:</td>
<td>Red</td>
<td>Yes</td>
</tr>
<tr>
<td>High Water Temperature:</td>
<td>Red</td>
<td>Yes</td>
</tr>
<tr>
<td>Low Oil Pressure:</td>
<td>Red</td>
<td>Yes</td>
</tr>
</tbody>
</table>
J. Weatherproof housings:

1. General: The weatherproof housing shall be capable of completely enclosing and shielding from rain and wind the following equipment:
   
   a. Engine generator set.
   
   b. Batteries and battery rack.
   
   c. Battery charger.
   
   d. Engine generator control panel.
   
   e. Space heaters.
   
   f. DC and AC lights and duplex outlet.
   
   g. Fuel tank.

2. The weatherproof housings shall have hinged lockable access doors on all sides for complete access. Provide a latch for each door to ensure adequate closing pressure to seal against weather.

3. The weatherproof housing roof shall have built-in supports of sufficient size and quantity to completely support the exhaust silencer(s).

4. The weatherproof housings shall be provided with lifting eyes

5. Provide with marine environment quality paint finish.

6. Provide all necessary 120 VAC battery heaters to maintain battery temperature between 50°F and 60°F in an outdoor ambient temperature of 30°F.

7. A 120-volt AC heater with thermostat shall be provided within the engine generator set control panel to eliminate condensation. Connect to the same circuit as the lights. Set thermostat at 70°F.

8. All heaters shall be automatically deactivated while the engine generator is running and not dependent on the thermostat for deactivation.

9. Provide two 50 watt, 24-volt DC, industrial-grade, enclosed and gasketed dome lights, connect to batteries. Provide two 120 VAC industrial grade enclosed and gasketed 100 watt incandescent lights. Locate one of each over the engine generator and one of each over the control panel. Provide one 0 - 60 minute, no-hold manual timer switch for each group. Mount the switches by the control panel.

10. One 120 VAC duplex outlet with weatherproof cover. Connect to 120 volt AC light circuit.

11. Sound Attenuation: Sound attenuate the entire enclosure to reduce the noise level in a free field hemispherical condition, from no load to 100% rated load, such that the noise level from the enclosure does not exceed 65 DBA Leg (10 mins) at 50 feet from any part of the enclosure in any direction.

   a. Air intake: Locate at enclosure rear; air enters through sound attenuators.
b. Radiator air discharge: Exit enclosure through a 90-degree sound attenuated discharge plenum.

c. Insulation material: Mineral wool. Secured to enclosure interior surfaces causing a galvanized perforated liner.

d. Insulate enclosure roof, side panels and doors.

e. Do not insulate louvered openings.

2.11 SOURCE QUALITY CONTROL

A. Engine generator set shall be completely factory tested under rated full load and rated power factor for performance and proper functioning of control and interfacing circuits. Test shall be a minimum of 2 hours or time required reaching operating temperature. Testing at unity power factor only (resistance only banks) is not acceptable, since KW output is affected by the higher generator efficiency at unity power factor and the KVAR for motor starting and regulation loads varies with power factor. Unity power factor is acceptable for on-site testing.

B. In additional to the above, provide the following minimum factory tests:

1. Monitor voltage regulation.
2. Verify transient and steady state governing.
4. Monitor engine operating parameters: Coolant temperature, oil pressure, etc.
5. Operate safety shutdowns.
6. Test alternators to determine that they are free of mechanical and electrical defects. Tests shall include the following:

   a. Resistance of all windings (cold).
   b. Insulation resistance of all windings.
   c. High potential on all windings.
   d. Open circuit saturation.
   e. Voltage balance on windings.
   f. Current balance on windings.
   g. Voltage transient at rated KVA (voltage regulation, stability and response).
   h. Regulator range test (voltage adjust).
   i. Phase sequence.
   j. Mechanical balance (vibration).
   k. Inherent voltage regulation.
   l. Circulating current.
m. Dissipation factor tests.

7. The above tests shall be conducted in accordance with IEEE-115, NEMA MG-1 and MIL-STD 705 standards. Dissipation factor tests shall be performed per IEEE Std. 286.

C. All operational and alarm functions shall be factory tested prior to shipping to the field. All alarm functions shall be field tested after installation.

D. Record all factory test data on approved Manufacturers log format and submit to Engineer for review.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Contractor shall thoroughly examine Project site conditions for acceptance of engine generator 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 engine generator 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 engine generator in accordance with Manufacturer's written instructions, as indicated on the Drawings and as specified herein.

B. Install equipment supplied under this Section at the locations indicated on the Drawings. Any substitute units must conform to the dimensions of the engine generator room indicated on the Drawings.

C. Engine generator set shall be anchored and braced to withstand seismic forces as calculated per Section 260010: Basic Electrical Requirements.

D. Engine generator power conduits and conductors: Contractor shall remove bottom of main load termination junction box and stub-up conduits directly into box. Provide ground bonding bushings with insulated throats and code sized grounding conductor from each conduit to engine generator ground terminals.

3.04 FIELD QUALITY CONTROL

A. Refer to Specification Section 260800: Electrical Commissioning.

B. 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 emergency generator.

C. 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 engine generator 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 engine generator upon satisfactory completion of tests and results.

5. Verify ratings and settings and make final adjustments.

D. At least three weeks prior to any testing notify the Engineer so that arrangement 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 including full-load rated load banks and cables. The Testing Agency shall specify the specific power requirements.

F. Contractor shall verify with Mechanical Engineer, prior to energizing building emergency loads, that all time delays and building/energy management system programs for controlling large emergency mechanical motor loads are set. This is to ensure that those large motors will be sequentially added to the engine generator, after a time delay and to prevent an out-of-phase condition during transfer to emergency power.

G. 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. Inspect correct anchorage and grounding.
   d. Inspect air baffles, filter media and cooling fans.
   e. Check tightness of all control and power connections.
   f. Check that all covers, barriers and doors are secure.
   g. Confirm correct application of Manufacturer's recommended lubricants.
   h. Perform mechanical operational tests in accordance with Manufacturer's instructions.

3. Pretesting:
   a. Insulation resistance tests of buses, components, feeders and branch circuit conductors and control circuits.
   b. Continuity tests of circuits.
   c. Start-up test (no load):
      1) With prime mover in a "cold start" condition and all building emergency loads at normal operating level, initiate a normal power failure by opening all switches or breakers supplying the normal power to the building or facility. Test load shall be that load which is served by the emergency power system.
2) Observe and record the time delay on start.
3) Observe and record the cranking time until the prime mover starts and runs.
4) Observe and record the time required coming up to operating speed.
5) Record voltage and frequency overshoot.
6) Perform phase-rotation test to determine compatibility with load requirements.
7) Observe and record time required achieving steady-state condition with all switches transferred to the emergency position.
8) Record voltage, frequency and amperes for each phase.
9) Verify correct functioning of governor and regulator.
10) Verify function and temperature regulation for battery and engine heaters.
11) Record prime mover oil pressure, water temperature and battery charge rate at 5-minute intervals for the first 15 minutes and at 15-minute intervals thereafter.
12) Perform vibration baseline test. Plot amplitude versus frequency for each main bearing cap.
13) Continue load test with building load for one hour, observing and recording load changes and the resultant effect on voltage and frequency.
14) Return normal power to the building or facility, record the time delay on retransfer to normal for each automatic transfer switch (set for 30 minutes) and the time delay on prime mover cool-down period (set at 5 minutes) and shutdown.
15) After completion of the start-up test the engine generator set shall be allowed to cool for 5 minutes.

4. Electrical tests:

a. Full-load test:

1) This test shall be initiated immediately after the 5 minute cool down time period by opening all switches or breakers serving the normal power terminals on the transfer switches.

2) A load shall be applied for a eight (8) hour full-load test. Provide load banks of sufficient size to provide a load equal to 100 percent of the generator’s KW rating.

3) Upon reaching 90% of rated voltage and 95% of rated frequency the transfer switch(es) shall transfer the 100 percent full-load to the engine/generator set.

4) Record the data listed in start-up test items #1e,f,g and h above at first load acceptance and every 15 minutes thereafter until the completion of the eight hour test.

5) After seven and one half-hours close all switches or breakers serving the transfer switches to allow an automatic engine generator cool-down period and shutdown.
6) This full load test shall not result in activation of the high temperature pre-alarm or high temperature shutdown.

b. Cycle crank test: Utilize any method recommended by the Manufacturer to prevent the prime mover from running. Put the control switch into the "RUN" position to cause the prime mover to crank. Verify the three 15 second crank/15 second rest cycles and the subsequent overcrank lockout alarm. Immediately reset the lockout alarm and repeat the test to verify that the batteries supported the six: 15-second crank, 15-second rest periods (90 seconds of cranking). Record battery DC voltage as indicated on the battery charger at beginning and end of test.

c. Alarm/shutdown safety check:

1) General: Verify and record that all alarms and indicating lights function at both the remote annunciator panel and the control panel. Verify and record proper lockout/resets.

2) Verification of the following alarms shall be done by manually closing the relay contacts with the engine stopped.

   a) Low water temperature.
   b) Pre-high engine water temperature.
   c) High engine water temperature.
   d) Pre-low engine oil pressure.
   e) Low engine oil pressure.
   f) Overspeed.
   g) Low fuel level.
   h) Battery charger malfunction (Current failure alarm relay in the battery charger).
   i) Low DC voltage in the batteries (Disconnect in the battery lead).
   j) Fuel leak.
   k) Low coolant level.

3) Perform the following verifications with the engine stopped.

   a) Disconnect AC power to battery charger to verify "Battery Charger Malfunction" indicating lights.
   b) Place control switch in the "off/reset" position to verify "NOT-IN-AUTO" flashing red indicating lights.
   c) Open generator output circuit breaker to verify flashing red "NOT-IN-AUTO" indicating lights.

d. Emergency stop safety check:

1) Open engine generator circuit breaker. Place generator control switch in "RUN" position.
2) After engine generator is running for 2 minutes press the emergency stop button. Verify and record engine shutdown.

3) Repeat step “a” and “b” above for each emergency stop button associated with the engine generator.

4) Close the engine generator output breaker.

e. Allow for final load bank testing, as specified above, after receipt of the approved pre-final test results from the Electrical Engineer. This final testing is to be done in the presence of the Engineer. Give two weeks prior notice to commencement.

H. Functional performance testing: Refer to Specification Section 260800: Electrical Commissioning for requirements of system wide functional performance testing.

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 the Engineer's hourly rate.

J. Contractor shall replace at no costs to the Owner all devices which are found defective or do not operate within factory specified tolerances.

K. Contractor shall submit the Testing Agency's final report to the Engineer 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.

L. Refill fuel tank(s) to full capacity upon completion of all tests.

3.05 CLEANING

A. Upon completion of Project prior to final acceptance the Contractor shall thoroughly clean both the interior and exterior of engine generator per Manufacturer's approved methods and materials. Remove paint splatters and other spots, dirt and debris.

B. Touch-up paint any marks, blemishes or other finish damage suffered during installation.

3.06 TRAINING

A. Refer to Specification Section 260800: Electrical Commissioning.

B. 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.

C. Contractor shall schedule training with a minimum of 7 days advance notice.

END OF SECTION
SECTION 26 36 23
TRANSFER 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. Automatic transfer switch.

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. 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):

2. National Electrical Manufacturer Association (NEMA):
   NEMA ICS 1; General Standards for Industrial Control and Systems.
   NEMA ICS 2; Standards for Industrial Control Devices, Controllers and Assemblies.
   NEMA ICS 4; Terminal Blocks.
   NEMA ICS 6; Enclosures for Industrial Controls and Systems.

3. Underwriters Laboratories, Inc. (UL):
   UL 467; Grounding and Bonding Equipment.
   UL 486E; Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors.
   UL 1008; Transfer Switch Equipment.

   NFPA 110; Emergency and Standby Power Systems.

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 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 to Include:
   a. Front, plan and side view elevations with overall dimensions indicated.
   b. Location of devices and instruments and the make type, size and rating of all equipment.
   c. Dimensional locations of conduit entry points and locations of barrier plates.
   d. Nameplate legends.
   e. AIC rating.
   f. Size and number of bus bars per phase, neutral and ground.
   g. Detailed point-to-point wiring diagram, differentiating between Manufacturer-installed and field-installed wiring.
5. Furnish structural calculations for equipment anchorage as described in Section 260010: Basic Electrical Requirements.
6. Certified independent laboratory test data shall be provided to confirm that the switch rating and design conforms to UL-1008.
7. Submit Manufacturer's installation instructions.
8. Complete bill of material listing all components.

B. Dimensions and configurations of transfer switches 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.

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. Detailed instructions for repair of the transfer switch.
4. Pictorial parts list and part numbers.
5. Pictorial and schematic Electrical Drawings of wiring systems, including operating and safety devices, control panels, instrumentation and annunciators.
6. Telephone numbers for the authorized parts and service distributors.
7. Include all service bulletins and torque Specifications for all terminations.
8. 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: Transfer switch 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 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 SYSTEM START-UP
A. Upon completion of installation, a factory trained dealer service representative shall perform initial start-up of the transfer switch. Sufficient time shall be allowed to properly check the system out and perform required minor adjustments before the Engineer's witnessed test shall begin.

1.09 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. Asco.
2. Russelectric Inc.
3. Onan.
B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.
2.02 GENERAL REQUIREMENTS

A. Automatic open transition transfer type switches:
   1. Switches shall be configured as an open transition (break-before-make) transfer switch and a
      microprocessor controller to provide automatic operation. Arrangement shall be double-throw
      power transfer switch mechanism type. The switch shall be mechanically interlocked to ensure
      only two possible positions, normal or emergency.
   2. Switches shall transfer the load with an interruption (open transition) by momentarily disconnecting
      both sources of power, only when both sources are present and acceptable.
   3. The switches shall operate in this conventional mode, break-before-make (open transition), when
      the power source serving the load fails.

B. Transfer switch(es) shall be in accordance with Specifications and as indicated on the Drawings.

C. Where 4-pole switches are indicated, provide 100 percent rated neutral switching capacity.

D. Train and bundle factory wiring and identify consistently with Shop Drawings, either by color code or by
   numbered or lettered wire and cable tape markers at terminations.
   1. Designated terminals accommodate field wiring.
   2. Power terminal arrangement and field wiring space.
   3. Pressure-type terminals, suitable for copper or aluminum conductors, sized as indicated.
   4. Control wiring equipped with lugs suitable for connection to terminal strips.

E. Transfer switch ratings:
   1. Voltage: 480 volts, 3 phase, 4 wire, 60 Hz.
   2. Switched poles: 4-pole, switched neutral.
   3. Switch operation: Open transition.
   4. Continuous rating: as indicated on the Drawings.
   5. Interrupting capacity: 100 percent of continuous rating.
   6. Withstand current rating: UL-1008; rated to withstand the available RMS symmetrical short circuit
      current. Rating shall match or exceed the value indicated on Drawings at distribution equipment
      serving transfer switch (on utility service side).

2.03 AUTOMATIC TRANSFER SWITCH (ATS)

A. The ATS shall be electrically operated and mechanically held. The electrical operator shall be a momentarily
   energized, solenoid mechanism.

B. The ATS shall be positively locked and unaffected by momentary outages, so that contact pressure is
   maintained at a constant value and contact temperature rise is minimized for maximum reliability and
   operating life.

C. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented,
   blow-on construction for high withstand and close-on capability and be protected by separate arcing
   contacts.
D. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. Switches rated 600 amps and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.

E. For open transition type, where neutral conductors must be switched, the ATS shall be provided with fully rated overlapping neutral transfer contacts. The neutrals of the normal and emergency power sources shall be connected together only during the transfer and retransfer operation and remain connected together until power source contacts close on the source to which the transfer is being made. The overlapping neutral contacts shall not overlap for a period greater than 100 milliseconds.

F. Where neutral conductors are to be solidly connected, a neutral conductor plate with fully rated AL-CU pressure connectors shall be provided.

G. The ATS shall be equipped with a safe manual operator, permanently attached to the motor operator, designed to prevent injury to operating personnel. The manual operator shall provide the same contact-to-contact transfer speed as the electrical operator to prevent a flashover from switching the main contacts slowly.

H. The ATS control section shall be supplied with a protective cover and be mounted at a location within the enclosure suitable for ease of maintenance. Sensing and control logic shall be solid-state type. Printed circuit boards shall be keyed to prevent incorrect installation. Interfacing relays shall be industrial control grade plug-in type with dust covers.

I. All switch and relay contacts, coils, springs and control elements shall be removable from the front of the transfer switch without removal of the switch from the enclosure and without disconnection of drive linkages or power conductors.

J. All control relays shall be continuous duty; industrial type with wiping contacts rated at least 10 amperes.

K. The thermal capacity of the main contacts shall not be less than 20 times the continuous duty rating for a minimum of 3 electrical cycles as established by certified test data.

2.04 ATS CONTROL OPERATION

A. The controller’s sensing and logic shall be provided by a single built-in microprocessor for maximum reliability, minimum maintenance, and the ability to communicate serially through a serial communication module.

B. A single controller shall provide twelve selectable nominal voltages for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to ±1% of nominal voltage. Frequency sensing shall be accurate to ±0.2%. The panel shall be capable of operating over a temperature range of -20 to +60 degrees C and storage from -55 to +85 degrees C.

C. The controller shall be connected to the ATS by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the ATS for routine maintenance. Sensing and control logic shall be provided on multi-layer printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers. The panel shall be enclosed with a protective cover and be mounted separately from the ATS unit for safety and ease of maintenance. The protective cover shall include a built-in pocket for storage of the operator’s manuals.

D. The microprocessor controller shall include, but not necessarily be limited to the following:

   1. Voltage and frequency sensing monitors. Monitors shall initiate a standby sequence of operation upon complete loss or reduction of any phase-to-phase voltage to an adjustable range of 70% to 95% of rated voltage. The ATS shall transfer to the standby source when its voltage reaches 95% of rated frequency and an adjustable value between 85% and 95% of rated voltage.
2. The ATS shall retransfer to normal when the voltage reaches an adjustable value between 85% and 95% and all time delays have expired.

3. The standby sequence of operation shall be initiated upon loss or reduction of normal source voltage, after an adjustable time period of between 0 and 5 seconds. Retransfer to the normal source shall occur after the normal source has been restored for an adjustable time period of between 0 and 30 minutes. This time delay shall automatically be bypassed if the standby source should fail and the normal source is available. After retransfer to the normal source, the generator(s) shall continue to run for an adjustable time period between 0 and 5 minutes.

E. Accessories:

1. Contact on the main shaft that closes when normal source fails for initiating engine starting, rated 10 amps, 32 VDC. Contacts shall be gold plated for low voltage service.

2. Contact on the main shaft that opens when normal source fails rated 10 amps, 32 VDC contacts shall be gold plated for low voltage service.

3. Provide a green signal light to indicate when the ATS is connected to the normal source. A red signal light to indicate when the ATS is connected to the emergency source.

4. Two white signal lights to indicate availability of both sources. The light shall illuminate only when the source is truly available, i.e. within normal voltage and frequency tolerances; monitor three phases on the utility and one phase on the emergency.

5. All lights shall be visible without opening the cover. Provide single pushbutton to test all indicating lights.

6. Provide two auxiliary contacts that are closed when the ATS is connected to normal and two auxiliary contacts that are closed when the ATS is connected to emergency; Rated 10 amps, 120 VAC.

7. A test pushbutton switch to momentarily simulate normal source failure. Pushbutton shall be spring maintained in the automatic position. Locate the pushbutton on the outside of the front cover.

8. Adjustable voltage sensing relays on each phase of normal source set to drop out and start the generator at 85% of normal and restore to utility at 90% of normal rating.

9. Voltage and frequency monitors to prevent transfer to emergency until the emergency source reaches 90% of its voltage and 95% of its frequency rating.

10. Time delay on restoring load to normal after power failure has ended, adjustable 0 - 30 minutes and set at 30 minutes. Any momentary dips in the line will cause the time delay to reset and start its time cycle over. This time delay shall be automatically by-passed if the emergency source fails and the normal source is available.

11. Provide a pushbutton switch for manual transfer to normal to bypass the time delay. However, if the normal source fails, retransfer to emergency source should be automatic if the emergency source is available. Pushbutton shall be mounted to the front cover.

12. Time delay on stopping of engine after load has been restored to normal source to provide a generator cool down period, adjustable 0 - 30 minutes, set at 5 minutes.

13. Time delay, to delay generator-start signal and override momentary normal source outages, adjustable 0.5 - 6 seconds, set at 1 second.
14. Time delay on transfer to emergency source after emergency source becomes available, adjustable 0 - 5 minutes, set at 0 seconds.

15. The above user adjustable devices shall be adjustable without the use of tools, power supplies, meters, etc. The above settings shall be set at the factory.

16. A two position switch, "TEST-NO LOAD/TEST WITH LOAD," such that when in the "TEST-NO LOAD" position and the test switch is activated the generators shall start but the ATS shall remain in the normal position. In the "TEST WITH LOAD" position the ATS will transfer to the emergency source. In either position, the switch shall automatically transfer to the live source in the event of a failure of the other source. It shall be possible to use this switch to transfer back and forth between sources during a test. Mount switch to front cover.

17. Plant exerciser with 7-day dial to automatically exercise the generating plant. Adjustable type with minimum of 15-minute increments.

18. Equipment grounding lug sized for ground wires indicated on Drawings.

19. Provide long barrel, 2-hole, high-compression circumference crimp type lugs for the feeder conductors, size as specified on the Drawings. Bussing shall be designed to accommodate the number of crimp type lugs as required by the feeder size indicated in the Drawings.

20. Time delay for switching from the off position to the emergency source position, adjustable 0 - 60 seconds, set at 2 seconds.

21. Time delay for switching from the off position to the normal source position, adjustable 0 - 60 seconds, set at 2 seconds.

22. All control wires shall be 600 volt, rated.

2.05 ENCLOSURE

A. Transfer switch shall be wall mounted and non-ventilated NEMA ICS 6, type 1, smooth sheet metal enclosure constructed in accordance with UL 1008.

2.06 FINISH

A. Five step zinc phosphate pre-treatment, one coat of rust inhibiting dichromate primer and one coat baked-on enamel finish, ANSI 61 (light gray).

B. A seven step spray wash, electroplate primer with final baked-on enamel finish; ANSI 61 (light gray) is an acceptable finish alternative.

2.07 SOURCE QUALITY CONTROL

A. Factory tests:

1. Transfer switch shall be completely assembled, wired, adjusted and tested, per ANSI C37.20, at the factory under simulated service conditions to assure the accuracy of the wiring and the functioning of all equipment. The minimum of the following tests shall be performed and the documentation and measurements shall be included in Operation and Maintenance Manual.

2. Dielectric test.

3. Mechanical test.

5. Electrical operation and control wiring test.
6. Control wiring.
7. Polarity test.

B. Submit the certified test reports to the Engineer to confirm that all components have been tested to substantiate designs according to applicable ANSI and NEMA Standards. Tests shall verify the performance of the components as well as the suitability of the enclosure venting, rigidity and bus bracing.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Contractor shall thoroughly examine Project site conditions for acceptance of transfer 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. Ensure all conduit stub-ups for bottom entry into transfer switch are in place and located as required per Shop Drawings.

3.03 INSTALLATION

A. Install transfer switch(es) in accordance with Manufacturer's written instructions, as indicated on the Drawings and as specified herein.

B. Transfer switches shall be anchored and braced to withstand seismic forces as calculated per Section 260010: Basic Electrical Requirements.

C. 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 NETA Standard Tables.

D. Mark torque bolt heads using red or pink paint.

E. “Train” interior wiring; bundle and clamp, using specified plastic wire wraps specified under Section 260519: Building Wire and Cable.

F. Replace any panel pieces, doors or trims having dents, bends, warps or poor fit that may impede ready access, security or integrity.

G. Conduits terminating in concentric, eccentric or oversized knockouts at transfer switch shall have ground bushings and bonding jumpers installed interconnecting all such conduits and the switch enclosure.

3.04 FIELD QUALITY CONTROL

A. Refer to Specification Section 260800: Electrical Commissioning.

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 transfer switch 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 transfer switch 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 system is energized.

F. 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. Perform manual transfer operation.
   g. Confirm proper lubrication.
   h. Check switch to ensure positive mechanical interlocks between normal and alternate sources.

3. Electrical tests:
   a. Perform insulation-resistance tests phase-to-phase and phase-to-ground with switch in both source positions. Test voltage shall be 1000-volts DC.
   b. Perform a contact-resistance test across all main contacts.
   c. Verify settings and operation of control devices in accordance with the Specifications.

G. Functional performance testing: Refer to Specification Section 260800: Electrical Commissioning for requirements of system wide functional performance testing.

H. 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.
I. Contractor shall replace at no costs to the Owner all devices which are found defective or do not operate within factory specified tolerances.

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, observation, deficiencies and remedies. Test report shall be included in the operation and maintenance manuals.

3.05 CLEANING

A. Prior to energizing of transfer switch 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 transfer switch per Manufacturer's 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. Refer to Specification Section 260800: Electrical Commissioning.

B. 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.

C. Contractor shall schedule training with a minimum of 7 days advance notice.

END OF SECTION
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 lighting fixtures.
2. Site lighting fixtures.
3. Diodes.
4. Ballast and LED drivers.
5. Diffusers.
6. Pole standards.

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. Division 03: Cast-in-place concrete. Light pole foundations and backboxes.
2. Division 05: Miscellaneous. Fittings, brackets, backing supports, rods, etc. as required for support and bracing of lighting fixtures.

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-L-00116D; Lamps, Fluorescent (general specification).

   ANSI C82.1; Specification for Fluorescent Lamp Ballasts.
   ANSI C82.2; Fluorescent Lamp Ballasts, Method of Measurement.

3. Underwriters Laboratories, Inc. (UL):
   UL 66; Fixture Wire.
   UL 542; Lampholders, Starters and Starter Holders for Fluorescent Lamps.
   UL 844; Electric Lighting Fixtures for Use in Hazardous Locations.
   UL 1598; Luminaires.
UL 2108; Low Voltage Lighting Systems.

4. National Electrical Manufacturer Association (NEMA):

5. Illumination Engineering Society of North America (IESNA):
   IESNA LM-80-2008; Approved Method for Measuring Lumen Maintenance of LED Light Sources.

6. Restriction of Hazardous Substances in LED (RoHS):

1.03 SYSTEM DESCRIPTION

A. Provide and install a fully functional and operating lighting fixture system as indicated, complete with lamps, wiring, control 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 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. Independent Testing Laboratories, Inc. or equal, photometric test report for each luminaire type and lamp combination listed on the fixture schedule. Test reports shall be based on Illuminating Engineering Society published test procedures and shall contain candlepower distribution curves in five lateral planes for fixtures with asymmetric distributions and fixture luminance data for vertical angles above 45 degrees from nadir.

4. Shop Drawings:
   a. Suspension details for fixtures recessed in, mounted on or suspended from hung ceilings. Details shall clearly illustrate proposed methods for complying with the requirements of CAC Title 24 and UBC Standard No. 47-18 requiring support independent of the suspended ceiling system.
   b. Where noted in the Fixture Schedule or drawings, submit Shop Drawings of special mounting details, including fixture support, attachment methods, etc. Shop Drawings shall include plan and section views indicating all structural members being used for support.

5. Submit Manufacturer's installation instructions.

6. Complete bill of material listing all lighting fixtures, lamps and other components.

7. Warranty.
8. In addition to the requirements for Substitutions, under Section 260010: Basic Electrical Requirements, all requests for approval of non-specified products must be accompanied by the following:

   a. A list of comparable buildings where the product is currently installed and can be observed. Buildings shall be within a 100 mile radius of Lighting Consultants office.

   b. Furnish a working sample complete with housing, trim, 8’ cord and plug, and specified lamp.

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 description and catalog cut of each lighting fixture type.

      2. Instructions 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: Lighting fixtures 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 1 year parts and labor warranty for malfunctions resulting from defects in materials and workmanship. Warranty shall begin upon acceptance by the Owner.

   B. Ballast for fluorescent and high intensity discharge fixtures offered under this Section shall be covered by a 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. Diodes:
   a. Cree (LED)
   b. Lumi-leds (LED)

2. LED drivers:
   a. Osram Sylvania
   b. North American Philips Lighting Co. (NAPLC)

3. Lighting fixtures: Refer to Fixture Schedule on Drawings.

B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

2.02 GENERAL

A. 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.

B. Fasteners shall be manufactured of galvanized steel.

C. Fixtures shall be free of light leaks and shall be designed to provide sufficient ventilation of lamps and ballasts, including vent holes where required.

D. 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. All intersections and joints shall be formed true and of adequate strength and structural rigidity to prevent any distortion after assembly. All surfaces shall be finished so as to eliminate all exposed sharp edges. 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.

E. Lampholders shall hold lamps securely against normal vibrations and maintenance handling. Provide solid nickel or nickel-and-silver-plated contacts in lampholders for following types of lamps:
   1. Metal halide.
   2. Tungsten-halogen.

F. Wiring channels and lampholder mountings shall be rigid and accurately constructed.

2.03 LAMPS

A. Light emitting diodes (LED):

1. Refer to the Fixture Schedule for size and type of LED lamps required.

2. All diodes shall come from the same manufacturer and carry the same bin number.

3. All diodes shall be tested and tuned for the optimal Kelvin color point.
5. Minimum CRI (Color Rendering Index): 80
6. LED fixture components shall be free of all toxic materials to include lead, cadmium and mercury, and shall be RoHS compliant.
7. Groups of three or more diodes in a single housing shall be tested for even distribution.
8. Standard lumen output shall meet or exceed the State of California Title 24 Energy Code for high efficiency luminaries.
9. All LED fixtures shall have an IES formatted electronic photometric report.
10. Diodes shall have a minimum life of 50,000 hours and maintain at least 70% of initial lamp lumens throughout this period.

2.04 BALLASTS

A. LED Drivers:
   1. LED drivers shall be integral to fixture housing or remotely located, when specified, within 15 feet of diode assembly.
   2. Drivers shall have a minimum life of 50,000 hours and maintain at least 70% of initial lamp lumens for that period.

2.05 LENSES

A. Fresnel:
   1. Lenses shall have uniform brightness throughout the entire visible area at angles from 45 to 90 degrees vertical, without bright spots or striations.
   2. Lenses shall have opaque risers in colors as specified under the Fixture Schedule.
   3. The same Manufacturer, unless otherwise specified, shall furnish all fixtures with fresnel lenses.

B. Glass:
   1. Flat glass lenses shall be heat tempered borosilicate glass unless otherwise noted.
   2. Glass finishes (i.e. sandblasted, etching, polishing) shall be performed as described in the fixture description.

C. Acrylic:
   1. Lenses shall be injection molded crystal clear 100% virgin acrylic (except as indicated otherwise in the Fixture Schedule). 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 Fixture Schedule.

4. Plastic electrical light diffusers must meet the requirements of Section 2-5209, CAC, Flame Spread Rating.

2.06 REFLECTOR CONES

A. Provide 45-degree lamp and lamp imaging cut-off unless otherwise specified in the Fixture Schedule. In fixtures where upper reflector is separated from cone, cut-off shall be 45-degrees unless otherwise noted.

B. Plastic materials shall to be used for reflector cones or aperture plate materials.

C. Fixture 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.

D. 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 Fixture 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 fixture parts (housing, mounting frame, etc.) shall be visible between the ceiling surface and the edge of the cone flange. The same requirement shall be applicable to fixtures where the main reflector extends down to the bottom edge of the fixture without a separate cone. In such cases, the flange shall be formed as an integral part of the main reflector.

E. 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.

F. The finish on the inner surface of the reflector shall be as described in the Fixture 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.

G. Reflector cone retention devices shall not deform the cone in any manner.

2.07 FIXTURES

A. Refer to the Fixture Schedule.

B. The finish of all fixtures and trim shall be submitted to and approved by the Architect prior to ordering.

C. All standard fixtures must bear UL label. Attaching of labels after delivery of fixtures is not acceptable.

D. All labels affixed to the fixture shall be in a location not visible from normal viewing angles.

2.08 ARCHITECTURAL COORDINATION

A. Consult Architectural Drawings for details of ceiling construction, finish, reflected ceiling plans and other applicable details and provide lighting fixtures suitable for the particular type of ceiling at each location.

B. Where fixtures 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 fixture order.

C. Where fixtures 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 fixture order.
2.09 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 fixtures, supports and appurtenances at the indicated heights above grade without deflection or whipping.

B. Arm, bracket and tenon mount materials: Match the poles.

C. Mountings, fastenings and appurtenances: Corrosion-resistant components compatible with the poles and fixtures that will not cause galvanic action at contact points. Provide mountings that will correctly position the luminaire to provide the indicated light distribution.

D. Pole shafts: Square straight.

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. Steel poles: Steel tubing conforming to ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psi. Poles are 1-piece construction up to 40 feet in length and have access handhole in wall.

I. Pole-top tenons: Fabricated to support the fixture indicated and securely fastened to the pole top.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Contractor shall thoroughly examine Project site conditions for acceptance of lighting fixture 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 fixtures. Contractor shall be responsible for coordination of fixture mounting and compatibility with ceiling construction.

B. Fixtures in areas where exposed or concealed pipe and ductwork prevents direct access to the structural ceiling, shall be provided with appropriate support system to suspend fixture below obstructions to avoid conflicts with same.

C. Consult Architectural or Landscape Drawings for details of ceiling and wall construction, finish, landscape features and other applicable details and provide backboxes and trims suitable for the particular type of ceiling or wall at each location.

3.03 INSTALLATION

A. Install lighting fixtures 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. Fixtures shall be plumb, level, square, in straight lines and without distortion. Remedy light leaks that may develop after installation of recessed or enclosed fixtures.
D. Turn over Project with all lamps in new and operating condition. Lamps that are burned less than 100 hours at Project closeout are considered new.

3.04 FIXTURE SUPPORTS

A. Physical supports:

1. Surface mounted fixtures 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 fixtures weighing over 50 pounds, provide fixture studs in recessed box.

2. Support surface mounted fixtures more than 18” wide at or near each corner or edge, in addition to support from outlet box.

3. Twisting wire around the bracket and two adjacent ceiling support channel runners on either side of fixture shall support recessed downlights manufactured with built-in brackets.

4. Where ceiling and/or wall construction or pipe and/or ductwork is such that mounting channels, strong-backs, trapezes, brackets, etc., are required to properly support fixtures, provide these supports under this Section, unless otherwise indicated.

5. Support outlet boxes as specified in Section 260533: Boxes. Provide all boxes with grounding pigtail.

6. On concrete ceilings, use one of the following for supporting fixtures other than by outlet box:
   a. Preset concrete inserts, provided inserts are completely covered by the fixture canopy.
   b. 1/4” by appropriate length wedge type anchor.

B. Seismic supports:

1. Recessed fixtures in suspended ceilings shall be supported by connecting two fixture support wires to the fixture at diagonal opposite corners for fixtures weighing 56 pounds or less. Connect four wires, one at each corner for fixtures weighing more than 56 pounds.

2. Surface mounted fixtures on suspended ceilings shall be attached to the main ceiling runner with at least two positive clamping devices and shall have a fixture support wire attached to each clamping device and to the structure above.

3. Recessed downlight fixtures in suspended ceilings shall be supported by connecting one fixture support wire to the fixture housing. Recessed H.I.D. fixtures shall have two fixture support wires attached to the housing.

4. All suspended fixtures shall be able to swing 45 degrees from vertical in any direction without obstruction. Furnish suspended fluorescent fixtures 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. Submit Drawings of hanger assembly for review prior to ordering. If suspended fixture is not free to swing 45 degrees in any direction, without obstructions, provide fixture seismic restraint to prevent contact in conform to California Uniform Building Code, Section 2330, Seismic Design.

5. Unless fixtures are cable hung, Contractor shall, provide for all suspended fixtures a safety wire or cable attached to the fixture and structure at each support capable of supporting four times the supported load.
6. All recessed fluorescent fixtures shall be furnished with earthquake clips where installed in tee bar ceiling.

3.05 IDENTIFICATION SYSTEM
A. All junction box coverplates 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.

3.06 INSTALLATION OF POLES
A. General: Store poles on decay-resistant treated skids at least 1 ft. 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. Pole installation: Use fabric web slings (not chain or cable) to raise and set poles.

3.07 CONCRETE FOUNDATIONS
A. Construct concrete foundations with 3000 pound, 28 day concrete conforming to Division 03, Section "Cast-In-Place Concrete." Comply with details and Manufacturer's recommendations for reinforcing, anchor bolts, nuts and washers.

3.08 FIELD QUALITY CONTROL
A. Visual and mechanical inspection.
1. Inspect for physical damage, defects, alignment and fit.
2. Perform operational test of each lighting fixture after installed, circuited and energized.
3. Perform emergency operational test of all lighting fixtures connected to emergency circuiting by interrupting normal power source.
B. Contractor shall replace at no cost to the Owner all equipment which is found defective or do not operate within factory specified tolerances.

3.09 CLEANING
A. Clean lighting fixtures prior to Project closeout in accordance with Manufacturer's recommended materials and methods.

END OF SECTION
SECTION 26 61 13
FIRE ALARM 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. Fire alarm control panel(s) ‘FACP’
2. Fire alarm annunciators
3. Fire alarm terminal cabinets ‘FATC’
4. Initiating devices
5. Notification appliances
6. Auxiliary equipment control and supervision
7. Record Drawings
8. Pretesting and final testing

B. Work furnish and installed under another Section, but connected under this Section:

1. Fire sprinkler alarm system flow switches, valve monitors and post indicating valves
2. Elevator controller for recall
3. Door hold-open/closure devices
4. Fire barrier roll-down doors and shutters
5. Fire/smoke dampers
6. Fan and damper smoke control system equipment

C. Work furnished and connected to alarm system under this Section, but installed and connected to HVAC system under another Section:

1. Duct mounted smoke detectors at supply air HVAC equipment 2000 cfm and larger.
2. In-duct mounted smoke detectors at ducted fire/smoke damper. Except that wiring for damper power, control and monitoring shall be under this contract.

D. Work furnished and installed under another Section: HVAC shutdown wiring via dry contacts in remote mounted programmable relays.

E. 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. Division 08: Door Hardware
2. Division 14: Elevators
3. Division 23: HVAC System

4. Division 21: Fire Sprinkler System

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 C62.41; Guide for Surge Voltage in Low-Voltage AC Power Circuits
   - ANSI/ASME A17.1; Safety Code for Elevators and Escalators

2. National Fire Protection Association (NFPA):
   - NFPA 13; Standards for the Installation of Fire Sprinkler Systems
   - NFPA 72; National Fire Alarm Code
   - NFPA 90A; Standard for the Installation of Air Conditioning and Ventilating Systems
   - NFPA 101; Life Safety Code

3. Underwriters Laboratories, Inc. (UL):
   - UL 38; Manually Activated Signaling Boxes
   - UL 268; Smoke Detectors for Fire Protective Signaling Systems
   - UL 268A; Smoke Detectors for Duct Applications
   - UL 464; Audible Signal Appliances
   - UL 497B; Protectors for Data Communications and Fire Alarm Circuits
   - UL 521; Heat Detectors for Fire Protective Signaling Systems
   - UL 864; Control Units for Fire-Protective Signaling Systems
   - UL 1424; Cables for Power-Limited Fire-Alarm Circuits
   - UL 1481; Power Supplies for Fire-Protective Signaling Systems
   - UL 1638 Visual Signaling Appliances Standard
   - UL 1971 Signal Devices for the Hearing Impaired

4. Factory Mutual System (FM):
   - FM P7825 Approval Guide
1.03 DEFINITIONS

A. Addressable device: A fire alarm system initiating, control or monitoring device module component on a signaling line circuit (SLC) with discrete digital identification that can have its status individually identified or that is used to individually control other functions, using site-specific programming at the fire alarm control panel.

B. Alarm signal: A signal indicating an emergency that requires immediate action, such as a signal indicative of fire.

C. Annunciator: A unit containing one or more indicator lamps, alphanumeric displays or other equivalent means in which each indication provides status information about a circuit, condition or location.

D. Circuits and pathways:
   1. Class B: Performance that does not include a redundant pathway and will not be capable of operation past a single open or ground fault condition, but does include monitoring and annunciation of a trouble signal when either condition occurs. Any conditions that affect the intended operation of the path are annunciated as a trouble signal.

E. Initiating device: A system component that originates transmission of a change-of-state condition, such as in a smoke detector, manual fire alarm box or supervisory switch.

F. Initiating device circuit: A circuit to which automatic or manual initiating devices are connected where the signal received does not identify the individual device operated.

G. Notification appliances: A fire alarm system component such as a bell, horn, speaker, light or text display that provides audible, tactile or visible outputs or any combination thereof.

H. Notification appliance circuit: A circuit or path directly connected to a notification appliance(s).

I. Signaling line circuit: A circuit or path between any combination of circuit interfaces, control units or transmitters over which multiple system input signals or output signals or both, are carried.

J. Supervisory signal: A signal indicating the need for action in connection with the supervision of guard tours, the fire suppression systems or equipment or the maintenance features of related systems.

K. Trouble signal: A signal initiated by the fire alarm system or device indicative of a fault in a monitoring circuit or component.

1.04 SYSTEM DESCRIPTION

A. The fire alarm system shall be a microprocessor-based direct wired, multi-priority, peer-to-peer networked system. The system shall utilize independently addressed, microprocessor-based smoke detectors, heat detectors, and modules as described in this Specification. It shall be complete with all necessary hardware, software and memory specifically tailored for this installation. It shall be possible to permanently modify the software on site by using a plug-in programmer.

B. It shall be 24Vdc closed circuit, electronically supervised, common signaling, device indicating, and automatic alarm type. The system shall include all wiring, raceways, pullboxes, terminal cabinets, outlet and mounting boxes, control equipment, alarm and supervisory signal initiating devices, alarm notification appliances and all other accessories required for a complete operating system.

C. Provide system with the following circuit and pathway performance:
   1. Initiating devices circuits (IDCs): Class B.
   2. Signaling line circuits (SLCs): Class B.
3. Notification appliance circuits (NACs): Class B.

D. Standby power: The standby power supply shall be an electrical battery with capacity to operate the system under maximum supervisory load for twenty four (24) hours and capable of operating the system for five (5) minutes of evacuation alarm on all devices, operating at maximum load. The system shall include a charging circuit to automatically maintain the electrical charge of the battery. The system shall automatically adjust the charging of the battery to compensate for temperature.

E. Voltage drop:

1. Under all operating conditions, the voltage on the NAC must be sufficient to operate all the notification appliances so that they deliver the proper signal intensity. The worst case operating condition shall be calculated from when the control unit primary power supply has failed and the battery capacity is at its lowest point. An end of useful battery life starting value of 20.4 Volts shall be used at the starting voltage unless the manufacturer’s instructions indicate that a higher or lower value should be used. The current draw of an appliance at the minimum listed operating voltage (16 Volts) should be used.

2. The point-to-point Ohm’s Law voltage drop calculations of all alarm system circuits shall not exceed

F. Auxiliary equipment requiring control and monitoring:

1. Flow switches, tamper switches and PIV monitoring
2. Emergency generator monitoring
3. Elevator recall and monitoring
4. Interface and provide fan shutdown control for all supply fans over 2000cfm
5. Interface and provide fire/smoke damper (FSD) control and monitoring
6. Door hold/open release device power and control

1.05 SEQUENCE OF OPERATION

A. For system description of output controls and monitoring, based on input signals, refer to Sequence of Operation Matrix on the Drawings.

B. General alarm operation: Upon alarm activation of any area smoke detector, duct smoke detector, heat detector, manual pull station, sprinkler waterflow, etc., the following functions shall automatically occur:

1. The internal audible device shall sound at the control panel and annunciator.

2. The LCD Display shall indicate all applicable information associated with the alarm condition including zone, device type, device location and time/date.

3. Any remote or local annunciator LCD/LED’s associated with the alarm zone shall be illuminated.

4. The following notification signals and actions shall occur simultaneously:

   a. Horns shall sound throughout the building.

   b. Activate visual strobes throughout the building.

5. All self-closing fire/smoke doors held open shall be released.
6. All automatic events programmed to the alarm point shall be executed and the associated outputs activated.

C. Elevator lobby/equipment room detectors: Upon alarm activation of any elevator lobby smoke detector or equipment/control room detectors, the following functions shall automatically occur:

1. Perform general alarm sequence above.
2. Activation of elevator lobby smoke detectors (other than primary floor) shall recall the elevators to primary floor.
3. Activation of elevator lobby smoke detectors located on the primary recall floor shall recall the elevator the alternate floor.
4. Activation of equipment/control room smoke detectors shall recall the elevator to the primary floor.
5. Activation of the equipment room heat detector shall initiate the shunt-trip of service power to the associated elevator equipment.

D. Supervisory operation: Upon supervisory activation of any sprinkler valve supervisory switch, fire pump off-normal, etc., the following functions shall automatically occur:

1. The internal audible device shall sound at the control panel and annunciator.
2. The LCD display shall indicate all applicable information associated with the supervisory condition including: zone, device type, device location and time/date.
3. Any remote or local annunciator LCD/LED's associated with the supervisory zone shall be illuminated.
4. Transmit signal to the central station with point identification.

E. Trouble operation: Upon activation of a trouble condition or signal from any device on the system, the following functions shall automatically occur:

1. The internal audible device shall sound at the control panel and annunciator.
2. The LCD keypad display shall indicate all applicable information associated with the trouble condition including: zone, device type, device location and time/date.
3. Any remote or local annunciator LCD/LED's associated with the trouble zone shall be illuminated.
4. Transmit signal to the central station with point identification.

F. Monitor activation: Upon activation of any device connected to a monitor circuit (fire pump, emergency generator status, etc.), the following functions shall automatically occur:

1. The LCD display shall indicate all applicable information associated with the status condition including: zone, device type, device location and time/date.
2. Any remote or local annunciator LCD/LED's associated with the status zone shall be illuminated.

G. In addition to the above sequence of operation, the FACP shall perform the following functions:

1. Identify every addressable device by location, priority and device type.
2. Read and display at FACP the sensitivity of addressable smoke and heat detection devices.
3. Remain 100% operational and capable of responding to an alarm condition while in the routine maintenance mode.

4. Be capable of supporting non-addressable as well as addressable devices.

5. Allow individual programmable control of each connected remote or panel-mounted relay.

6. Provide the user with the field programmability to add or change addressable device types and custom messages on-site.

7. Display up to 127 alarms and/or up to 127 trouble indications, one at a time, as a list on the system printer/terminal.

8. Change the status of configured circuits (arming or disarming) and change status of relays.

9. Generate an addressable detector sensitivity report providing a chamber voltage listing (device testing) for each detector.

1.06 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. A complete set of shop drawings shall be supplied. The shop drawings shall be reproduced electronically in digital format. This package shall include but not be limited to:

   a. All drawings and diagrams shall include the contractor's title block, complete with drawing title, contractor's name, address, date including revisions, and preparer's and reviewer's initials.

   b. Detailed system operational description. Any Specification differences and deviations shall be clearly noted and marked.

   c. A riser diagram that individually depicts all control panels, annunciators, addressable devices and notification appliances. Field addressable devices and notification appliances may be grouped together by specific type per loop or circuit.

   d. Complete 1/8” = 1'-0 scale floor plan drawing locating all system devices and elevation of all equipment. Floor plans shall indicate accurate locations for all control and peripheral devices as well as raceway size and routing, junction boxes, and conductor size, and quantity in each raceway. All notification appliances shall be provided with a candela rating and circuit address that corresponds to that depicted on the Riser Diagram. If individual floors need to be segmented to accommodate the 1/8” scale requirements, KEY PLANS and BREAK-LINES shall be provided on the plans in an orderly and professional manner. End-of-line resistors (and values) shall be depicted.
e. Control panel wiring and interconnection schematics. The drawing(s) shall depict internal component placement and all internal and field termination points. Drawing shall provide a detail indicating where conduit penetrations shall be made, so as to avoid conflicts with internally mounted batteries. For each additional data-gathering panel, a separate control panel drawing shall be provided, which clearly indicated the designation, service and location of the control enclosure.

f. Complete calculations shall clearly indicate the quantity of devices, the device part numbers, the supervisory current draw, the alarm current draw, totals for all categories, and the calculated battery requirements. Battery calculations shall also reflect all control panel component, remote annunciator, and auxiliary relay current draws.

g. System (Load & Battery) calculations shall be provided for each system power supply, each notification appliance circuit and each auxiliary control circuit that draws power from any system power supply.

h. Additionally, Drawings shall include:
   1) Symbols legend.
   2) Equipment list showing quantity, make, model and CSFM listing number for each device.
   3) Wire and cable schedule.
   4) Scope of Work with overall system description.
   5) Sequence of operation matrix with system inputs signals and output functions.
   6) Code summary and Building type.
   7) Assignment of Class and/or Style designation for device circuits.
   8) Elevation indicating mounting heights for manual pull stations, audible and visual devices and combination audible/visual devices.
   9) Rated penetration details.
   10) Typical wiring diagram details of field devices.
   11) Detector mounting details at HVAC ducts.
   12) Voltage drop calculations for system wiring circuits.

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 materials listing all components.

8. Warranty.

B. Contractor shall submit approved Shop Drawings for review by State or Local Fire Marshal prior to the purchase and installation of equipment. Provide quantities of Drawing sets as required by jurisdiction. Drawings shall be wet stamped and signed by a registered professional Engineer.
C. Record Drawings:

1. Furnish Record Drawings as described in Section 260010: Basic Electrical Requirements, utilizing Shop-Drawing submissions with updated field conditions. These Drawings shall include but not be limited to the following:
   
a. Plot plans and building floor plans, showing point-to-point wiring location of and conduit routing to all devices.

b. Block Diagram/Riser Diagram showing the FACP, system components and all conduit and wire type/sizes between each.

2. Drawings shall be incorporated into the Record Drawing submission.

3. Final acceptance will not be made until the Engineer has approved the Record Drawings.

1.07 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 Drawings of wiring system, including all initiation and annunciation devices, control panel, annunciators, etc.

5. Telephone numbers for the authorized parts and service distributors.

6. Final testing reports.

1.08 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. All work in this Section shall be performed (furnished, installed, connected, programmed and tested) by a qualified fire alarm contractor. The fire alarm contractor shall provide the following documentation to show compliance with the contractor qualifications.

1. Contractor’s License: A copy of the contractor’s valid State License. The contractor must be licensed in the State where project is located and have been in business in that State for a minimum of 5 years.

2. Proof of Experience: Proof that the fire alarm contractor has successfully installed similar fire alarm systems on a previous project of comparable size and complexity. Provide a statement summarizing any pending litigation involving an officer or principal of/for the company, the nature of the litigation and what effect the litigation may carry as it relates to this work in the worst case scenario. Non-disclosure of this item, if later discovered, may result, at the Owner’s discretion, in termination of this contract with the contractor bearing all associated costs.

3. Insurance Certificates: Copy of fire alarm contractor’s current liability insurance and state industrial insurance certificates in conformance with the contract document.
4. Service Capability: The fire alarm contractor shall have in-house Engineering, installation and service personnel with a maintenance office within 50 miles of the project location.

5. Authorization Letters: Letters from the fire alarm equipment manufacturer stating that the fire alarm contractor is a Factory Authorized Distributor, and is trained and certified for the equipment proposed on this project and is licensed to purchase and install the software required to provide the specified functions.

6. Certifications:
   a. Provide a copy of the National Institute for Certification in Technologies (NICET) Technician Level 3 Certificate for the employee actively involved in this project.
   b. Documentation that the fire alarm contractor has on staff personnel factory-trained and certified for the equipment proposed for this project.

1.09 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery: Fire alarm system 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.

1.10 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.

B. The warranty package shall include, but not be limited to the following:
   1. Emergency maintenance service.
   2. Service by factory trained service representative of system Manufacturer.
   3. Replacement of any defective components.

1.11 SYSTEM START-UP

A. Upon completion of installation, a factory trained dealer service representative shall perform initial start-up of the fire alarm 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 Service:

1. For a period of one year following acceptance the equipment Supplier shall have a person(s) familiar with this Project attend four quarterly 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. During the eleventh month following system acceptance, on a weekend day, the equipment Supplier shall perform a complete test of the system, in a manner similar to the acceptance test. A written report shall be submitted to the Owner certifying that each initiating device has been tested. A copy of these test forms shall be submitted to the Engineer for review and acceptance.

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. EST.
2. Gamewell/FCI (Fire Control Instruments).
4. Siemens.

B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

2.02 CONTROL PANEL ‘FACP’

A. General:

1. The control panel shall comply with applicable requirements of UL864 and shall provide power, annunciation, supervision and control for the complete fire alarm system. The panel shall be installed in a surface mounted steel cabinet, containing all modules necessary to operate as indicated herein. The operating controls shall be located behind hinged, locked door with viewing window. All control modules shall be labeled, and all zone locations shall be identified.

2. The panel shall be supervised, site programmable, and of modular design supporting up to 64 network nodes. The peer-to-peer network shall contain multiple nodes consisting of the command center, main controller, remote control panels, and annunciation nodes. Each node is an equal, active functional node of the network, which is capable of making all local decisions and generating network tasks to other nodes in the event of node failure or communications failure between nodes. When utilizing a network and multiple wiring faults occur, the network shall re-configure into many sub-networks and continue to respond to alarm events from every panel that can transmit and receive network messages.

3. The panel module shall control and monitor all local or remote peripherals. It shall support a large 168 character LCD, power supply, remote LCD and zone display annunciators, etc.

4. The programmer shall be able to download all network applications from the configuration computer to all the network panels from a single location on the system.
5. The panels shall have the ability to add an operator interface control/display at each node that shall
  annunciate, command and control system functions.

6. The system shall store all basic system functionality and job specific data in non-volatile memory.
  All site specific and operating data shall survive a complete power failure intact.

7. The control panel shall contain a standby power supply that automatically supplies electrical
  energy to the system upon primary power supply failure. The system shall include a charging
  circuit to automatically maintain the electrical charge of the battery.

8. All addressable devices shall be individually identified by the system and any quantity of
  addressable devices may be in alarm at any time up to the total number connected to the system.

9. Dynamic supervision of system electronics, wiring, initiating devices and software shall be provided
  by the control system. Failure of system hardware or wiring shall be indicated by type and location
  on the alphanumeric annunciator. Software and processor operation shall be monitored by an
  independent hardware watchdog, which will indicate their failure. The panel shall provide failsafe
  operation, i.e. all incoming alarms shall override all other modes of operation.

10. Provide a service mode to permit the arming and disarming of individual initiating or output devices
    as well as manually operating output devices. Status of these devices shall be displayed upon
    command from the control panel. The panel shall automatically return to the normal mode in the
    event the panel remains unattended in the service mode.

11. The panel shall be capable of measuring and adjusting the sensitivity of addressable detectors
    upon request. An alphanumeric display shall be provided to display custom messages and give
    readings of detector sensitivity detector by detector. Each device on an addressable initiating
    circuit shall be checked continuously to include the following:

    a. Sensitivity.
    b. Response.
    c. Opens.
    d. Shorts.
    e. Ground faults.
    f. Functionality.
    g. Status.

12. The panel shall monitor the addressable smoke detectors in such a manner that if the detectors
    become dirty and reach and maintain 80% of alarm threshold for five (5) consecutive hours, a
    trouble condition indicating exactly which device needs service shall be automatically annunciated.
    If the device becomes too insensitive for a period of 10 seconds, the trouble indication will read:
    "Input device response too low".

13. The panel shall report, by specific device number, any device removed from an addressable
    initiating circuit and all other devices shall continue to function.

14. The panel shall automatically indicate the total quantity of alarms and troubles, which have
    occurred prior to reset at the control unit.

15. No alarm or trouble indication shall be resettable until it has been acknowledged. It shall not be
    possible to reset the system until all alarms have been acknowledged.
16. The panel shall be capable of:
   a. Counting the number of addressable devices within a designated area or "zone" which
      are in alarm.
   b. Counting "zones" which are in alarm.
   c. Counting the number of addressable devices, which are in alarm on the system.
   d. Differentiating among types of addressable devices such as smoke detectors, manual
      stations, workflow switches, heat detectors, etc.
   e. Assigning priorities to types of devices, zones or groups of devices.
   f. Cross-Zoning.

17. Each addressable device shall report its condition to the panel control unit every three (3) seconds
    in a manner such that failure of the connections to or internal electronics of the device will result in
    a trouble signal that identifies the specific device involved.

B. Signaling line circuits (SLC):

1. The control panel shall be supervised, site programmable, and of modular design supporting up to
   125 detectors and 125 remote modules per addressable SLC. The panel shall support up to 10
   SLC's per panel for a total system capacity of 2500 intelligent addressable points. The system
   shall be designed with peer-to-peer networking capability for enhanced survivability, with support
   for up to 64 nodes, each with up to 2500 points and an overall capacity of 160,000 points.

2. The system shall provide electronic addressing of analog/addressable devices.

3. The system shall have built-in automatic system programming to automatically address and map
   all system devices attached to the main controller.

4. The system shall use full digital communications to supervise all addressable loop devices for
   placement, correct location, and operation. It shall allow swapping of "same type" devices without
   the need of addressing and impose the "location" parameters on replacement device. It shall
   initiate and maintain a trouble if a device is added to a loop and clear the trouble when the new
   device is mapped and defined into the system.

5. The system shall have a UL Listed detector sensitivity test feature, which will be a function of the
   smoke detectors and performed automatically every 4 hours.

C. Digital alarm communicator transmitter (DACT):

1. The system shall provide DACT for off premise communications capability, transmitting system
   events to single or multiple Central Monitoring Station (CMS) receivers.

2. The system shall capable of providing the CMS with point identification of system events using
   Contact ID or SIA DCS protocols.

3. In the event of a panel CPU failure during a fire alarm condition, the DACT degrade mode shall
   transmit a general fire alarm signal to the CMS.

D. Internal Modular Power Supply:

1. System power supply(s) shall provide multiple power limited 24 VDC output circuits as required by
   the panel.
2. Upon failure of normal (AC) power, the affected portion(s) of the system shall automatically switch over to secondary power without losing any system functions.

3. Each system power supply shall be individually supervised. Power supply trouble signals shall identify the specific supply and the nature of the trouble condition.

4. All standby batteries shall be continuously monitored by the power supply. Low battery and disconnection of battery power supply conditions shall immediately annunciate as battery trouble and identify the specific power supply affected.

5. All system power supplies shall be capable of recharging up to 260AH batteries, from a fully discharged condition to a capacity sufficient to allow the system to perform consistent with the requirements of this section, in 48 hours maximum.

6. Power supply shall be adequate to supply all system components of the fire alarm system, including FACP modules, initiating devices, notification appliances, remote control and monitoring devices, annunciators, etc. All power connections whether AC or DC shall be separately fused within panel.

E. Storage batteries: Shall be provided and shall be the sealed, lead-acid types. The batteries shall have ample capacity, with primary power disconnected, to operate the fire alarm system for a period of 24 hours. Following this period of operation via batteries, the batteries shall have ample capacity to operate all components of the system, including all alarm annunciating devices in the total alarm mode for a period of 5 minutes. Battery cabinet shall be a separate compartment within the control panel.

F. Battery charger: Shall be completely automatic, with high/low charging rate, capable of restoring the batteries from full discharge to full charge within 8 hours. Pilot light shall indicate when batteries are manually placed on a high rate of charge as part of the unit assembly if a high rate switch is provided. Charger shall be located in control panel.

G. Reports:

1. The system shall provide the operator with system reports that give detailed description of the status of system parameters for corrective action, or for preventative maintenance programs. The system shall provide these reports via the main LCD, and shall be capable of being printed on any system printer.

2. The system shall provide a report that gives a sensitivity listing of all detectors that have less than 75% environmental compensation remaining. The system shall provide a report that provides a sensitivity (% Obscuration per foot) listing of any particular detector.

3. The system shall provide a report that gives a listing of the sensitivity of all of the detectors on any given panel in the system, or any given analog/addressable device loop within any given panel.

4. The system shall provide a report to determine the carbon monoxide detectors end-of-life.

5. The system shall provide a report that gives a chronological listing of up to the last 1740 system events.

6. The system shall provide a listing of all of the firmware revision listings for all of the installed network components in the system.

2.03 ANNUNCIATORS

A. Main control and annunciator panel:

1. Main annunciator shall be located with the FACP.
2. The main display shall be a large 168 character LCD with normal, alarm, trouble, supervisory, disabled point and ground fault indicators.

3. The main display shall show the first and most recent highest priority system events without any operator intervention. All system events shall be directed to one of four message queues. Messages of different types shall never inter-mixed to eliminate operator confusion. A "Details" switch shall provide additional information about any device highlighted by the operator.

4. Receipt of alarm, trouble, and supervisory signals shall activate integral audible devices at the control panel(s) and at each remote annunciation device. The integral audible devices shall produce a sound output upon activation of not less than 85 dBA at 10 feet.

5. The internal audible signal shall have different programmable patterns to distinguish between alarm, supervisory, trouble and monitor conditions.

6. The annunciator shall contain the following controls:
   a. System reset switch with indicator
   b. System alarm silence switch with indicator
   c. System panel silence switch with indicator
   d. Programmable switch with indicator
   e. Details switch
   f. System message queue scroll switches.
   g. 10-Digit keypad to enable/disable system and functions.

7. An authorized operator shall have the ability to operate or modify system functions like system time, date, passwords, holiday dates, restart the system and clear control panel event history file.

8. An authorized operator shall be capable of performing test functions within the installed system.

B. Fireman’s remote annunciator panel (FRAP):

1. Remote LCD network alphanumeric annunciators shall display each and every point in the system.

2. Network alphanumeric annunciators shall be located as indicated on the plans. This annunciator shall be an integral part of the peer to peer network for survivability.

3. Annunciator shall contain a supervised, back-lit, liquid crystal display with a minimum of 8 lines and 21 characters per line. The annunciator shall support full ability to serve as the operating interface to the system and shall include the following features:
   a. Matched appearance with other system displays
   b. LCD display shall be configurable to show the status of any or all of the following functions anywhere in the system:
      1) Alarm
      2) Supervisory
      3) Trouble
4) Monitor

4. Annunciator must be capable of supporting custom messages as well as system event annunciation. It must be possible to filter unwanted annunciation of trouble, alarm or supervisory functions on a by point or by geographic area. The annunciators shall be mounted in stand-alone enclosures at location as indicated on the plans.

2.04 INTELLIGENT ADDRESSABLE DETECTORS

A. General:

1. Each detector device shall have a microprocessor with non-volatile memory to support its functionality and serviceability. Devices shall store as required for its functionality the following data: device serial number, device address, device type, personality code, date of manufacture, hours in use, time and date of last alarm, amount of environmental compensation left/used, last maintenance date, job/project number, current detector sensitivity values, diagnostic information (trouble codes) and algorithms required to process sensor data and perform communications with the loop controller.

2. Each device shall be capable of electronic addressing, either automatically or application programmed assigned, to support physical/electrical mapping and supervision by location. Setting a device’s address by physical means shall not be necessary.

3. The intelligent detectors shall be capable of full digital communications using both broadcast and polling protocol. Each detector shall be capable of performing independent fire detection algorithms. The fire detection algorithm shall measure sensor signal dimensions, time patterns and combine different fire parameters to increase reliability and distinguish real fire conditions from unwanted deceptive nuisance alarms. Signal patterns that are not typical of fires shall be eliminated by digital filters. Devices not capable of combining different fire parameters or employing digital filters shall not be acceptable.

4. Each detector shall be capable of making alarm decisions based on fire parameter information stored in the detector head. Distributed intelligence shall improve response time by decreasing the data flow between detector and analog loop controller. Maximum total analog loop response time for detectors changing state shall be 0.75 seconds. The integral microprocessor shall dynamically examine values from the sensor and initiate an alarm based on the analysis of data.

5. The detector shall continually monitor any changes in sensitivity due to the environmental effects of dirt, smoke, temperature, aging and humidity.

6. Each detector shall have a separate means of displaying communication and alarm status. A green/red LED shall flash to confirm communication with the analog loop controller and display alarm status.

7. The detector shall be capable of identifying up to 32 diagnostic codes. This information shall be available for system maintenance. The diagnostic code shall be stored at the detector.

8. Each smoke detector shall be capable of transmitting pre-alarm and alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level. Each smoke detector may be individually programmed to operate at any one of five (5) sensitivity settings.
9. Each device microprocessor shall contain an environmental compensation algorithm, which identifies and sets ambient “Environmental Thresholds” approximately six times an hour. The microprocessor shall continually monitor the environmental impact of temperature, humidity, other contaminants as well as detector aging. The process shall employ digital compensation to adapt the detector to both 24 hour long-term and 4 hour short-term environmental changes. The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches 80% and 100% of the allowable environmental compensation value. Differential sensing algorithms shall maintain a constant differential between selected detector sensitivity and the “learned” base line sensitivity. The base line sensitivity information shall be updated and permanently stored at the detector approximately once every hour.

B. Ionization smoke detector:
1. The intelligent ionization detector shall be rated for ceiling installation at a minimum of 30 ft centers and be suitable for wall mount applications.
2. The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from 0.61% to 1.91%. The ionization detector shall be suitable for operation in the following environment:
   a. Temperature: 32°F to 120°F (0°C to 49°C)
   b. Humidity: 0-93% RH, non-condensing
   c. Installation attitude: 6000 feet
   d. Air velocity: 0 to 75 ft/min

C. Photoelectric smoke detector:
1. Provide intelligent analog photoelectric detector shall utilize a light scattering type photoelectric smoke sensor to sense changes in air samples from its surroundings.
2. Each unit shall have a field-replaceable smoke chamber.
3. The photo detector shall be rated for ceiling installation at a minimum of 30 ft centers and be suitable for wall mount applications.
4. The photoelectric smoke detector shall be suitable for direct insertion into air ducts up to 3 ft high and 3 ft wide with air velocities up to 5,000 ft/minute.
5. The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3.5%. The photoelectric detector shall be suitable for operation in the following environment:
   a. Temperature: 32°F to 120°F (0°C to 49°C)
   b. Humidity: 0-93% RH, non-condensing
   c. Installation attitude: no limit

D. Fixed temperature/rate-of-rise heat detector:
1. Provide intelligent combination fixed temperature/rate-of-rise heat detectors with low mass thermistor heat sensor and operate at a fixed temperature and at a temperature rate-of-rise. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm.
2. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data.

3. The intelligent heat detector shall have a nominal fixed temperature alarm point rating of 135°F (57°C) and a rate-of-rise alarm point of 15°F (9°C) per minute.

4. The heat detector shall be rated for ceiling installation at a minimum of 50 ft centers and be suitable for wall mount applications.

E. Multi-sensor photoelectric/heat detector:

1. Provide intelligent combination photoelectric smoke and heat detectors with analog photoelectric detector that utilizes a light scattering type photoelectric smoke sensor to sense changes in air samples from its surroundings. The heat detector shall have a low mass thermistor heat sensor and operate at a fixed temperature. It shall continually monitor the temperature of the air to process an alarm.

2. Each unit shall have a field-replaceable smoke chamber

3. Each unit shall provide split sensor programming such that the combination device shall only require one software address, while still providing two distinct inputs. This capability will allow for separate actions to be initiated independently from the two separate elements (smoke & heat) without requiring a separate software address on the loop.

4. The multi-sensor shall be rated for ceiling installation at a minimum of 30 ft centers and be suitable for wall mount applications.

5. The intelligent heat detector shall have a nominal fixed temperature alarm point rating of 135°F (57°C) and a rate-of-rise alarm point of 15°F (9°C) per minute.

6. The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3.5%. The photoelectric detector shall be suitable for operation in the following environment:
   a. Temperature: 32°F to 120°F (0°C to 49°C)
   b. Humidity: 0-93% RH, non-condensing
   c. Installation Attitude: no limit

F. Photoelectric smoke/carbon monoxide detector:

1. Provide intelligent photoelectric smoke and carbon monoxide detectors with analog photoelectric detector that utilizes a light scattering type photoelectric smoke sensor to sense changes in air samples from its surroundings. The integral electrochemical carbon monoxide cell shall be provided.

2. Each unit shall have a field-replaceable smoke chamber

3. Each unit shall be provided with a field-replaceable carbon monoxide sensor module.

4. The carbon monoxide sensor module shall have an end of life at six years. End of life status shall be continuously monitored and reported by the control panel.

5. Each unit shall provide split sensor programming such that the combination device shall only require one software address while still providing two distinct inputs. This capability will allow for separate actions to be initiated independently from the two separate elements (smoke & CO) without requiring a separate software address on the loop.
6. The photoelectric detector shall be rated for ceiling installation at a minimum of 30 ft centers and be suitable for wall mount applications.

7. The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3.5%. The photoelectric detector shall be suitable for operation in the following environment:
   a. Temperature: 32°F to 120°F (0°C to 49°C)
   b. Humidity: 0-93% RH, non-condensing
   c. Installation Attitude: no limit

G. Standard detector bases:
   1. Provide standard detector mounting bases suitable for mounting on a standard 4” octagon or square box. The base shall contain no electronics and support all intelligent detector types.
   2. Removal of the respective detector shall not affect communications with other detectors.
   3. Terminal connections shall be made on the room side of the base.

H. Relay detector bases:
   1. Provide standard detector mounting bases suitable for mounting on a standard 4” octagon or square box. The base shall support all intelligent detector types.
   2. Removal of the respective detector shall not affect communications with other detectors.
   3. Terminal connections shall be made on the room side of the base. Bases, which must be removed to gain access to the terminals, shall not be acceptable.
   4. The relay shall be a bi-stable type and selectable for normally open or normally closed operation.
   5. The position of the contact shall be supervised.
   6. The relay shall automatically de-energize when a detector is removed.
   7. The operation of the relay base shall be controlled by its respective detector processor. Detectors operating standalone mode shall operate the relay upon changing to alarm state. Relay bases not controlled by the detector microprocessor shall not be acceptable.
   8. Form "C" relay contacts shall have a minimum rating of 1 amp @ 30 Vdc and be listed for pilot duty.

I. Duct detector:
   1. Provide intelligent addressable analog photoelectric duct smoke detectors that utilize a light scattering type photoelectric smoke sensor to sense changes in air samples from its surroundings. The integral microprocessor shall dynamically examine values from the sensor and initiate an alarm based on the analysis of data. Systems using central intelligence for alarm decisions shall not be acceptable. The detector shall continually monitor any changes in sensitivity due to the environmental effects of dirt, smoke, temperature, aging and humidity.
2. The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from 0.79% to 2.46%. The duct detector shall be suitable for operation in the following environment:
   a. Temperature: -20°F to 158°F (-29°C to 70°C)
   b. Humidity: 0-93% RH, non-condensing
   c. Air velocity: 100 to 4000 ft/min

3. Provide an air exhaust tube and an air sampling inlet tube, which extends into the duct air stream up to ten feet. The sampling tube can be installed with or without the cover in place and can be rotated in 45 degree increments to ensure proper alignment with the duct airflow.

4. Status LEDs shall remain visible through a clear assembly cover.

5. The unit shall contain a magnet-activated test switch.

6. One integral Form C auxiliary alarm relay shall be provided. The relay contact shall be capable of being individually programmed from the control panel. The contact shall be rated for 2.0A at 30VDC.

2.05 INTELLIGENT ADDRESSABLE MODULES

A. General:
   1. Each remote device shall have a microprocessor with non-volatile memory to support its functionality and serviceability. Devices shall store as required for its functionality the following data: device serial number, device address, device type, personality code, date of manufacture, hours in use, time and date of last alarm, amount of environmental compensation left/used, last maintenance date, job/project number, current detector sensitivity values, diagnostic information (trouble codes) and algorithms required to process sensor data and perform communications with the loop controller.
   2. Each device shall be capable of electronic addressing, either automatically or application programmed assigned, to support physical/electrical mapping and supervision by location.
   3. The module shall be suitable for operation in the following environment:
      a. Temperature: 32°F to 120°F (0°C to 49°C)
      b. Humidity: 0-93% RH, non condensing

B. Single input module:
   1. Provide intelligent signal input modules for monitoring of PIV’s, tamper switches, flow switches, fan & damper status, generator status, preaction system alarm or trouble or any other sets of dry contacts required to be monitored.
   2. The single input module shall provide one (1) supervised Class B input circuit capable of a minimum of 4 personalities, each with a distinct operation.
   3. The module shall be suitable for mounting on a standard 4” square box with 1-gang ring.
   4. The single input module shall support the following circuit types:
      a. Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.)
b. Normally-Open Alarm Delayed Latching (Waterflow Switches)
c. Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.)
d. Normally-Open Active Latching (Supervisory, Tamper Switches)

C. Dual input module:
1. Provide intelligent dual input modules for monitoring of sets of PIV’s, tamper switches, flow switches, fan & damper status, generator status, preaction system alarm or trouble or any other sets of dry contacts required to be monitored.
2. The dual input module shall provide two (2) supervised Class B input circuits each capable of a minimum of 4 personalities, each with a distinct operation.
3. The module shall be suitable for mounting on a standard 4” square box with 1-gang ring.
4. The dual input module shall support the following circuit types:
   a. Normally-open alarm latching
   b. Normally-open alarm delayed latching
   c. Normally-open active non-latching
   d. Normally-open active latching

D. Signal module:
1. Provide intelligent single input signal modules for activation of booster power supplies, audible/visual circuits.
2. The single input signal module shall provide one (1) supervised Class B output circuit capable of a minimum of 2 personalities, each with a distinct operation.
3. The module shall be suitable for mounting on a standard 4” square box with 2-gang ring.
4. The single input signal module shall support audible/visible signal power selector (polarized 24 Vdc @ 2A, 25Vrms @50w or 70 Vrms @ 35 watts of audio)

E. Synchronized signal module:
1. Provide intelligent single input signal modules for activation of booster power supplies and/or audible/visual circuits that require synchronization.
2. The single input signal module shall provide one (1) supervised Class B output circuit capable of a minimum of 2 personalities, each with a distinct operation.
3. The module shall be suitable for mounting on a standard 4” square box with 2-gang ring.
4. The single input signal module shall support audible/visible signal power selector (polarized 24 Vdc @ 2A, 25Vrms @50w or 70 Vrms @ 35 watts of audio)
5. Provides UL1971 auto-sync output for synchronizing multiple notification appliance circuits
F. Control relay module:
   1. Provide intelligent control relay modules for activation and/or shutdown of fans, dampers, door holder circuits, door locks, shunt trip, elevator recall or any other fail safe system requiring control or activation.
   2. The control relay module shall provide one Form R dry relay contact rated at 2 amps @ 24 Vdc to control external appliances or equipment shutdown.
   3. The control relay shall be rated for pilot duty and releasing systems.
   4. The control relay module shall be suitable for mounting on a standard 4" square box with 1-gang ring.

G. Manual pull station:
   1. Provide intelligent single action, single stage fire alarm pull stations. The fire alarm pull station shall be of metal construction with an internal toggle switch. Provide a locked test feature. Finish the station in red with silver “PULL IN CASE OF FIRE” lettering.
   2. The manual station shall be suitable for mounting on a standard 4” square box with 1-gang ring.
   3. Provide compatible surface mount red box at all surface mount locations.

2.06 NOTIFICATION APPLIANCES

A. Horns:
   1. Horns shall be a low profile design, finished in red with white lettering and shall not protrude more than 1" off the finished wall surface. In-out screw terminals shall be provided for wiring.
   2. Horns shall be provided with a switch selectable audible output of at least two decibel levels. Maximum 84dBA output at 10 ft. when measured in reverberation room per UL 464.
   3. Horns shall have two selectable tone options of temporal or non-temporal continuous pattern.
   4. Horns shall be suitable for wall mounting and shall mount in a standard 4" square x 2 1/8" deep electrical box. All mounting hardware shall be captive and there shall be no mounting screws visible after the device is installed.
   5. Horns shall also be suitable for ceiling mounting and shall mount in a standard 4" square x 2 1/8" deep electrical box. All mounting hardware shall be captive and there shall be no mounting screws visible after the device is installed.
   6. Where surface mounted horns are installed a skirt enclosure or manufacturer’s color-matched surface mount box, shall be installed to conceal the electrical box to which the strobe lights are mounted. The correct surface box shall be used to ensure the skirt fits properly and is flush with the wall or ceiling.

B. Strobe lights:
   1. Strobes shall be a low profile design, finished in red with white lettering and shall not protrude more than 1" off the finished wall surface. In-out screw terminals shall be provided for wiring.
   2. Strobes shall provide synchronized flash outputs at maximum pulse duration of 0.2 seconds. The light output shall be an even pattern with no hot spots. Strobes appliances shall be comprised of a Xenon flashtube with a clear lens and be entirely solid state.
3. The strobe shall have selectable 15, 30, 75 or 110 cd settings for wall mounting.

4. It shall be possible to change the strobe setting without removing the device from the wall.

5. Strobes shall be suitable for wall mounting and shall mount in a standard 4” square x 1 ½” deep electrical box. All mounting hardware shall be captive and there shall be no mounting screws visible after the device is installed.

6. Where surface mounted strobe lights are installed a skirt enclosure or manufacturer’s color-matched surface mount box, shall be installed to conceal the electrical box to which the strobe lights are mounted. The correct surface box shall be used to ensure the skirt fits properly and is flush with the wall or ceiling.

C. Combination horn/strobe lights:

1. Horns shall be a low profile design, finished in red with white lettering and shall not protrude more than 1” off the finished wall surface. In-out screw terminals shall be provided for wiring.

2. Horns shall be provided with a switch selectable audible output of at least two decibel levels.

3. Horns shall have two selectable tone options of temporal or non-temporal continuous pattern.

4. Strobes shall provide synchronized flash outputs at maximum pulse duration of 0.2 seconds. The light output shall be an even pattern with no hot spots. Strobes appliances shall be comprised of a Xenon flashtube with a clear lens and be entirely solid state.

5. It shall be possible to flash the strobe at a temporal flash rate to match the horn.

6. The strobe shall have selectable 15, 30, 75 or 110 cd settings for wall mounting.

7. It shall be possible to change the strobe setting without removing the device from the wall.

8. Horn/strobes shall be suitable for wall mounting and shall mount in a standard 4” square x 1 ½” deep electrical box. All mounting hardware shall be captive and there shall be no mounting screws visible after the device is installed.

9. Where surface mounted horn/strobe lights are installed a skirt enclosure or manufacturer’s color-matched surface mount box, shall be installed to conceal the electrical box to which the strobe lights are mounted. The correct surface box shall be used to ensure the skirt fits properly and is flush with the wall or ceiling.

D. Weatherproof horns and strobes and/or combination appliances:

1. Appliances shall be a semi-flush design, finished in red with white lettering. In-out screw terminals shall be provided for wiring.

2. Horns shall be provided with a switch selectable audible output of at least three decibel levels of 99, 95, and 90dBA.

3. Horns shall have two selectable tone options of temporal or non-temporal continuous pattern.

4. Strobes shall provide synchronized flash outputs at maximum pulse duration of 0.2 seconds. The light output shall be an even pattern with no hot spots. Strobes appliances shall be comprised of a Xenon flashtube with a clear lens and be entirely solid state.

5. The strobe shall have a 75 cd setting for wall mounting.
6. Strobe shall operate over an extended temperature range of -31°F to 150°F. All inputs shall be polarized for compatibility with standard reverse polarity supervision of circuit wiring.

7. Appliance backbox shall be weatherproof and vandal resistant.

E. Remote booster power supplies:

1. Unit shall be a self contained with 24Vdc power supply and batteries housed in its own locked enclosure. Keys provided shall be identical to the keys provided for all other fire alarm equipment provided.

2. Power supply shall be available in both 10 Amp or 6.5 Amp models and 120Vac.

3. On board LED indicators for each NAC, battery supervision, ground fault and AC power.

4. The power supply shall provide four (4) independent 3Amp NACs. Each circuit can be configurable as an auxiliary output.

5. Configurable for any one of three signaling rates: 120SPM; 3-3-3 temporal; or, continuous.

6. Two independent and configurable inputs switch selectable to allow correlation of the two (2) inputs and the four (4) outputs.

7. NACs shall be configurable for either four Class B or two Class A circuits.

8. The unit shall be compatible with SIGA-CC1S for synchronization of multiple power supplies without inter-connect wiring.

9. Brackets shall be provided inside the enclosure to allow mounting the signaling modules. All signaling modules shall be listed to be located inside the booster power supply enclosure.

10. A selectable dip switch shall enable built in synchronization for horns and strobes which may be used to synchronize downstream devices, as well as other boosters and their connected devices.

2.07 AUXILIARY EQUIPMENT CONTROL AND SUPERVISION

A. Fire sprinkler system components: Include single or dual input modules at waterflow and/or tamper switch on each floor of building, fire pump room, etc., for monitoring status:

1. Each waterflow switch will initiate an alarm signal.

2. Each tamper switch will initiate a trouble signal.

3. Each post indicating valve (PIV) will initiate a trouble signal.

B. Emergency generator status: Include single or dual input modules at generator for monitoring the following conditions:

1. Generator running to initiate a trouble signal.

2. Generate malfunction to initiate a trouble signal.

3. Generator output circuit breaker(s) open.
C. Elevator interface: Include the following in each elevator machine/control room or electrical room for interface with the elevator system:

1. Addressable control relay in each machine/control room for elevator recall purposes to ground floor.

2. Addressable control relay in each machine/control room for elevator recall purposes to an alternate floor, designated by fire marshal. Alternate floor will activate if ground floor lobby smoke detector is in alarm.

3. Single or dual input modules in machine/control rooms to monitor auxiliary contacts of elevator disconnect switches for power availability.

4. Addressable control relay at electrical room where circuit breaker with shunt trip feeding elevator equipment is located. Relay shall interface with shunt trip to open circuit breaker upon heat detection in elevator machine/control room. Also, if heat detector is located in elevator shaft, then this shall open circuit breaker as well.

5. Single input module in the electrical room where shunt trip is located to monitor available power of shunt trip circuit.

D. Supply fan/air handlers shutdown: All supply air fan, 2000cfm and greater, shall be furnished with a duct-mounted smoke detector and addressable control relay for shutdown purposes. Upon smoke detection, the fan shall be automatically controlled to the “OFF” position.

E. Fire/smoke dampers (FSDs):

1. FSDs for return air systems: Include spot smoke detector(s) over the openings of all return air FSDs for “OPEN/CLOSE” control upon detection of smoke. Provide one detector if open is 36” wide or less, two if opening is 72” wide or less and three if opening is 108” wide or less.

2. FSDs for supply air systems: Include in-duct smoke detector(s) within ducts adjacent to supply air FSDs for “OPEN/CLOSE” control upon detection of smoke. Provide one detector if open is 36” wide or less, two if opening is 72” wide or less and three if opening is 108” wide or less.

F. Door hold-open/closure devices: Provide an addressable control relay for doors with magnetic hold-open/closure devices as well as a 24Vdc power circuit from fire alarm system to release doors when system is in alarm.

G. Roll-down fire doors and shutters: Provide an addressable control relay for fire roll-down doors or shutters for interconnection with fire-fly release devices on doors for closure when system is in alarm.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Contractor shall thoroughly examine Project site conditions for acceptance of fire alarm 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. General:

1. Install fire alarm system in accordance with Manufacturer's written instructions, as indicated on the Drawings and as specified herein.
2. The 120volt, 2-wire, 60 cycles AC two-20A circuit supply required to power the system shall be connected as indicated on the Drawings. Connect to red colored circuit breaker(s) in panelboard. Identify circuit as "Fire Alarm Circuit Control."

B. Conductors:

1. Refer to Section 260519: Building Wire and Cable.

2. All circuits shall be rated power limited in accordance with CEC Article 760.

3. All system conductors shall be of the type(s) specified herein.

   a. All initiating circuit, signaling line circuit, AC power conductors, shield drain conductors and grounding conductors, shall be solid copper, stranded or bunch tinned (bonded) stranded copper.

   b. All wiring shall be color-coded throughout.

   c. Signaling line circuits: Shall be 18 AWG minimum multi-conductor jacketed twisted cable or as per manufacturer's requirements.

   d. Initiating device circuits: 24Vdc circuits shall be 18 AWG minimum or per manufacturer's requirements.

   e. Notification appliance circuits:

      1) Horn-strobe or strobe: Non-twisted pair, not less than 14 AWG or as recommended by the manufacturer.

   f. 120Vac circuits:

      1) Minimum 10 AWG for panel power circuits.

      2) Minimum 12 AWG for all other circuits.

      3) Each circuit shall have its own dedicated neutral conductor.

C. Conduit raceway:

1. All system components listed to UL864 Control Units for Fire Protective Signaling Systems maybe installed within a common conduit raceway system, in accordance with the manufacture's recommendations. System components not listed to the UL864 standard shall utilize a separate conduit raceway system for each of the sub-systems.

2. All system conduits shall be EMT, 1/2 -inch minimum, except for flexible metallic conduit used for whips to devices only, maximum length 6 feet, 1/2-inch diameter, minimum.

3. Conduits shall be sized according to the conductors contained therein. Cross sectional area percentage fill for system conduits shall not exceed 40%.

4. All fire alarm conduit systems shall be routed and installed to minimize the potential for physical, mechanical or by fire damage, and so as not to interfere with other building systems, facilities or equipment, and to facilitate service and minimize maintenance.

5. All system conduits, junction boxes, pull boxes, terminal cabinets, electrical enclosures and device back boxes shall be readily accessible for inspection, testing, service and maintenance.
6. All penetration of floor slabs and firewalls shall be sleeved (1” conduit minimum) fire stopped in accordance with all local fire codes.

7. All junction box covers shall be painted red.

D. Equipment:

1. All devices and appliances shall be mounted to flush mounted boxes where areas are finished. Exceptions being above suspended ceiling, exposed ceiling areas, or equipment rooms to facilitate connections to other equipment.

2. All pull stations shall be mounted 48 inches above the finished floor, as measured on handle.

3. All audio/visual devices shall be mounted at a minimum of 80 inches and no more than 96 inches above the finished floor, as measured on strobe center. Devices shall be mounted no less than 6 inches from the ceiling.

4. No area smoke detectors shall be mounted within 36 inches of any HVAC supply, return air register or lighting fixture.

5. No area smoke or heat detector shall be mounted within 12 inches of any wall.

6. All fire alarm devices shall be accessible for periodic maintenance.

7. End-of-line resistors shall be furnished as required for mounting as directed by the manufacturer. Devices containing end-of-line resistors shall be appropriately labeled. Devices should be labeled so removal of the device is not required to identify the EOL device.

8. All addressable modules shall be mounted within 36 inches of the monitored or controlled point of termination. This shall include, but is not necessarily limited to, fan shutdown, elevator recall, shunt trip, sprinkler status points, or door release. Label all addressable modules as to their function.

9. Power-limited/non-power-limited CEC wiring standards shall be observed.

10. Relays shall be appropriately labeled on the exterior to indicate “FIRE ALARM SYSTEM” and their specific function (i.e. FAN SHUTDOWN).

3.03 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 fire alarm 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 fire alarm 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 fire alarm system control panel upon satisfactory completion of tests and results.

5. Verify 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. 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. The system shall be completely tested prior to final acceptance testing. All points shall be tested from point of initiation to the final point or points of annunciation. All circuits shall be tested for continuity and ability to transmit the required signal correctly to the FACP. Any problem due to wrong wire type, wire twist, impedance, mismatches, noise filtering or shielding shall be completely corrected during pretesting and prior to any final acceptance tests.
   b. Testing shall include each and every device in the system. Coordinate with other trades as necessary for testing.
      1) Sprinkler flow switches: Record time delay from water flow to alarm and adjust as necessary for a 30-50 second delay.
      2) Tamper switches: Verify "trouble" signal is received and alarmed on closing of each valve.
      3) Smoke detectors, in-duct smoke detectors and duct mounted smoke detectors: Test with actual or approved artificial smoke. Verify that reset does not occur when devices are cleared of smoke. Verify supervisory circuit function. Perform pressure differential test on all duct mounted smoke detectors.
      4) Door release: Verify that proper alarm activates every held-open door, roll-down doors and shutters, that doors close completely to the closed position.
      5) Elevator recall: Verify that elevators recall to designated floor by testing elevator lobby detectors with smoke. This is necessary on the ground floor and one other only.
      6) Audible/visual notification: Activate by means of an alarm-initiating device that audible and visual devices are clearly audible and/or visual throughout.
7) Central station notification: Verify that one set of conductors in the terminal cabinet becomes a short circuit on any "trouble" condition and that the other set becomes a short circuit on any "alarm" condition. Verify that the conductor groups are labeled properly.

8) Emergency generator power: Verify these annunciate their respective "Trouble" and "Running" conditions.

c. Test report:

1) 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.

2) Submit two typed copies of the test report in a neatly bound folder for review and approval. Failure to comply with this will result in a delay of final testing and acceptance.

E. Functional performance testing:

1. After the approval of the test report, provide a schedule of final testing to be done in the presence of the Fire Marshal and Owner's Representative. The schedule must be received by the Engineer a minimum of 2 weeks prior to the Final Test Date and must list the dates and time slots in which the various systems can be tested.

2. Coordination of the Final Test dates with all parties (General Contractor, Mechanical Contractor, Elevator Contractor, Owner and others) shall be the sole responsibility of the Contractor. If a party is required to be present during any phase of testing to activate a device, ensure that the party or a qualified representative of the party is present throughout that phase of the testing.

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 TRAINING

A. Factory authorized service representative shall conduct a 8 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
SECTION 27 00 10
BASIC COMMUNICATIONS REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Table of Contents, Division 27 - Communications:

<table>
<thead>
<tr>
<th>SECTION NO.</th>
<th>SECTION TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>260526</td>
<td>GROUNDING AND BONDING</td>
</tr>
<tr>
<td>260529</td>
<td>ELECTRICAL HANGERS AND SUPPORTS</td>
</tr>
<tr>
<td>260531</td>
<td>CONDUIT</td>
</tr>
<tr>
<td>260533</td>
<td>BOXES</td>
</tr>
<tr>
<td>270010</td>
<td>BASIC COMMUNICATIONS REQUIREMENTS</td>
</tr>
<tr>
<td>270526</td>
<td>COMMUNICATIONS GROUNDING AND BONDING</td>
</tr>
<tr>
<td>270528</td>
<td>COMMUNICATIONS PATHWAYS</td>
</tr>
<tr>
<td>270536</td>
<td>COMMUNICATIONS CABLE TRAYS</td>
</tr>
<tr>
<td>271100</td>
<td>COMMUNICATIONS EQUIPMENT ROOMS</td>
</tr>
<tr>
<td>271313</td>
<td>COMMUNICATIONS COPPER BACKBONE CABLELING</td>
</tr>
<tr>
<td>271323</td>
<td>COMMUNICATIONS OPTICAL FIBER BACKBONE CABLELING</td>
</tr>
<tr>
<td>271500</td>
<td>COMMUNICATIONS HORIZONTAL CABLELING</td>
</tr>
<tr>
<td>275113</td>
<td>COMMUNICATIONS PAGING SYSTEM</td>
</tr>
<tr>
<td>281300</td>
<td>SECURITY ALARM MONITORING SYSTEM</td>
</tr>
<tr>
<td>282300</td>
<td>VIDEO SURVEILLANCE SYSTEM</td>
</tr>
<tr>
<td>281353</td>
<td>IP VIDEO INTERCOM</td>
</tr>
</tbody>
</table>

B. Work included: This Section includes general administrative and procedural requirements for Division 27. 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.
4. Coordination.
5. Record documents.
6. Operation and maintenance manuals.
7. Excavation.
8. Rough-in.
9. Communications installation.
10. Cutting, patching, painting and sealing.
11. Field quality control.
12. Cleaning.
13. 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 27 Sections.

2. Earthwork: Include trenching, backfilling, boring and soil compaction as required for the installation of underground conduit, in-grade pull boxes, vaults, etc. Refer to Division 31, Earthwork.

3. Selective demolition: Nondestructive removal of materials and equipment for reuse or salvage as indicated. Also dismantling communications 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, pull box slabs, vaults, 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, cable trays, racks, etc. Refer to Division 05, Miscellaneous Metals.

6. Miscellaneous lumber and framing Work: Include wood grounds, nailers, blocking, fasteners and anchorage for support of communications 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 vaportight. Refer to Division 07, Thermal and Moisture Protection.

8. Access panels and doors: Required in walls, ceilings and floors to provide access to communications 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 exposed conduit, pull and junction boxes, etc. where indicated as field painted in this Division. Refer to Division 09, Painting.

D. Work furnished and installed under another Division requiring connections under this Division includes but is not limited to:

1. Elevator controllers.

2. Fire alarm control panel.

3. Temperature control panel(s).

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:


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
BICSI Building Industry Consulting Service International, Inc
EIA Electronics Industries Alliance
ETL Electrical Testing Laboratories
FCC Federal Communications Commission
ICEA Insulated Cable Engineers Association
IEEE Institute of Electrical and Electronics Engineers, Inc
NEMA National Electrical Manufacturer's Association
NETA National Electrical Testing Association
NFPA National Fire Protection Association
TIA Telecommunication Industry Association
UL Underwriters' Laboratories

1.03 DEFINITIONS

A. Adapter: Shall mean a connecting device joining two fiber connectors, either like or unlike.

B. Cabling: A system comprised of cables, wires, cords, and connecting hardware.

C. Channel: End-to-end transmission path, i.e. the entire portion of the horizontal cabling to each outlet consisting of the Permanent Link, line cord (at the workstation), patch cord, and, if a full crossconnection is implemented, the crossconnect termination/connecting apparatus and equipment cord.

D. Connect: To install required patch cords, equipment cords, cross-connect wires, etc. to complete an electrical or optical circuit.

E. Cord: Shall mean length of cordage having connectors at each end. The term “cord” is synonymous with the term “jumper” and “lead.”

F. Identifier: A unique code assigned to an element of the telecommunication infrastructure that links it to its corresponding record.

G. Passive link segment: Shall mean the cable, connectors, couplings, and splices between two fiber optic termination units.

H. Permanent link: Test configuration for a horizontal cabling link excluding test cords, connections at the ends of the test cords, patch cords, equipment cords, line cords, etc. The “permanent” portion of the horizontal cabling to each outlet consisting of cable, consolidation point (if used), termination/connecting apparatus in equipment rooms, and the connectors at outlets.
I. Abbreviations:

1. BEP: Building Entrance Protection, for termination of OSP twisted pair cabling.
2. CAT: Category, used when identifying the performance characteristics of twisted pair cabling.
3. CMP: Communication Media Plenum, rating applied to ISP twisted pair cable.
4. CMR: Communication Media Riser, rating applied to ISP twisted pair cable.
5. IDF: Intermediate Distribution Facilities, telecommunication equipment rooms housing network equipment and containing termination fields for backbone cabling from MDF and horizontal cabling from outlet devices.
7. MDF: Main Distribution Facilities, telecommunication equipment room housing possible service entrance facilities for interbuilding backbone cabling, network equipment, house voice system equipment headend, backbone cabling distribution headend, termination fields for backbone and horizontal cabling.
8. MM: Multimode, fiber cable.
9. MPOE: Minimum Point of Entry, for serving telecommunications utility terminations. House’s service provider’s termination field(s) and interfaces between utility’s facilities and premises facilities.
11. OFN: Optical Fiber Non-conductive, general purpose indoor non-plenum rated.
12. OFNP: Optical Fiber Non-conductive Plenum, plenum rated cable.
13. OFNR: Optical Fiber Non-conductive Riser, non-plenum rated riser cable.
15. PIC: Plastic Insulated Conductors.
16. PVC: Polyvinyl Chloride.
17. SM: Singlemode, fiber cable.
18. UTP: Unshielded Twisted Pair, copper cable type.

1.04 SYSTEM DESCRIPTION

A. Provide a complete telecommunication cabling system installation as specified herein and as shown on the Drawings. In general, system shall include, but not be limited to, the following:

1. OSP backbone fiber optic cabling:
   a. Backbone fiber optic cable shall route underground between each building’s main distribution facility (MDF), in a star topology, and shall consist of one 24-strand multimode and one 24-strand singlemode, OSP, fiber optic cable(s).
OSP backbone fiber optic cables shall terminate on full height rack in MDF rooms for
cable interface with ISP backbone fiber optic cables. Terminate cables on backside of
rack mounted 24-port patch panels.

Include full height rack(s) at MDF room(s) for fiber termination with 24-port patch panels
as required and patch cord management placed above and below each 24-port patch
panel.

OSP backbone fiber optic patch panel field shall interface with ISP backbone fiber optic
patch panel field at MDF via fiber patch cords between modular connectors on front side
of patch panels.

Fiber optic cable connector standard shall be Type LCSCST. Connectors shall be
singleplexduplex type.

2. OSP backbone twisted pair cabling:

Backbone twisted pair cable shall route underground between each buildings main
distribution facility (MDF), in a star topology, and shall consist of one multi-conductor
500-pair, Category 3, UTP, OSP, filled copper cable.

Provide splice cases for transitioning between filled OSP cable and ISP riser cable prior
to termination on punch down blocks in MDF rooms.

Terminate backbone twisted pair cables on Category 3, wall-mounted, 110 style, BEP
blocks at each MDF.

3. ISP backbone fiber optic cabling:

Backbone fiber optic cable shall route between MDF at each building and the
intermediate distribution facilities (IDF’s) throughout same building, and shall consist of
one 12-strand multimode and one 12-strand singlemode, ISP, fiber optic cable(s). IDF’s
shall connect directly to the MDF in a star topology without requiring an intermediate
patch at any other point.

ISP backbone fiber optic cables shall terminate on same rack as OSP backbone fiber at
MDF room, utilizing rack mounted, 24-port patch panels with patch cord management
placed above and below for each 24-ports of combined multimode and singlemode
fibers. Locate the ISP backbone patch field just below the OSP patch field. At IDF’s,
locate rack mounted, 12-port patch panels at top of full height dedicated rack with patch
cord management placed above and below. Separate singlemode from multimode cable
terminations with singlemode above in rack layout. Fiber optic backbone cables shall
terminate on backside of fiber patch panels.

ISP backbone fiber optic patch panel field shall interface with routing/switching
equipment, furnished by Owner, at MDF and/or each IDF via fiber patch cords from
modular connectors on patch panel front side.

Fiber connector standard is type LCSCST, singleplexduplex type.

4. ISP backbone twisted pair cabling:

Backbone twisted pair cable shall route between MDF at each building and the
intermediate distribution facilities (IDF’s) throughout same building, and shall consist of
one 100-pair, Category 3, ISP, UTP copper cable. IDF’s shall connect directly to the
MDF in a star topology without requiring an intermediate patch at any other point.
b. Terminate copper backbone cables on Category 3, wall-mounted, 110 style punchdown blocks at MDF and IDF’s.

c. Provide an additional field of pre-wired, wall-mounted, 110 style punchdown blocks for cross-connect purposes with adjacent backbone field. Backside of 110 blocks shall be pre-wired to 25-pair cables with 50-pin connectors to interface with rack mounted, 48-port, voice field patch panel.

d. Include crossconnect cabling between 110 block backbone field and 110 block pre-wired voice field.

e. Provide Category 6A, 48-port, 19” rack mountable patch panel with modular 8-pin connector front and pre-wired backs to 50-pin connector for interface with 110 block pre-wired voice field.

f. Wire management shall be provided above and below each 48-port patch panel, 2 RU.

5. Horizontal fiber optic cabling:

a. Horizontal fiber optic cables shall route between MDF or IDF’s and each workstation outlet, and shall consist of one multimode, ISP, 2-strand fiber optic cable(s).

b. Horizontal fiber optic cables shall terminate on back of rack mounted, 48-port, 19” wide patch panel at MDF and each IDF with patch cord management placed above and below.

c. Horizontal fiber optic patch panel field shall interface with routing/switching equipment, furnished by Owner, at MDF and/or each IDF via fiber patch cords from modular connectors on patch panel front.

d. Fiber connector standard is type LCSCST duplex at patch panels and workstation plates.

6. Horizontal twisted pair cabling:

a. Horizontal twisted pair cables shall route between MDF or IDF’s and workstation outlets, and shall consist of three Category 6A, 4-pair, UTP, plenum-non-plenum rated copper cables.

b. Horizontal twisted pair cables shall terminate on back of rack mounted, Category 6A, 48-port, 19” wide patch panels with modular 8-pin connector front for interface with Owner furnished routers/switches or voice patch panel field via Category 6A patch cords. Patch panels shall have 110 type terminations at rear for horizontal cable terminations.

c. Wire management shall be provided above and below, 2 RU, for each 48-port patch panel.

d. Copper jack standard is Category 6A, RJ-45 connectors at patch panels and workstation outlets.

7. Patch cords:

a. Patch cords shall match the physical and performance criteria of the specified horizontal twisted pair cable and be terminated at each end with 8-postion modular plugs.

b. Patch cords shall be furnished in varying lengths as required.

c. Patch cord quantities shall match the following:

1) One patch cord for data field per every standard workstation outlet.
2) One patch cord for voice field per every standard workstation outlet.
3) One parch cord for voice field per every telephone only outlet.

8. Workstation outlets:
   a. Standard telecommunication outlets shall consist of the following, unless otherwise noted on the Drawings:
      1) Three horizontal twisted pair cable(s) per outlet.
      2) One horizontal fiber optic cable(s) per outlet.
      3) SingleDouble-gang coverplate with 4-ports.
      4) Three RJ-45 connector jacks for twisted pair terminations.
      5) One LCSCST duplex connector for fiber optic terminations.
   b. Wall mounted telephone outlets shall consist of the following, unless otherwise noted on the Drawings:
      1) One horizontal twisted pair cable per outlet.
      2) Single-gang metal coverplate with 1-port and two support studs.
      3) One RJ-45 connector jack for twisted pair terminations.
   c. Wall mounted pay telephone outlets shall consist of the following, unless otherwise noted on the Drawings:
      1) One horizontal twisted pair cable per outlet.
      2) Single-gang metal coverplate with 1-port.
      3) One RJ-45 connector jack for twisted pair terminations.

B. Provide a complete system installations as specified herein and as shown on the Drawings for the following:
   1. Sound reinforcement system.
   2. Television distribution system.
   3. Public address system.
   4. School communication system.
   5. Assistive listening system.
   6. Nurse call system.
   7. Clock system.

1.05 SUBMITTALS

A. Format: Furnish submittal data neatly bound in an 8-1/2” x 11” folder or binder 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. 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 submittals, the Manufacturer shall provide anchorage calculations for floor and wall mounted electrical equipment so that it shall remain attached to the mounting surface after experiencing forces in conformance with CCR, Title 24, Table 23P, Part II and with Section 2312 "Earthquake Regulations" of the "Uniform Building Code" for Seismic Zone 4 Area, Importance Factor of 1.25/1.5. Structural Calculations shall be prepared 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. 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.

H. 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.

1.06 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 telephone service:

2. Contact for television service:

---

### 1.07 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 fixture schedule listing Manufacturers and products actually 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 5 mil (minimum) mylar of the original Drawings by a professional draftsperson. The construction documents will be provided for the Contractor’s use in reproducing at their cost the construction documents via computer aided drafting (CAD) process. A set of CAD files of the electrical documents will be provided to the Contractor in either Autocad Release 14 or DXF file format.

3. Record drawing submissions shall be provided to the Engineer to review upon the completion of the following phases of Work:

   a. All underground installation.

   b. Building electrical rough-in.

   c. Final electrical installation.

4. 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. Two sets of full size prints.

   b. Four sets of half size prints.

   c. One set of full size reproducibles.

   d. DXF files of Drawings.

---

### 1.08 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 3 - EXECUTION

3.01 EXCAVATION

A. General: Cutting and digging shall be under the direct supervision of the General Contractor and included as necessary for the Work of this Section.

B. Excavation for underground vaults and 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 drip-line 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 side 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: Place soil materials in layers to required subgrade elevations for each area classification, using materials and methods specified in Division 31, Earthwork.

1. Under building slabs, use drainage fill materials.

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 particular 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.


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/fire alarm/life safety system shall be performed.

4. Circuit numbering verification: Select on a random basis various circuit breakers in 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 122 volts for 120 volt 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 month 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: At the time of completion, a period of not less than 24 hours shall be allotted by the Contractor for instruction of building operating and maintenance personnel in the use of all systems. This 24 hours training is in addition to any instruction time called out in the Specifications for specific systems, i.e., Fire Alarm, Generator, etc. 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.

B. Special tools: Provide one of each tool 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.

3.08 INTERFACE / RESPONSIBILITY MATRIX

<table>
<thead>
<tr>
<th>SYSTEM EQUIPMENT</th>
<th>SPECIFIED UNDER DIVISION</th>
<th>FURNISHED UNDER DIVISION</th>
<th>INSTALLED UNDER DIVISION</th>
<th>CONDUIT &amp; BOX FOOD UNDER DIVISION</th>
<th>WIRED &amp; CABLED UNDER DIVISION</th>
<th>TERMINATED UNDER DIVISION</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TELECOMMUNICATION SYSTEM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incoming Service</td>
<td>27</td>
<td>Utility</td>
<td>Utility</td>
<td>26</td>
<td>Utility</td>
<td>Utility</td>
<td></td>
</tr>
<tr>
<td>Riser Backbone</td>
<td>27</td>
<td>27</td>
<td>27</td>
<td>26</td>
<td>27</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>Active Electronic Components</td>
<td>27</td>
<td>27</td>
<td>27</td>
<td>26</td>
<td>26/27</td>
<td>26/27</td>
<td>18</td>
</tr>
<tr>
<td>Patch Panels &amp; Terminal Blocks</td>
<td>27</td>
<td>27</td>
<td>27</td>
<td>-</td>
<td>27</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>Equipment Racks</td>
<td>27</td>
<td>27</td>
<td>27</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Terminal Backboards</td>
<td>27</td>
<td>06</td>
<td>06</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Cable Trays</td>
<td>27</td>
<td>26</td>
<td>26</td>
<td>-</td>
<td>27</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Workstation Modular Jacks</td>
<td>27</td>
<td>27</td>
<td>27</td>
<td>26</td>
<td>27</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>Electrified Partition Sys. Interface</td>
<td>27</td>
<td>27</td>
<td>27</td>
<td>26</td>
<td>27</td>
<td>27</td>
<td></td>
</tr>
</tbody>
</table>

| AUDIO/VISUAL SYSTEMS: | | | | | | | |
| Equipment Racks | 27 | 27 | 27 | 26/27 | 26/27 | 26/27 | 22 |
| Power Receptacles | 26 | 26 | 26 | 26 | 26 | 26 | |
| Wall Mtd Audio Device | 27 | 27 | 27 | 27 | 27 | 27 | |
## Interface / Responsibility Matrix

<table>
<thead>
<tr>
<th>System Equipment</th>
<th>Specified Under Division</th>
<th>Furnished Under Division</th>
<th>Installed Under Division</th>
<th>Conduit &amp; Box Roughin Under Division</th>
<th>Wired &amp; Cabled Under Division</th>
<th>Terminated Under Division</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall Mtd Control Device</td>
<td>27</td>
<td>27</td>
<td>27</td>
<td>27</td>
<td>27</td>
<td>27</td>
<td>22</td>
</tr>
<tr>
<td>Custom Floor Boxes</td>
<td>27</td>
<td>27</td>
<td>27</td>
<td>26/27</td>
<td>26/27</td>
<td>26/27</td>
<td>22</td>
</tr>
<tr>
<td>Recessed Speakers</td>
<td>27</td>
<td>27</td>
<td>26/27</td>
<td>26</td>
<td>26</td>
<td>27</td>
<td>23</td>
</tr>
<tr>
<td>Surface or Pendant Speakers</td>
<td>27</td>
<td>27</td>
<td>27</td>
<td>26</td>
<td>26</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>Projection Screens</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>Pull Boxes</td>
<td>27</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>27</td>
<td></td>
</tr>
</tbody>
</table>

### Matrix Remarks

18 Division 27 “Telecommunication” shall provide wiring and terminations for low-voltage communication cabling between equipment. Division 26 shall provide devices, wiring and terminations to equipment for 120 volt power service.

822 Division 27 “Audio/Visual” shall provide audio and control devices to include their installation and termination of low-voltage cabling. Division 26 shall provide floor box, power receptacle and termination of line-voltage power service.

23 Division 27 “Audio/Visual” shall install speaker, but shall turn speaker backbox over to Division 26 for installation.

END OF SECTION
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. Communications system 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. Division 05: Building Steel.
   2. Division 22: Cold Water Piping.
   3. Division 26: Grounding and Bonding.

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.

1.03 SYSTEM DESCRIPTION
A. Provide communications system grounding and bonding as described herein and indicated on the Drawings.

1.04 SUBMITTALS
A. Submit in accordance with the requirements of Section 270010: Basic Communications 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. Bonding strap:
   a. Chatsworth Product Inc. "CPI."
   b. Cooper/B-Line.
   c. Thomas & Betts.

2. Bonding connectors and lugs:
   a. Panduit.
   b. Thomas & Betts.
   c. O-Z/Gedney.

B. Substitutions: Under provisions of Section 270010: Basic Communications 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 NEC/CEC.

C. 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 EQUIPMENT BONDING

A. General:

1. The telecommunication system grounding backbone is covered under Section 260526: Grounding and Bonding and shown on the drawings in Riser Diagram format. It includes grounding bus bars, grounding riser conductors, connections to main service ground system, ground lugs and clamps, etc.
2. The work outlined in this Section covers the bonding of all telecommunication equipment and apparatus in the equipment rooms to the telecommunication system grounding backbone.

B. Bonding conductor:
   1. Refer to Section 260519: Building Wire and Cable.
   2. Conductor: #6 AWG (or larger), copper, stranded.
   3. Insulation: THHN/THWN, green in color.

C. Cable runway bonding straps:
   1. Refer to Section 260526: Grounding and Bonding.
   2. Conductor: Flexible braided copper strap with factory installed termination connectors.

D. Connectors and lugs:
   1. Conductor to conductor connector: C-type copper compression tap, heavy-wall, for tapping into unbroken continuous conductors as a splice, wire joint, "T" tap, or making parallel wire connections. Connector can be used with stranded or solid conductors.
   2. Conductor to busbar, racks, cabinets, or other equipment/component connector: Two-hole, copper, compression type lugs for #6 AWG conductors.
   3. Conductor to cable runway connector: Cable tray ground clamp, Extruded aluminum/tin-plated, mechanical type connector with set screws for tightening both tray and bonding conductor.

2.04 SOURCE QUALITY CONTROL
   A. Factory testing:

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 APPLICATION

3.03 PREPARATION

3.04 INSTALLATION
   A. Equipment bonding:
      1. Provide telecommunication bonding conductor and appropriate hardware between the telecommunication system grounding backbone bus in each equipment room and the equipment racks/rack bays, overhead cable support, vertical cable support, telecommunication conduits, primary pathways that exit/enter the rooms (if applicable), and all other metallic telecommunication infrastructure components.
      2. Telecommunication bonding conductor:
         a. The minimum size for the bonding conductor shall be #6 AWG THHN/THWN.
b. Install the bonding conductors in a manner that will protect them from physical and mechanical damage.

c. Route the bonding conductors in the shortest possible path, using right angles for turns and routed parallel to building lines.

d. Utilize a minimum of 1'-0” bending radius.

e. At the backbone ground busbar:

1) Thoroughly clean the busbar prior to attaching connectors and terminating conductors.

2) Attach connectors to the busbar with appropriate size cadmium bronze bolt, flat washer and Belleville washer.

3) Torque all connectors.

3. Rack bays:

a. Bond equipment racks, frames, frame bays, cabinets, server racks, and all other similar support systems located within the same equipment room or space to the backbone ground busbar in same room.

b. Rack bays may be bonded in series using either of the following configurations:

1) Provide a bonding conductor from the backbone busbar to the closest rack and route through ground lug connected to rack, extending the conductor the full length of the rack bay. Each individual rack shall have a ground lug attached that the bonding conductor passes through. Insulation on bonding conductor, where it passes through the lug, shall be removed prior to tightening connection around conductor.

2) Provide a bonding conductor from the backbone busbar to the closest rack and then along the entire length of rack bay. “T” tap a pigtail, sized the same as the bonding conductor, from the bonding conductor to each individual rack and terminate on ground lug connected to rack.

4. Overhead and vertical cable runway support:

a. Bond cable runway located within the same equipment room or space to the backbone ground busbar in same room.

b. Provide a “ground kit” (straps and connectors) to bond sections of the runway for ground continuity. This requirement applies to runway sections and junctions within the same equipment room.

3.05 FIELD QUALITY CONTROL

A. Refer to Specification Section 270800: Communications Commissioning.

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. Prefunctional testing:

1. Visual and mechanical inspection:
2. Cable tests:

3. Test values:

D. 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.

E. Contractor shall replace at no costs to the Owner all cables, equipment and devices which are found defective or do not operate within factory specified tolerances.

F. Contractor shall submit 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.

3.06 CLEANING

A. Upon completion of Project prior to final acceptance the Contractor shall thoroughly clean all equipment per Manufacturers approved methods and materials. Remove paint splatters and other spots, dirt and debris.

B. Touch-up paint any marks, blemishes or other finish damage suffered during installation.

3.07 TRAINING

A. Refer to Specification Section 270800: Electrical Commissioning.

B. 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.

C. Contractor shall schedule training with a minimum of 7 days advance notice.

END OF SECTION
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. List Scope.

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. Division 00:

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):
2. Electronics Industries Alliance (EIA):
3. Factory Mutual System (FM):
4. Federal Communications Commission (FCC) Regulations:
5. Federal Specifications (FS):
6. Institute of Electrical and Electronic Engineers (IEEE):
7. National Electrical Manufacturer Association (NEMA):
9. Telecommunications Industry Association (TIA)
10. Underwriters Laboratories, Inc. (UL):

1.03 DEFINITIONS

1.04 SYSTEM DESCRIPTION

1.05 SUBMITTALS

A. Items specified under this Section are Priority 1. Refer to Section 270010: Basic Communications Requirements for specific Priority 1 requirements.

B. Submit in accordance with the requirements of Section 270010: Basic Communications 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. 
3. Furnish structural calculations for equipment anchorage as described in Section 270010: Basic Communications Requirements.
4. Submit Manufacturer's installation instructions.
5. Complete Bill of Material listing all components.
6. Final test results.
7. Warranty.

C. Dimensions and configurations of equipment 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.

1.06 OPERATION AND MAINTENANCE MANUALS

A. Supply operation and maintenance manuals in accordance with the requirements of Section 270010: Basic Communications 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.

1.07 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.

C. Manufacturer's qualifications:

D. Installer's qualifications:

1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery: Equipment 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 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 7 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 service technician shall perform initial start-up of the equipment. Sufficient time shall be allowed to properly check the system out and perform required minor adjustments before the Engineer's witnessed test shall begin.

1.11 EXTRA MATERIAL:
A. Provide one spray can of matching finish paint for touching up damaged surfaces after installation.

1.12 MAINTENANCE
A. Maintenance:

1.

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. List Manufacturers.

B. Substitutions: Under provisions of Section 270010: Basic Communications Requirements.

2.02 GENERAL

2.03 EQUIPMENT SPECIFICATIONS

2.04 SOURCE QUALITY CONTROL
A. Factory testing:

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 APPLICATION
3.03 PREPARATION

3.04 INSTALLATION

A. Install equipment in accordance with Manufacturer's written instructions, as indicated on the Drawings and as specified herein.

3.05 FIELD QUALITY CONTROL

A. Refer to Specification Section 270800: Communications Commissioning.

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. Prefunctional testing:
   1. Visual and mechanical inspection:
   2. Cable tests:
   3. Test values:

D. 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.

E. Contractor shall replace at no costs to the Owner all cables, equipment and devices which are found defective or do not operate within factory specified tolerances.

F. Contractor shall submit 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.

3.06 CLEANING

A. Upon completion of Project prior to final acceptance the Contractor shall thoroughly clean all equipment per Manufacturers approved methods and materials. Remove paint splatters and other spots, dirt and debris.

B. Touch-up paint any marks, blemishes or other finish damage suffered during installation.

3.07 TRAINING

A. Refer to Specification Section 270800: Electrical Commissioning.

B. 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.

C. Contractor shall schedule training with a minimum of 7 days advance notice.

END OF SECTION
SECTION 27 05 36
COMMUNICATIONS CABLE TRAYS

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. Cable trays.
2. Cable tray accessories.
3. Wire basket cable support system 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.

1.02 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 VE 1; Cable Tray Systems

   ASTM A123 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
   ASTM A510 General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
   ASTM A633 Electrodeposited Coatings of Zinc and Steel

1.03 SUBMITTALS

A. Submit in accordance with the requirements of Section 270010: Basic Communications Requirements, the following items:

1. Data/catalog cuts for each product and component specified herein, listing and physical and communications 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 cable tray products special installation techniques.

4. Complete bill of material listing all components.

5. Shop Drawings: Indicate layout, dimensions, support locations and mounting details.

6. Furnish structural calculations for equipment support as described in Section 270010: Basic Communications Requirements.
1.04 OPERATION AND MAINTENANCE MANUAL

A. Supply operation and maintenance manuals in accordance with the requirements of Section 270010: Basic Communications Requirements, to include the following.

1. Instructions for routine maintenance to include bolt-tightening procedures.

2. Pictorial parts list and part numbers.

3. Telephone numbers for the authorized parts and service distributors.

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. Chatsworth

2. B-Line Systems, Inc.

3. Cablofil EZ Tray

B. Substitutions: Under provisions of Section 270010: Basic Communications Requirements.

2.02 WIRE BASKET SYSTEM SECTIONS AND COMPONENTS

A. General: Provide wire basket of type and sizes indicated; with connector assemblies, clamp assemblies, connector plates, splice plates and splice bars. Construct units with round edges and smooth surfaces, in compliance with applicable standards and with the following additional construction features.

B. Construction:

1. Wire basket system shall be made of high strength steel wires and formed into a standard 2” x 4” wire mesh pattern with intersecting wires welded together. All wire ends along system sides shall be rounded during fabrication.

2. All straight section longitudinal wires shall be straight, with no bends.

3. Wire basket size shall be 2” deep x 6” or 12” wide x 118” long.

4. Wire diameter: 0.177 inches, minimum.

5. All fitting shall be field formed as needed to accommodate layout as indicated.

6. All splicing assemblies shall be the bolted type using serrated flange locknuts.

7. Hardware, including splice connectors and support components shall all be furnished by Manufacturer.
C. Materials and finishes:

1. Hot-dip galvanized after fabrication:
   a. Straight sections shall be made from steel meeting the minimum mechanical properties of ASTM A510 and shall be coated after the wire basket system has been fabricated in accordance with ASTM A123 (CSA Type 1).
   b. All hot-dip galvanized after fabrication sections must be returned to the point of manufacture after coating for inspection and removal of all icicles and excess zinc.

2. Electro-galvanized zinc: Support accessories and miscellaneous threaded hardware shall be coated in accordance with ASTM B633 SC3. All threaded components shall be coated in accordance with ASTM B633 SC1.

D. Support system:

1. Wire basket shall be pendant hung via threaded rods and expansion anchors to form a trapeze system with construction channel.
2. Wire basket under floor support stand designed to elevate basket 4" off the floor.
3. No hardware required to mount basket to bracket. Simply bend tabs of bracket down around wires.
4. Attach bracket to floor using ¼” x 1” long expansion anchors.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Contractor shall thoroughly examine Project site conditions for acceptance of cable tray installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.02 PREPARATION

A. Location of cable tray 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. Provide offsets as required to avoid obstruction of cable tray with other trades.

B. Exposed cable trays shall be run parallel or at right angles to the centerlines of columns and beams.

C. Cable trays 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.

D. When cable tray is utilized for telecommunication cabling, it shall not be placed closer than 3 inches to any branch circuit power raceway.

3.03 INSTALLATION

A. Install cable tray in accordance with Manufacturer's written instructions, as indicated on Drawings and as specified herein.

B. Shall conform to NEMA VE 1 requirements.

C. Support cable tray at each connection point, at the end of each run and at other points to maintain spacing between supports of 8 feet maximum.
D. Cable tray support shall be a trapeze type hanger system consisting of two (2) 3/8" threaded rods supported from structure above with 1 5/8" x 1 5/8" construction channel span between. Channel shall have 1" slots spaced 2" on center and be mounted with open side down. Mount cable tray on trapeze hanger using hold-down clamps to secure.

E. Provide lateral bracing support along cable tray spaced at a maximum of 30'-0" on center. Bracing shall consist of 1 5/8" x 1 5/8" construction channel attached to one side of trapeze channel and installed at a 45-degree angle up to structural slab. Anchor bracing channel to slab with expansion bolts. Alternate bracing on both sides of cable tray.

F. Use expansion connectors where indicated in NEMA VE 1.

G. Provide bonding continuity between cable tray sections and fittings and ground per NEC.

3.04 PENETRATION

A. Cable trays penetrating fire rated walls shall be the solid-bottom-type with a flanged-solid cover and extend 18 inches beyond wall on both sides. Cover shall be sealed and non-removable.

B. Wall shall be patched around cable tray per the requirements of Division 07.

C. Provide fire rated fire-stop pillows within solid cable tray to maintain fire separation rating of wall. Install pillows per the requirements of the Manufacturer in quantities as required based on opening size. Pillows shall be Nelson type PLW fire-stop or approved equal.

END OF SECTION
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. Equipment racks.
2. Server and network cabinets.
3. Vertical cable management.
4. Horizontal cable support.
5. Cable runways.

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. Division 00:

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):
2. Electronics Industries Alliance (EIA):
3. Factory Mutual System (FM):
4. Federal Communications Commission (FCC) Regulations:
5. Federal Specifications (FS):
6. Institute of Electrical and Electronic Engineers (IEEE):
7. National Electrical Manufacturer Association (NEMA):
9. Telecommunications Industry Association (TIA)
10. Underwriters Laboratories, Inc. (UL):

1.03 DEFINITIONS

1.04 SYSTEM DESCRIPTION
1.05 SUBMITTALS

A. Items specified under this Section are Priority 1. Refer to Section 270010: Basic Communications Requirements for specific Priority 1 requirements.

B. Submit in accordance with the requirements of Section 270010: Basic Communications 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.

3. Furnish structural calculations for equipment anchorage as described in Section 270010: Basic Communications Requirements.

4. Submit Manufacturer's installation instructions.

5. Complete Bill of Material listing all components.

6. Final test results.

7. Warranty.

C. Dimensions and configurations of equipment 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.

1.06 OPERATION AND MAINTENANCE MANUALS

A. Supply operation and maintenance manuals in accordance with the requirements of Section 270010: Basic Communications 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.

1.07 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.

C. Manufacturer's qualifications:
D. Installer’s qualifications:

1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery: Equipment 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 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.

1.10 SYSTEM START-UP

A. Upon completion of installation, a factory trained service technician shall perform initial start-up of the equipment. Sufficient time shall be allowed to properly check the system out and perform required minor adjustments before the Engineer's witnessed test shall begin.

1.11 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. Equipment racks and cable runways:
   a. Chatsworth Product Inc. “CPI.”
   b. Cooper/B-Line.
   c. Panduit.

B. Substitutions: Under provisions of Section 270010: Basic Communications Requirements.

2.02 EQUIPMENT RACKS, 2-CHANNEL TYPE:

A. Application: Suitable for the support of termination apparatus, cable and cord management apparatus, network equipment, and other similar equipment within a telecommunication room.

C. Channel:
   1. Size: 3" deep with flanges on each side (double sided).
   2. Flange: 1.265" wide by 0.25" thick with mounting holes.
   4. RMU markings: The RMU markings shall be permanently stamped on the outside of both flanges on both channels.

D. Assembled rack: Rack shall be complete with two four mounting channels, two base angles (3.5" high by 6" deep by 0.375" thick), two top angles (1.5" high by 1.5" deep by 0.375" thick), a bottom center pan, and a top center pan. Rack shall be 7'-0" high (overall) by 19" mounting width (20.25" width overall), 28" from front mounting plane to back mounting plane, and shall contain 4558 EIA mounting spaces (1.75" on center).

E. Load rating: 1000 lbs, when evenly distributed for the height of rack.

F. Finish: Powder coat, black.

G. Accessories: Include required accessories, such as floor installation kits, mounting hardware, etc. for a complete installation.

2.03 VERTICAL MANAGEMENT SECTIONS:
A. Application: Suitable for cable routing (back) and cord slack storage (front) vertically within a rack bay, from bottom of rack to the top.

B. Configuration: The vertical management sections shall be double-sided having covered cable guides on the front and flip-retainers on the rear.

C. Size and capacity: 7'-0" high by 10" wide, having at least 7" deep cable storage capacity in back and 7" deep cord storage capacity in front.

D. Mounting: The vertical management sections shall have matching bolt holes for attachment to equipment rack.

E. Finish: Black, guide and cover.

2.04 HORIZONTAL CABLE SUPPORT BAR:
A. Application: Suitable to horizontally support cables at termination points on back of patch panels.

B. Finish: Shall match the rack.

2.05 HORIZONTAL MANAGEMENT PANELS:
A. Application: Suitable to horizontally support cord management within rack bay on front of patch panels.

B. Configuration: The horizontal management panels shall be single-sided.

C. Size: 2U high by 19" mounting width.

D. Finish: Black, guide and cover.
2.06 CABLE RUNWAY:
A. Application: Suitable for the support and management of cabling, either overhead or mounted vertically on walls, within equipment rooms. Also, provides overhead equipment rack bracing.

B. Construction:
1. Runway shall be constructed of two longitudinal side elements known as “stringers” and crossing members known as “rungs.” Rungs are spaced 12” on center and are welded to stringers on both sides.

2. Stringers and rungs are constructed of rectangular tube steel, 1-1/2” by 3/8” by 0.65” wall thickness.

3. Size: 10’-0” straight section by 24” wide.

C. Accessories: Provide accessories for a complete installation as shown on the drawings to include 45º and 90º junctions, “T” junctions, butt splices, swivel butt splices, end caps, end closing kits, vertical wall brackets, wall angle supports, triangle supports, rack-to-runway attachments, drop-out kits, bonding straps, etc.

2.07 LABEL PLATES FOR EQUIPMENT RACKS:
A. Label plates shall be suitable to affix onto top angle of equipment rack.

B. Label plate shall be “engraved-able” stock melamine plastic laminate substrate.

C. Size: 1/2” high by 6” long by 1/16” thick.

D. Lettering shall be white, engraved, 1/8” high.

2.08 SOURCE QUALITY CONTROL
A. Factory testing:

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 INSTALLATION
A. Install equipment in accordance with Manufacturer's written instructions, as indicated on the Drawings and as specified herein.

B. Rack bays:
1. Equipment racks:

   a. Provide parts and accessories required to complete each rack per manufacturer’s instructions and as detailed on drawings.

   b. Anchoring and bracing:

      1) Anchor racks to the floor using structural engineer approved concrete anchors.
2) Each rack must be attached to the floor at four points.

3) If required for seismic bracing, provide bracing devices (i.e. brackets, threaded rod with strut, etc.) attached to wall or structure above using appropriate fasteners.

c. Tolerances:
   1) Verify dimensions to establish proper clearances as follows:
      a) Front: 40” clearance from channel front mounting flange.
      b) Back: 57” clearance from channel back mounting flange.
   2) Provide the correct amount of space between each rack for proper installation (according to manufacturer’s written instructions) of the vertical management sections.

2. Vertical management sections:
   a. Provide vertical management sections mounted to racks with one between each rack and one on both ends.
   b. Bolt sections to the racks at the points designed by the manufacturer and per the manufacturer’s instructions.

3. Horizontal management panels:
   a. Provide the horizontal management panels mounted to racks with one above each patch panel and one below the bottom patch panel in each rack bay where patch panels occur.
   b. Provide fasteners and parts required to complete the installation.

4. Accessories: Provide all accessories as required for a complete installation. Include one bag of rack mounting screws, as come packaged with rack product. Attach the screws directly to the rack, which shall constitute turn-over to the Owner.

C. Overhead cable runway support:
   1. Provide support devices (i.e. brackets, threaded rod with strut, etc.) attached to wall or structure above using appropriate fasteners. Installation shall meet manufacturer’s instructions and layout on the drawings.
   2. Provide all parts and accessories required for a complete installation.
   3. Cable runway support shall be centered over equipment racks where shown running parallel.
   4. Coordinate the installation of the overhead cable runway support with other trades having Work in same area.

D. Vertical cable runway support:
   1. Install cable runway vertically on walls where noted and/or shown on the drawings. Runway shall be for the support of cables routed vertically on walls within the equipment rooms.
   2. Provide parts and accessories as required for a complete installation.
3. Install the cable runway such that the rungs are facing outward (the greater distance from the rung to the stringer edge is facing inward).

3.03 FIELD QUALITY CONTROL

A. Refer to Specification Section 270800: Communications Commissioning.

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. Prefunctional testing:
   1. Visual and mechanical inspection:
   2. Cable tests:
   3. Test values:

D. 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.

E. Contractor shall replace at no costs to the Owner all cables, equipment and devices which are found defective or do not operate within factory specified tolerances.

F. Contractor shall submit 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. Upon completion of Project prior to final acceptance the Contractor shall thoroughly clean all equipment per Manufacturers approved methods and materials. Remove paint splatters and other spots, dirt and debris.

B. Touch-up paint any marks, blemishes or other finish damage suffered during installation.

3.05 TRAINING

A. Refer to Specification Section 270800: Electrical Commissioning.

B. 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.

C. Contractor shall schedule training with a minimum of 7 days advance notice.

END OF SECTION
SECTION 27 13 13
COMMUNICATIONS COPPER BACKBONE CABLING

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. List Scope.

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. Division 00:

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):
2. Electronics Industries Alliance (EIA):
3. Factory Mutual System (FM):
4. Federal Communications Commission (FCC) Regulations:
5. Federal Specifications (FS):
6. Institute of Electrical and Electronic Engineers (IEEE):
7. National Electrical Manufacturer Association (NEMA):
9. Telecommunications Industry Association (TIA)
10. Underwriters Laboratories, Inc. (UL):

1.03 SYSTEM DESCRIPTION

A. Extend copper backbone cable from the maintenance 2nd floor telecommunications room to the new Communications room.

B. Provide Tie cable from termination blocks at each IDF to a rack mounted category 5e voice panel.

1.04 SUBMITTALS

A. Items specified under this Section are Priority 1. Refer to Section 270010: Basic Communications Requirements for specific Priority 1 requirements.
B. Submit in accordance with the requirements of Section 270010: Basic Communications 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:

3. Furnish structural calculations for equipment anchorage as described in Section 270010: Basic Communications Requirements.

4. Submit Manufacturer's installation instructions.

5. Complete Bill of Material listing all components.

6. Final test results.

7. Warranty.

C. Dimensions and configurations of equipment 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.

1.05 OPERATION AND MAINTENANCE MANUALS

A. Supply operation and maintenance manuals in accordance with the requirements of Section 270010: Basic Communications 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.

1.06 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’s qualifications:

D. Installer’s qualifications:
1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery: Equipment 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 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 1 year parts and labor warranty for malfunctions resulting from defects in materials and workmanship. Warranty shall begin upon acceptance by the Owner.

1.09 SYSTEM START-UP

A. Upon completion of installation, a factory trained service technician shall perform initial start-up of the equipment. Sufficient time shall be allowed to properly check the system out and perform required minor adjustments before the Engineer's witnessed test shall begin.

1.10 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. General Cable

2. Superior Essex.

B. Substitutions: Under provisions of Section 270010: Basic Communications Requirements.

2.02 BACKBONE TWISTED PAIR CABLING

A. ISP backbone twisted pair cable:

B. Application:

1. Suitable for indoor installations, between floors exposed in equipment rooms as vertical risers, or above suspended ceilings and below raised floors exposed in cable trays, hangers or on deck. If space is used as an air plenum, cable shall either be plenum rated or installed in EMT conduit.

2. Each cable run shall be continuous single cable, homogenous in nature, without splices.

3. Twisted pair PIC type cable, air core, with an “ALVYN” sheath, compatible with Bell System type “ARMM.”
4. Multipair cable shall be CMP when installed exposed above ceiling space. Cable shall be CMR rated when installed in conduit when passing between floors and other telecommunications equipment rooms.

5. Conductors:
   a. Annealed solid copper, 24 AWG.
   b. Fully insulated conductors consisting of an inner layer of expanded polyolefin and covered with an outer layer (skin) of solid PVC.
   c. Conductors shall be twisted into pairs. Twisted pairs shall be stranded into 25-pair bundles and into larger units of 25-pair increments, to make up the specified pair count, as well as supper units (if required by pair count).
   d. Twisted pairs and units shall be color-coded to industry standards, ANSI/ICEA Publication S-80-576 and EIA-230.

6. Core and sheath:
   a. Cable core (twisted pairs) shall have a tape applied longitudinally, wrapped around its entirety. Tape material shall be non-hydroscopic polypropylene film or equivalent.
   b. Sheath type shall be “ALVYN” consisting of an inner shield and an outer jacket:
   c. Shield: 0.008” aluminum corrugated tape applied longitudinally with an overlap.
   d. Jacket: Flame-retardant PVC, adhesively bonded to shield.
   e. Cable shall be NEC rated as CMR or CMP cable and UL listed as such.

7. Electrical performance of the twisted pairs and overall cable shall comply with TIA/EIA-568-C Part 2 requirements for Category 3 UTP cabling, minimum.

2.03 BACKBONE TWISTED PAIR TERMINATIONS:

A. Inside plant:
   1. Suitable for installation within equipment rooms for termination of twisted pair backbone cables, either wall or rack mounted, vertically oriented in wall mount column configuration.
   2. Wall mounted 110 block type. Provide kits as required for 100, 300 or 900-pair, 5-pair based.
   3. 110 style vertical wire managers as required.
   a. Insulated displacement connector blocks consisting of oxygen free mechanical fastening system, arranged in a flame-retardant molded plastic, and fastened to a mounting bracket.

2.04 LABELS:

A. Labels type shall be durable plastic (PE or equal) tags, suitable for indoor and/or outdoor use, and shall contain UV inhibitors. The tags shall attach to the cable via an integrated tie or via a separate steel or plastic tie wrap.

B. Printable area shall be 1.50” by 2.62”, minimum.
2.05 CROSS CONNECT WIRES:

A. Cross connect wires shall be suitable for installation within the MPOE, BDF and IDF and fully compatible with the termination apparatus specified within this Section.

B. Cross connect wires shall be manufactured from a single, continuous length of insulated wire, homogenous in nature. Splices are not permitted anywhere.

C. Conductors:

1. Insulated conductors: #24 AWG, solid copper wire insulated with thermoplastic polyethylene or high-density polyolefin for non-plenum rated applications.


PART 3 - EXECUTION

3.01 EXAMINATION

A. Contractor shall thoroughly examine Project site conditions for acceptance of the telecommunication cabling system installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.

B. Verify that pathways and supporting devices are properly and completely installed prior to cable installation.

C. Verify dimensions of pathways to include length, i.e. “true tape” conduit runs.

D. Prior to installation, verify that the MPOE, MDF, ER and TR rooms are ready to accept cables and terminations.

3.02 INSTALLATION

A. ISP backbone twisted pair cabling:

B. Cabling:

C. Cable runs shall have continuous sheath continuity, homogenous in nature, without any splices.

D. Maximum cable length of 1,600 feet (500m) between the terminations at MDF, ER and TR.

E. Placement:

F. Place cables within designated pathways.

G. Maintain a minimum bend radius of 20 times the cable diameter during and after installation.

H. Maintain pulling tension within manufacturer’s limits.

I. Place and suspend cables in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables damaged during installation.

J. Place a pull rope along with cables where run in conduit and spare capacity still exists in the conduit. Tie off ends of pull rope.
K. Routing:
1. When routing horizontally within equipment rooms, utilize the overhead cable support system. When routing vertically within equipment rooms, utilize the vertical cable support system and provide approved cable straps at 24” intervals.
2. Route cables a minimum of 6” away from power sources to reduce interference from EMI.

L. Terminations:
1. Properly relieve strain from cables at termination points per manufacturer’s recommendations.
2. Bond metallic components of the cable sheath (i.e. shield) to the telecommunication ground system in accordance with the NEC and manufacturer’s instructions.
3. Terminate twisted pairs onto the termination apparatus in accordance with manufacturer’s latest instructions and TIA/EIA-568-C standard installation practices.

M. Termination apparatus:
1. Provide accessories required for a complete installation.
2. Install the termination apparatus such that the bottom row of terminations is no lower than 24” above finished floor and the top row of terminations is no higher than 60” above finished floor.
3. Mount termination apparatus plumb and square to building lines.

3.03 LABELING
A. General requirements:

B. Labeling, label colors, and identifier assignments shall conform to EIA/TIA-606-A Administration Standards and as approved by the Owner.

C. Provide permanent and machine-generated labels. Hand written labels will not be accepted.

D. Backbone twisted pair cable labeling:
1. Cables:
   a. Text color shall be black with #10 font size.

E. Identifier assignment:
1. First field: Type of cable.
2. Second field: Total number of pairs.
3. Third field: Cable number.
4. Fourth field: Active cable count and “dead” pairs.
5. Fifth field: Source and destination.
6. Sixth field: Terminal number (MPOE, BDF, IDF).
F. **Label installation:**

1. Provide labels on both ends of cables.
2. Install such that they are visible by a technician from normal stance.
3. Fully wrap label around the cable jacket (self lamination).
4. Provide one label within 12” of the termination apparatus.
5. Provide one label at the point where the cable enters/exits the equipment room.
6. Provide one label at the approximate mid-point between where the cable enters/exits the room and the termination apparatus.

G. **General:**

H. Calibrate test sets and associated equipment per the manufacturers instructions at the beginning of each day’s testing and after each battery charge. Fully charge the test sets prior to each day’s testing to ensure proper operation.

I. Ensure test equipment and test cords are clean and undamaged during testing activities. Per the University’s Representative’s discretion, halt testing activity and clean testing equipment, test cords and related apparatus.

J. Permanently record test results electronically within test equipment at the time of testing.

K. **Twisted pair testing:**

L. Test for UTP cabling as follows:

### TESTS FOR TWISTED PAIR CABLING TABLE

<table>
<thead>
<tr>
<th>Subsystem</th>
<th>Type</th>
<th>Test Configuration</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backbone</td>
<td>OSP</td>
<td>See Notes</td>
<td>Wire map &amp; length</td>
</tr>
<tr>
<td>Backbone</td>
<td>ISP/Riser</td>
<td>See Notes</td>
<td>Wire map &amp; length</td>
</tr>
</tbody>
</table>

D. **Precautions:**

E. Adhere to the equipment manufacturer’s instructions during all testing.

F. Prior to any testing activity or any measurements taken, ensure the test equipment is at room temperature, approximately 70°F.

G. Fully charge power sources before each day’s testing activity.

H. Backbone twisted pair testing:

I. The installation will be accepted when testing has indicated availability of 100% terminated pairs.

J. Test continuity and wire map for all pairs.

K. Test length for 2% of pairs of each cable. Pairs shall be from different 25 pair binder groups.

L. Record documents:
M. Permanently record all test results.

N. Export test results’ numerical values to a single Microsoft Excel spreadsheet.

O. Submit test results in a format acceptable to the Owner, Owner’s Representative and the University’s Representative before system acceptance.

P. Cable pair identifiers of the test reports shall match the identifiers as labeled in the field, i.e. use the same ID on the cable/termination label as what appears on the test report.

Q. Measurements shall carry a precision through one significant decimal place, minimum.

R. Use feet for the units for measurements shown on the print of the test measurements.

S. For each twisted pair backbone cable test, report shall contain the following information:

T. Project name and address.

U. Test company’s and Operator’s name.

V. Date measurements were taken.

W. Test equipment type to include model and serial numbers.

X. Cable identification number and pair number.

Y. Measurement results.

3.05 INSPECTION AND ADJUSTMENTS

A. Contractor shall inspect all installed Work in conjunction with the General Contractor and develop a "punchlist" for all items needing correction. Provide punchlist to the University’s Representative prior to their final walk of Project.

B. Punchlist work and the required remediation shall be performed prior to system final acceptance.

C. Replace or repair work completed by others that was defaced or destroyed during the installation of the telecommunication cabling system by this contractor.

D. Make changes to adjust the system to optimum operation for final use. Contractor is responsible for making changes to the system such that any defects in workmanship are correct and all cables and the associated termination hardware passes the minimum test requirements.

3.06 CLEANING

A. Remove all unused, excess and left over products, to include debris, spills, and installation equipment.

B. Leave finished work and adjacent surfaces in neat, clean conditions with no evidence of damage.

C. Legally dispose of debris.

D. Clean installed products in accordance with manufacturer’s instructions prior to final punchlist.
3.07 TRAINING

A. At the completion of all Work, a period of not less than 16 hours shall be allocated by the Contractor for instruction and training for the Owner Representative. The Cabling Contractor will need to describe how the cable is separated between different patch panels, how cross-connects are made and other basic cable plant management skills.

B. Contractor shall schedule training with a minimum of 7 days advance notice.

END OF SECTION
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. List Scope.

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. Division 00:

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):

2. Electronics Industries Alliance (EIA):

3. Factory Mutual System (FM):

4. Federal Communications Commission (FCC) Regulations:

5. Federal Specifications (FS):

6. Institute of Electrical and Electronic Engineers (IEEE):

7. National Electrical Manufacturer Association (NEMA):


9. Telecommunications Industry Association (TIA)

10. Underwriters Laboratories, Inc. (UL):

1.03 DEFINITIONS

A. Above finish floor (AFF) - Standard mounting height (e.g., 18 inch AFF) for a device using the center line of the device as the measurement point.

B. Administration - The methodology defining the documentation requirements of a cabling system and its containment, the labeling of functional elements and the process by which moves, additions, and changes are recorded.

C. ANSI/TIA/EIA - Associations involved in developing telecommunications industry standards.

D. Attenuation - The decrease in magnitude of transmission signal strength between points, expressed in dB as the ratio of output to input signal level.
E. Attenuation-to-crosstalk ratio (ACR) - The ratio obtained by subtracting insertion loss (attenuation [dB]) from near-end crosstalk (dB). ACR is normally stated at a give frequency.

F. Auditory assistance device - An intentional radiator used to provide auditory assistance to a handicapped person or persons. Such a device may be used for auricular training in an educational institution, for auditory assistance at places of public gatherings, such as a church, theater, or auditorium, and for auditory assistance to handicapped individuals, only, in other locations.

G. Backboard - Backboard generally refers to the 3/4" A-C grade plywood sheeting, lining the walls of the telecommunications room. Plywood shall be void-free, with two coats of fire retardant paint matching the painted interior walls covering both sides.

H. Backbone - A facility (e.g., pathway, cable, or conductors) between any of the following spaces: telecommunications rooms, common telecommunications rooms, floor-serving terminals, entrance facilities, equipment rooms, and common equipment rooms.

I. Basic link test configuration - Horizontal cable of up to 90m (295 ft) plus up to 2m (6.5 ft) of test equipment cord from the main unit of the tester to the local connection, and up to 2m (6.5 ft) of test equipment cord from the remote connection to the remote unit of the tester. Maximum length is 94 m (308 ft).

J. Bonding Conductor (BC) - A conductor used specifically for the purpose of bonding.

K. Cable Labeling System –

L. The scheme employed when identifying cable or its associated hardware.

M. Scheme adapted for labeling cables to identify them based on ANSI/TIA/EIA-606-A, Administration Standard for Commercial Telecommunications Infrastructure. See administration.

N. Cable Runway - Hardware designed and manufactured for horizontal pathway distribution of cable and inside wiring inside the BDF and IDF rooms.

O. CAT - Category used when identifying the performance characteristics of twisted pair cabling.

P. Ceiling Distribution System - A distribution system that utilizes the space between a suspended or false ceiling and the structural surface above.

Q. Closed-Circuit Television (CCTV) - A private television system, typically used for security purposes, in which the signal is transmitted to a limited number of receivers.

R. Communications plenum cable (CMP) - Type CMP communications plenum cable shall be listed as being suitable for use in ducts, plenums, and other spaces used for environmental air and shall also be listed as having adequate fire-resistant and low smoke-producing characteristics. (NEC) Cables must pass required test for fire and smoke characteristics of wires and cables, NFPA 262 or UL 910.

S. Communications Riser Cable (CMR) - Type CMR communications riser cable shall be listed as being suitable for use in a vertical run in a shaft or from floor to floor and shall also be listed as having fire-resistant characteristics capable of preventing the carrying of fire from floor to floor. (NEC) Cables must pass requirements for flame propagation.

T. Electromagnetic Interference (EMI) - Radiated or conducted electromagnetic energy that has an undesirable effect on electronic equipment or signal transmissions.

U. Entrance Conduit - Conduit that connects the campus underground infrastructure with the building’s Telecommunications Room.

V. Fire Retardant - Any substance added to delay the start or ignition of fire or slow the spread of the flame of any material.
W. Firestopping - The process of installing [specialty] listed fire-rated materials into penetrations of fire-rated barriers to reestablish the fire-resistance rating of the barrier.

X. Firestopping Location. A penetration through a fire-rated wall with a sleeve.

Y. Firestop System - A specific installation consisting of the material(s) (firestop penetration seals) that fill the opening in the wall or floor assembly, and around and between any items that penetrate the wall or floor (e.g., cables, cable trays, conduit, ducts, pipes), and any termination devices (e.g., electrical outlet boxes) along with their means of support.

Z. Grounding Conductor - A conductor used to connect the grounding electrode to the building's main grounding busbar.

AA. Grounding System - A system of hardware and wiring that provides an electrical path from a specified location to an earth ground point.

BB. Horizontal Cabling - The part of the cabling system that extends from the work area telecommunications outlet to the horizontal cross-connect in the telecommunications room.

CC. Hybrid Cable - An assembly of two or more cables, of the same or different types or categories, covered by one overall sheath.

DD. Infrastructure (Telecommunications) - A collection of those telecommunications components, excluding equipment, that together provide the basic support for the distribution of all information within a building or campus.

EE. Intermediate Cross-connect (IC) - the connection point between a backbone cable that extends from the main cross-connect and the backbone cable from the horizontal cross-connect.

FF. Loose Tube - A type of optical fiber cable construction where one or more fibers are laid loosely in a tube. Also called loose tube fiber.

GG. Main Cross-connect (MC) - The cross-connect normally located in the Telecommunications Equipment Room for cross-connection and interconnection of entrance cables, first-level backbone cables, and equipment cables.

HH. Metropolitan Area Network (MAN) - A data communications network that covers an area larger than a campus area and smaller than a wide area network. Typically interconnects two or more LANs and usually covers an entire metropolitan area.

II. MPOE - Minimum Point of Entry, Utility Partnerships/Alternate Carrier, usually located within the Telecommunications Room.

JJ. Multimode Fiber (MMF) - An optical fiber that carries many paths of light or an optical waveguide that allows many bound modes to propagate.

KK. Single-mode Fiber (SMF) - An optical fiber, usually step-index grade, which supports only one mode of light propagation. This does not necessarily imply single wavelength operation. The light source is normally a laser.

LL. Strand (STR) - A single unit of optical fiber within a cable (e.g., a 12-strand fiber cable has 12 individual optical fibers within the cable sheath).

MM. Telecommunications Entrance Facility - Utility Partnerships/Alternate Carrier Minimum Point of Entry that is usually located within the Main Cross-connect Room (MC).
NN. Telecommunications Equipment Room (TER) - A centralized space that provides space and maintains a suitable operating environment for the termination of backbone and campus cabling and house centralized communications and/or computer equipment (such as Core Switches and Servers). Note: An equipment room is considered distinct from a telecommunications closet because of the nature or complexity of the equipment housed by the equipment room.

OO. Telecommunications Main Grounding Busbar (TMGB) - A grounding busbar, located in the MC, connected to the main building ground electrode by a continuous 2/0 - #4 AWG wire (Wire size is dependant on the distance between the busbar and the building main).

PP. Telecommunications Room (TR) – A room dedicated to housing a group of telecommunications connectors (e.g., patch panel or punch-down block) that allows equipment and backbone cabling to be cross connected with patch cords or jumpers.

QQ. Underwriters Laboratories (UL) - A United States-based independent testing laboratory that sets safety tests and standards.

RR. Uninterruptible Power Supply (UPS) - A device that is inserted between a primary power source (e.g., a commercial utility) and the primary power input of equipment to be protected (e.g., a computer system) to eliminate the effects of transient variances or temporary outages. Retain acronyms, abbreviations, and terms that remain after this Section has been edited.

1. 04 SYSTEM DESCRIPTION
A. Provide a complete telecommunication fiber optic cabling system installation as specified herein and as shown on the Drawings. In general, system shall include, but not be limited to, the following:

B. OSP backbone fiber optic cabling:
1. Data System backbone fiber optic cable shall route underground between the site main cross connect room (MDF) and the site telecommunication room (TR). The installed cable shall consist of one 12-strand singlemode, OSP, fiber optic cable. Cable will be placed in innerduct.
2. OSP backbone fiber optic cables shall terminate on full height racks in the MDF and ER. The cable ends will be fusion spliced to SMF pigtailed with manufacturer terminated LC connectors and placed in LC connector plates.
3. OSP backbone fiber optic patch panel field shall interface with ISP backbone fiber optic patch panel field via fiber patch cords between modular connectors on the front side of patch panels.
4. OSP Fiber optic cable connector standard shall be Type LC. Connectors shall be singleplex type.

C. Security Camera backbone fiber optic cabling:
1. Indoor/Outdoor backbone fiber optic cables with power conductor.

D. Patch cords:
1. LC-LC duplex fiber patch cords shall be provided to patch between the OSP and ISP fiber cables.
2. Provide duplex patch cords as required to patch between Backbone (LC) and equipment (SC/LC/FC etc...) as required. Coordinate with owners IT Representative.
3. Refer to Drawings for complete documentation of above requirements and all additional requirements.
1.05 SUBMITTALS

A. Items specified under this Section are Priority 1. Refer to Section 270010: Basic Communications Requirements for specific Priority 1 requirements.

B. Submit in accordance with the requirements of Section 270010: Basic Communications 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

3. Furnish structural calculations for equipment anchorage as described in Section 270010: Basic Communications Requirements.

4. Submit Manufacturer's installation instructions.

5. Complete Bill of Material listing all components.

6. Final test results.

7. Warranty.

C. Dimensions and configurations of equipment 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.

1.06 OPERATION AND MAINTENANCE MANUALS

A. Supply operation and maintenance manuals in accordance with the requirements of Section 270010: Basic Communications 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.

1.07 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.

C. Manufacturer's qualifications:

D. Installer's qualifications:
1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery: Equipment 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 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.

1.10 SYSTEM START-UP

A. Upon completion of installation, a factory trained service technician shall perform initial start-up of the equipment. Sufficient time shall be allowed to properly check the system out and perform required minor adjustments before the Engineer's witnessed test shall begin.

1.11 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. The following Manufacturer shall be acceptable and in compliance with the project scope as specified herein and indicated on the Drawings.

1. Backbone fiber optic cable:
   a. Corning Cable Systems.
   b. Superior Essex
   c. BerkTek
   d. Belden
   e. Commscope

2. Fiber optic terminations:
   a. Panduit
   b. Corning Cable Systems.
   c. Ortronics
d. Leviton

e. Belden

f. Commscope

3. Indoor Fiber Splice Closure

a. Corning Cable Systems

b. Panduit

c. Ortronics

d. Leviton

e. Belden

4. Fiber Splice Trays

a. Corning Cable Systems

b. Panduit

c. Ortronics

d. Leviton

e. Belden

f. Commscope

5. Surveillance Camera Fiber and Power system

a. BerkTek One Reach

6. Test equipment:

a. Corning Cable Systems

b. Fluke Networks.

c. Laser Precision.

d. Tektronix.

B. Substitutions: Substitutions will not be accepted.

2.02 BACKBONE FIBER OPTIC CABLEING

A. OSP backbone fiber optic cable:

1. Application:

a. Suitable for outdoors, in underground PVC conduit installations where protection against water and moisture entry is required.
b. Optical transmission performance is not significantly affected by environmental fluctuations, installation or aging.

c. Materials do not evolve hydrogen in quantities that will increase light attenuation.

2. Singlemode fiber strands shall meet or exceed the following physical criteria:
   a. Core diameter: 8.3µm.
   b. Cladding diameter: 125µm, ±0.7µm.
   c. Core/cladding offset: ≤0.5µm.
   d. Coating diameter: 254µm, ±7.0µm.
   e. Coating/cladding concentricity: 12.0µm.
   f. Minimum tensile strength: 100,000psi.

3. Singlemode fiber strands shall meet or exceed the following performance criteria:
   a. Attenuation: 0.4dB/km at 1310nm and 0.3dB/km at 1550nm wavelengths, maximum.
   b. Mode field diameter: 8.4µm ±0.6µm at 1310nm and 8.9µm ±0.8µm at 1550nm.
   c. Cutoff wavelength: ≤1260nm.
   d. Dispersion: 8.0ps/nm•km at 1310nm and 2.6-6.0ps/nm•km at 1530-1565nm.

4. Buffering:
   a. Fibers shall be loosely buffered, either in a core tube or in multiple tubes around central member.
   b. Buffering tube(s) shall be filled with compound to protect against moisture penetration. Filling compound shall be non-hygrosopic and non-nutritive to fungus (“FLEXGEL,” or equivalent). The compound shall be easily removed with conventional nontoxic solvents.

5. Cable and sheath:
   a. Central member: Dielectric rod (glass-reinforced plastic, GRP).
   b. Fillers (where required to maintain circularity): Plastic rods matched to buffer tube diameter.
   c. Water blocking tape: Applied longitudinally over the central member/buffer tube(s)/filler core.
   d. Strength element: The cable shall have an internal strength element such as aramid yarn.
   e. Rip cord: Nylon or similar (to aid splitting the outer jacket).
f. Outer jacket: The cable shall have a seamless outer jacket, high or medium density polyethylene or equal, applied to and completely covering the internal components (central member, buffer tube(s), fillers, strength element, etc.). The outer jacket shall contain UV inhibitors for stable performance in direct sunlight. The outer jacket shall be non-hygrosopic and non-nutritive to fungus.

g. Printing: The jacket shall be printed/permanently marked with the manufacturer, sequential length (feet), fiber type, month and year or quarter and year of manufacture.

6. Tensile strength: The cable shall have a 600 lb minimum install rated load and 200 lb minimum long term rated load.

7. Operating temperature range: -30°C to 75°C.

8. Fiber Splice Trays:
   a. Splice trays shall support 12-24 fusion splices.
   b. Trays shall be compatible with the splice closure application and product.
   c. Provide the required quantity of fiber trays and splicing materials as required for a complete system.

B. Backbone fiber optic terminations:

1. Fiber optic patch panels:
   a. Patch panels shall be an enclosed housing for protecting, storing and organizing the termination of fiber cables and fiber strands. Shall also contain facilities to store fiber slack and provide patch cord management.
   b. Patch panels shall be passive physical equipment and apparatus used in terminating, interconnecting and cross-connecting fiber optic cabling. Panel shall possess a minimum fire resistant rating of UL94V-1 and shall conform to existing OSHA Health and Safety Laws.
   c. Patch panels shall come equipped with safety labels such as laser identification or warning labels as required by system considerations.
   d. Panels shall be 4U high, 19" rack mountable, accepting up to 12 adapter panels with 12 LC ports in each panel. Panels shall contain rear fiber entry slots, wire retainers and fiber storage drums. Furnish with slide out rails for front access and jumper troughs for cable management. Panels shall be suitable for multimode or singlemode fiber cable terminations.
   e. Panels shall be provided with LC couplings for termination of fiber cables with matching connectors.
   f. Provide patch panel and port quantities as required for cable terminations.

2. Fiber optic connectors:
   a. Singlemode:
      1) Materials:
         a) Ferrule ceramic (zirconia or alumina) with pre-radiused finish/face.
b) Connector housing: Plastic.

2) Connector shall meet or exceed Ultra PC performance.

3) Connector shall have an integral strain relief feature, including a bend limiting rear boot.

4) Connector shall be installable via either epoxy or anaerobic method.

5) Connector type shall be LC.

C. Fiber optic patch cords:

1. Suitable for indoor installations within equipment rooms.

2. Cords shall be factory-assembled from a single, continuous length of cordage, homogenous in nature, and terminated at both ends via connectors as required. Splices are not permitted anywhere.

3. Cordage:
   a. Conductors: 2 optical conductors/strands, matching physical and optical performance parameters of the singlemode cable plant specified above.
   b. Construction: "Mini Zipcord" type with strength member (aramid yarn) and jacket of PVC.
   c. Flame rating: NEC OFN rated or higher, and UL Listed as such.

4. Connectors:
   a. Singlemode patch cords shall be terminated with either duplex LC Ultra PC connectors at both ends or with duplex LC Ultra PC connectors at one end for connection with the cable plant and via connector type as required for connection to equipment at other end.

D. Labels:

1. Label type shall be a durable plastic tag, suitable for indoor and/or outdoor use, and shall contain UV inhibitors. The tag shall attach to the cable via a separate steel or plastic tie wrap.

2. Labels shall have a self-laminating feature.

3. Printable area shall be 3.5” x 2”, minimum.

4. Color shall be yellow with black legend test.

E. Miscellaneous:

1. Fiber slack storage rings.
   a. Leviton or equal
      1) OSP #48900-OFR
      2) ISP #48900-IFR

2. Velcro cable ties:
   a. Width: 0.75” or larger.
b. Color: Same color as the cable to which it is being applied.

F. Labels:

1. Label type shall be a durable plastic tag, suitable for indoor and/or outdoor use, and shall contain UV inhibitors. The tag shall attach to the cable via a separate steel or plastic tie wrap.

2. Labels shall have a self-laminating feature.

3. Printable area shall be 3.5” x 2”, minimum.

4. Color shall be yellow with black legend test.

5. Plenum cable ties:
   a. Suitable for use in plenums or air handling spaces.
   b. Color: Maroon or other distinctive non-white color.

2.03 ONE REACH FIBER SYSTEM

A.

2.04 CABLE TESTING EQUIPMENT

A. Fiber optic cabling:

1. Fiber optic light source:
   a. Connection interfaces shall be factory installed.
   b. Output shall be continuous wavelengths.
   c. The light sources may contain internal lenses, pigtails, and modal conditioners, provided they meet the launch conditions as described in “Post-Installation” Passive Link Attenuation Testing Procedures.
   d. LASER-based light source for multimode fiber testing shall have the following:
      1) Center wavelength of 850nm ±30nm and 1300nm ±20nm
      2) Special width (FWHM) of ≤50nm at 850nm and ≤150nm at 1300nm.
      3) Minimum output power level of ≥20dBm.
   e. LASER-based light source for singlemode fiber testing shall have the following:
      1) Center wavelength of 1320nm ±20nm and 1550nm ±20nm
      2) Special width (FWHM) of ≤5nm at 1310nm and ≤5nm at 1550nm.
      3) Minimum output power level of ≥3dBm.

2. Fiber optic power meter:
   a. Power meter for multimode and singlemode testing shall be capable of measuring relative of absolute power (or both) and must be independent of modal distribution.
b. Power meters used must be calibrated and traceable to the National Bureau of Standards.

c. Power meter used shall have the following:
   1) Dynamic range of 0dBm to -40dBm minimum.
   2) Accuracy of ±0.2dBm.

3. Fiber optic mandrel:
   a. Mandrel diameter for 50/125µm jacketed (3.0mm) fiber shall be 22mm.
   b. Mandrel diameter for 50/125µm unjacketed (0.9mm) fiber shall be 25mm.

4. Fiber optic OTDR:
   a. Singlemode source module:

<table>
<thead>
<tr>
<th>Wavelength</th>
<th>Dynamic Range</th>
<th>Attenuation Deadzone</th>
<th>Reflective Deadzone</th>
<th>Loss Resolution</th>
<th>Distance Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1310nm</td>
<td>40dB</td>
<td>6.0mt</td>
<td>3.5mt</td>
<td>0.001dB</td>
<td>0.1mt</td>
</tr>
<tr>
<td>1550nm</td>
<td>28dB</td>
<td>12.0mt</td>
<td>3.5mt</td>
<td>0.001dB</td>
<td>0.1mt</td>
</tr>
</tbody>
</table>

   b. Reader software: Windows-based software capable of reading stored traces and is fully functional with the testing equipment.

5. Fiber optic test cords:
   a. Singlemode fiber optic test cords:
      1) The fiber of the singlemode test cords shall have the core diameter and numerical aperture nominally equal to that of the singlemode fiber optic passive link.
      2) Test cord length for testing insertion loss: 1m to 5m.
      3) Connectors of the test cords shall be compatible with the connector types of the light source and the power meter, and with the cabling plant.
      4) The connectors shall exhibit ≤0.5 dB loss per connection @ both 1300 nm and 1550 nm, as measured per FOTP-171 D3. The connectors shall inhibit Fresnel reflections (i.e. have a “PC” finish).

PART 3 - EXECUTION

3.01 EXAMINATION

A. Contractor shall thoroughly examine Project site conditions for acceptance of the telecommunication fiber optic cabling system installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.

B. Verify that pathways and supporting devices are properly and completely installed prior to cable installation.

C. Verify dimensions of pathways to include length, i.e. “true tape” conduit runs.

D. Prior to installation, verify that equipment rooms are ready to accept cables and terminations.
E. ISP backbone fiber optic cabling:

1. Cabling:
   a. Cable runs shall have continuous sheath continuity, homogenous in nature, without any splices.
   b. Maximum cable length of 1,600 feet (500m) between the terminations at IC, and TR.
   c. Placement:
      1) Place cables within designated pathways.
      2) Maintain a minimum bend radius of 20 times the cable diameter during installation and a minimum bending radius of 10 times the cable diameter after installation.
      3) Maintain pulling tension within manufacturer’s limits.
      4) Place and suspend cables in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables damaged during installation.
      5) Do not use cable-pulling compounds for indoor installations.
      6) Provide 20 feet minimum sheath cable slack at each end of the run within the equipment rooms. Store cable slack in a fiber slack storage ring mounted on wall.
      7) Place a pull rope along with cables where run in conduit and spare capacity still exists in the conduit. Tie off ends of pull rope.
   d. Routing:
      1) Within equipment rooms, neatly dress and organize cables on designated cable routing facilities and fasten cables to routing facilities via tie wraps or Velcro type straps.
      2) When routing horizontally within equipment rooms, utilize the overhead cable support system. When routing vertically within equipment rooms, utilize the vertical cable support system and provide approved cable straps at 24” intervals.
   e. Terminations:
      1) Properly relieve strain from cables at termination points, at or within the fiber optic termination panels) per manufacturer’s instructions.
      2) Provide breakout kits to furcated fibers from buffer tubes. Provide required accessories and consumables for the complete termination of fiber strands.
      3) Terminate fiber strands at both ends using the specified fiber optic connectors appropriate for the mode type of the fiber. Perform termination in accordance with manufacturer’s instructions.
      4) Provide 3 feet of unsheathed fiber (tight buffer) slack within the patch panel/termination enclosure at each end of the link. Properly store fiber slack in rear of patch panel into the routing rings, per manufacturer’s instructions.
2. Termination apparatus:
   a. Provide fully assembled termination patch panels in designated equipment racks, located a top of rack. “Fully assembled” includes installation and mounting components and accessories such as adapter panels, coupling adapters, etc. required for operation.
   b. Provide accessories required for proper installation of each termination patch panel, including connector panels and adapters.
   c. Termination sequence:
      1) Rack-mount panels: Terminate singlemode fibers in sequential strand order.

F. OSP backbone fiber optic cabling:
   1. Innerduct:
      a. Provide innerduct and accessories for all conduits containing outside plant fiber optic cables. Innerducts shall consist of 4-1” ducts for each underground and building riser 4” conduit. Install innerduct per manufacturer’s instructions. Use pulling equipment and consumables (such as lubricants) allowed by the manufacturer. Place multiple innerduct using pulling harness designed specifically for the use and also using pulling swivel.
      b. At each vault or pullbox, building entrance, and equipment room, secure ducts with 4” plugs, bushings and gaskets as required for a sealed duct.
   2. Cabling:
      a. Cable runs shall have continuous sheath continuity, homogenous in nature, between either termination points or designated splice points. Only splices as noted on the Construction Documents are permitted.
      b. Placement:
         1) Place cables within designated pathways.
         2) Maintain a minimum bend radius of 20 times the cable diameter during installation and a minimum bend radius of 10 times the cable diameter after installation.
         3) Maintain pulling tension within manufacturer’s limits.
         4) Place and suspend cables in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables damaged during installation.
         5) Only use UL approved cable-pulling compounds when necessary to reduce pulling tension.
         6) Provide 20 to 30 feet minimum sheath cable slack at each end of the run within the equipment rooms. Store cable slack in the fiber slack storage ring mounted on wall.
         7) Place a pull rope along with cables where run in conduit and spare capacity still exists in the conduit. Tie off ends of pull rope.
c. Routing:

1) Route cables in innerduct between points of termination throughout entire length, except at the fiber take up reel.

2) Within equipment rooms, neatly dress and organize cables on designated cable routing facilities and fasten cables to routing facilities via tie wraps or Velcro type straps.

3) When routing horizontally within equipment rooms, utilize the overhead cable support system. When routing vertically within equipment rooms, utilize the vertical cable support system and provide approved cable straps at 24” intervals.

d. Terminations:

1) Properly relieve strain from cables at termination points, at or within the fiber optic termination panels) per manufacturer’s instructions.

2) Provide breakout kits to furcated fibers from buffer tubes. Provide required accessories and consumables for the complete termination of fiber strands.

3) Terminate fiber strands at both ends using the specified finer optic connectors appropriate for the mode type of the fiber. Perform termination in accordance with manufacturer’s instructions.

4) Provide 3 feet of unsheathed fiber (tight buffer) slack within the patch panel/termination enclosure at each end of the link. Properly store fiber slack in rear of patch panel into the routing rings, per manufacturer’s instructions.

3. Termination apparatus:

a. Provide fully assembled termination patch panels in designated equipment racks, located a top of rack. “Fully assembled” includes installation and mounting components and accessories such as adapter panels, coupling adapters, etc. required for operation.

b. Provide accessories required for proper installation of each termination patch panel, including connector panels and adapters.

c. Termination sequence:

1) Rack-mount panels: Terminate singlemode fibers first (upper left-most position), all in sequential strand order.

3.02 LABELING

A. General requirements:

1. Labeling, label colors, and identifier assignments shall conform to EIA/EIA-606-A Administration Standards and as approved by the Owner.

2. Provide permanent and machine-generated labels. Hand written labels will not be accepted.

B. Backbone and horizontal fiber optic cable labeling:

1. Cables:

   a. Text color shall be black with #10 font size.
b. Identifier assignment:
   1) First field: Type of cable.
   2) Second field: Total strand count.
   3) Third field: Cable number.
   4) Fourth field: Strands in use and dead strands.
   5) Fifth field: Source and destination.
   6) Sixth field: Terminal number (MDC, BDF, IDF).

c. Label installation:
   1) Provide labels on both ends of cables.
   2) Install such that they are visible by a technician from normal stance.
   3) Fully wrap label around the cable jacket (self lamination).
   4) Provide one label within 12” of the termination apparatus.
   5) Provide one label at the point where the cable enters/ exits the equipment room.
   6) Provide one label at the approximate mid-point between where the cable enters/ exits the room and the termination apparatus.

2. Fiber patch panels:
   a. Text color shall be black, #10 font size.
   b. Label installation:
      1) Provide labels at each port.
      2) Install labels into label window.

3.03 FIELD QUALITY CONTROL AND TESTING

A. General:
   1. Calibrate test sets and associated equipment per the manufacturers instructions at the beginning of each day’s testing and after each battery charge. Fully charge the test sets prior to each day’s testing to ensure proper operation.
   2. Ensure test equipment and test cords are clean and undamaged during testing activities. Per the Owners Representative’s discretion, halt testing activity and clean testing equipment, test cords and related apparatus.
   3. Permanently record test results electronically within test equipment at the time of testing.
B. Fiber optic testing:

1. Test fiber optic passive links as follows:

<table>
<thead>
<tr>
<th>Subsystem</th>
<th>Type</th>
<th>Test</th>
<th>Direction</th>
<th>Wavelength</th>
</tr>
</thead>
<tbody>
<tr>
<td>OSP backbone</td>
<td>Singlemode</td>
<td>Characterization, passive link insertion loss</td>
<td>Both</td>
<td>1310nm and 1550nm</td>
</tr>
<tr>
<td>ISP backbone</td>
<td>Singlemode</td>
<td>Passive link insertion loss</td>
<td>Both</td>
<td>1310nm and 1550nm</td>
</tr>
</tbody>
</table>

2. Precautions:
   
a. Adhere to the equipment manufacturer’s instructions during testing.
   
b. Prior to testing activity or measurements taken, complete the following activities:
      
      1) Ensure the test equipment is at room temperature, approximately 70ºF.
      
      2) Turn the light source and power meter power on for at least 5 minutes.
      
      3) Clean test/launch cords and system cords, if applicable, connectors and the cabling system adapters with a lint-free wipe and 90% (or higher) isopropyl alcohol.
   
c. Do not power off OTDR’s light source during testing activity.
   
d. Do not remove launch cord from the OTDR’s light source at any time (unless the testing is complete or the equipment is being put away for the evening or during trouble shooting).
   
e. Do not bend the launch cord smaller than 20 times the cord diameter during testing activities, as this may induce loss into the cord reducing the accuracy of the measurements).

C. Fiber optic characterization testing:

1. Equipment settings/measurement parameters:
   
a. Index of refraction: Match cable-under-test fiber parameters, default settings as follows:
      
      1) Singlemode: 1.466-1.467 @ 1310nm and 1.467-1.4677 @ 1550nm.
   
b. Pulse width (20ns for multimode and 50ns for singlemode):
      
      1) Singlemode: 10ns for cable lengths up to 6,560 feet (2,000m); 50ns for cable lengths between 6,560 feet (2,000m) and 32,800 feet (10,000m).
   
c. Backscatter:
      
      1) Singlemode: -74dB @ 1310nm and 1550nm.
   
d. Event threshold: 0.05dB.
e. Reflection threshold:
   1) Singlemode: -60dB.

f. Fiber break/end-of-fiber: 3dB.

2. Waveform: The waveform shall be real-time and normal density.

3. Obtain measurements using a “launch” cord connected to the test instrument and the cable under test.
   a. The fiber of the launch cord shall match the fiber of the cable under test in physical and performance parameters (i.e., type, core/cladding size, index of reflection, refraction profile, etc.). The fiber of the launch cord should match the fiber of the cable under test in manufacturer and product.
   b. Use launch cord length between 25 and 100 meters.

D. Fiber optic passive link insertion loss testing:
   1. Test cords performance verification:
      a. Connect test cord #1 between the light source and the power meter.
      b. The value displayed on the power meter is the Reference Power (Pref) measurement. If the power meter has a Relative Power Measurement Mode, enter this Reference Power Measurement (Pref) value into the meter. If it does not, hand-write Pref onto the record document for future reference.
      c. Disconnect test cord #1 from the power meter. Do not disconnect test cord #1 from the light source.
      d. Connect the “open” end of test cord #1 to an adapter of matching connector type. Connect one end of test cord #2 to the adapter and the other end to the power meter.
      e. The value displayed on the power meter is the Power Measurement (Psum). If the power meter is in Relative Power Measurement Mode, the meter reading represents the test cord #2 connection attenuation. If the meter does not have a Relative Power Measurement Mode, perform the following calculation to determine the connection attenuation:
         1) If Psum and Pref are in the same logarithmic units (dBm, dBu, etc.): Connection attenuation (dB) = (Psum - Pref)
         2) If Psum and Pref are in watts: Connection attenuation (dB) = [10 x log10 (Psum/Pref)]
         3) The measured connection attenuation must be less than or equal to the value found in the Table below.
      f. Flip the ends of test cord #2, so that the end connected to the power meter is now connected to the adapter, and the end connected to the adapter is now connected to the power meter.
      g. The meter reading is the reversed Power Measurement (Psum). Perform the proper calculations if not using Relative Power Measurement Mode.
h. Verify that both connection attenuation measurements are less than or equal to the value found in the following Table:

<table>
<thead>
<tr>
<th>Cable Type</th>
<th>SC Cord</th>
</tr>
</thead>
<tbody>
<tr>
<td>Singlemode</td>
<td>0.30dB maximum</td>
</tr>
</tbody>
</table>

i. If both measurements are found to be less than or equal to the values found in the Table, then test cord #1 is acceptable for testing purposes. Unacceptable attenuation measurements may be attributable to test cord #1 or #2. Examine each cord with a portable microscope and clean, polish or replace as necessary.

j. Repeat this test procedure from the beginning, reversing the test cords in order to verify the performance of test cord #2.

2. Test equipment set-up:

a. Follow the test equipment manufacturer’s initial adjustment and set-up instructions.

b. If the meter has a Relative Power Measurement Mode, select this mode.

c. If the meter can display power levels in dBm, select this unit of measurement to simplify subsequent calculations.

d. Set the light source and power meter to the same wavelength.

3. Singlemode passive link insertion loss testing procedure:

a. Determine the launch conditions:

1) Use the launch conditions as described in FOTP-78.

2) Employ a method to remove high-order propagating modes as described in FOTP-77.

b. Test method: Perform the passive link insertion loss testing of singlemode fibers according to the “Test Method A.1: One Jumper Reference,” per OFSTP-7.

1) After setting up the test equipment and verifying the performance of the test cords, the insertion loss of the passive link segments can be measured.

2) Connect test cord #1 between the light source and the power meter.

3) The meter reading is the Reference Power Measurement (Pref). If the power meter has a Relative Power Measurement Mode, enter the Pref value into the meter. If it does not have this mode, then hand-write the Pref for future reference and to be included in the Record Documents.

4) Disconnect test cord #1 from the power meter. Do not disconnect test cord #1 from the light source.

5) Connect test cord #1 to the passive link segment input.

6) At the opposite end of the passive link segment, connect test cord #2 to the link segment input and the power meter.
7) The meter reading is the Power Measurement (Psum). If the power meter is in Relative Power Measurement Mode, the meter reading represents the insertion loss. If the meter does not have this mode, perform the following calculation to determine the insertion loss:

   a) If Psum and Pref are in the same logarithmic units (dBm, dBu, etc.):
      Link segment attenuation (dB) = (Psum - Pref)

   b) If Psum and Pref are in watts: Link segment attenuation (dB) = \[10 \times \log_{10} \left(\frac{Psum}{Pref}\right)\]

8) Record Psum for inclusion into the record documents.

4. Acceptable measurement values:
   a. Remove and replace any cabling links failing to meet the criteria described in this Specification, at no cost to the Owner, with cables that prove to meet the minimum requirements.
   b. The general insertion loss equation for any link segment is as follows:
      1) Insertion loss = cable loss + connection loss + splice loss + CPR adjustment.
      2) Note: A connection is defined as the joint made by two mating fibers terminated with remateable connectors.
   c. Singlemode attenuation coefficients:
      1) OSP cable loss = Cable length (km) x (0.40dB/km @ 1310nm) or (0.30dB/km @ 1550nm).
      2) ISP cable loss = Cable length (km) x (0.650dB/km @ 1310nm) or (0.50dB/km @ 1550nm).
      3) Connection loss = (Connection x 0.24dB) + 0.24dB.
      4) Splice loss = Splices x 0.07dB.
      5) CPR adjustment = Not applicable for singlemode.

E. Record documents:
   1. Permanently record all test results.
   2. Export test results’ numerical values to a single Microsoft Excel spreadsheet.
   3. Submit test results in a format acceptable to the Owner and the Owners Representative before system acceptance.
   4. Cable, and fiber identifiers of the test reports shall match the identifiers as labeled in the field, i.e. use the same ID on the cable/termination label as what appears on the test report.
   5. Measurements shall carry a precision through one significant decimal place, minimum.
   6. Use feet for the units for measurements shown on the print of the test measurements.
   7. Print report such that fiber strands of a given cabling link have matching axis scales. The “X” and the “Y” axis shall be the same from report-to-report.
8. The trace of the printed test report shall show the launch cord.

9. For each fiber optic backbone cable test, report shall contain the following information:
   a. Project name and address.
   b. Test company's and Operator's name.
   c. Date measurements were taken.
   d. Test equipment type to include model and serial numbers.
   e. Cable identification number, fiber/strand number and fiber type (i.e. multimode, singlenode, etc).
   f. Measurement direction.
   g. Set-up parameters (i.e. wavelength, pulse width, refractive index, event threshold, etc.)
   h. OTDR trace.
   i. Length of fiber.
   j. Overall link loss.
   k. Passive link insertion loss testing:
      1) Wavelength.
      2) Loss measurement.

10. For each cabling link, include either a schematic graphic or a brief narrative accurately describing
    the test set-up. The description shall include test/launch cord (with length), expected events
    (connectors, slices, etc.) with expected distances, etc. This information will eliminate many
    questions the Owners Representative will have while reviewing the reports.

11. For each twisted pair backbone and horizontal cable test, report shall contain the following
    information:
   a. Project name and address.
   b. Test company's and Operator's name.
   c. Date measurements were taken.
   d. Test equipment type to include model and serial numbers.
   e. Cable identification number and pair number.
   f. Measurement results.

3.04 INSPECTION AND ADJUSTMENTS

A. Contractor shall inspect all installed Work in conjunction with the General Contractor and develop a "punchlist" for
   all items needing correction. Provide punchlist to the Owners Representative prior to their final walk of Project.

B. Punchlist work and the required remediation shall be performed prior to system final acceptance.
C. Replace or repair work completed by others that was defaced or destroyed during the installation of the telecommunication cabling system by this contractor.

D. Make changes to adjust the system to optimum operation for final use. Contractor is responsible for making changes to the system such that any defects in workmanship are correct and all cables and the associated termination hardware passes the minimum test requirements.

3.05 CLEANING

A. Remove all unused, excess and left over products, to include debris, spills, and installation equipment.

B. Leave finished work and adjacent surfaces in neat, clean conditions with no evidence of damage.

C. Legally dispose of debris.

D. Clean installed products in accordance with manufacturer's instructions prior to final punchlist.

3.06 TRAINING

A. At the completion of all Work, a period of not less than 16 hours shall be allocated by the Contractor for instruction and training for the Owner Representative. The Cabling Contractor will need to describe how the cable from each cover plate is separated between different patch panels, how cross-connects are made and other basic cable plant management skills.

B. Contractor shall schedule training with a minimum of 7 days advance notice.

END OF SECTION
SECTION 27 15 00
COMMUNICATIONS HORIZONTAL CABELING

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. List Scope.

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. Division 00:

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):
2. Electronics Industries Alliance (EIA):
3. Factory Mutual System (FM):
4. Federal Communications Commission (FCC) Regulations:
5. Federal Specifications (FS):
6. Institute of Electrical and Electronic Engineers (IEEE):
7. National Electrical Manufacturer Association (NEMA):
9. Telecommunications Industry Association (TIA)
10. Underwriters Laboratories, Inc. (UL):

1.03 DEFINITIONS

1.04 SYSTEM DESCRIPTION

A. Workstation outlets:

1. Administrative enclosed offices: Two outlets, Three horizontal twisted pair cable(s) per outlet.
2. Clerical/Staff clerical: One outlets, Three horizontal twisted pair cable(s) per outlet.
3. Secretary/Administrative assisted office: Two outlets, Three horizontal twisted pair cable(s) per outlet.
4. Printer/Plotter/Fax areas: One outlet, Four horizontal twisted pair cable(s) per outlet, additional outlets as shown on drawings.

5. Small to medium conference rooms:
   a. One wall phone outlet. One horizontal twisted pair cable(s) per outlet.
   b. One outlet on each wall, Three horizontal twisted pair cable(s) per outlet.
   c. One (1) telecommunication floor outlet, each consisting of three (3) jacks, centered below the conference room table.
   d. One (1) telecommunication outlets, each consisting of two (2) jacks, mounted in the ceiling for WAP.
   e. One (1) telecommunications surface mount outlet consisting of two (2) jacks in each A/V cabinet.
   f. If the room has an Interactive Whiteboard, place one (1) telecommunication outlet consisting of three (3) jacks on the left and right of the whiteboard, 18-inches AFF.
   g. If the room has LCD monitor, place one (1) telecommunication outlet consisting of two (2) jacks behind each monitor, 12-inches offset horizontally and vertically from the monitor mount so as to not interfere with the display or display mount.

6. Large Conference Rooms
   a. Two (2) telecommunication outlets each consisting of three (3) jacks on each wall
   b. One telecommunication wall-phone outlet consisting of one (1) jack on a wall near the door.
   c. One (1) telecommunications surface mount outlet consisting of two (2) jacks in each A/V cabinet.
   d. One or two telecommunication outlets each consisting of two (2) jacks mounted in the ceiling for WAP.
   e. Nine (9) telecommunication floor outlets consisting of three (3) jacks each spread out in a 3x3 layout covering the room floor area.
   f. If the room has a media lectern/podium, place one (1) telecommunication outlet consisting of three (3) jacks a floor box near the media lectern/podium.
   g. If the room has an Interactive Whiteboard, place one (1) telecommunication outlet consisting of three (3) jacks on the left and right of the whiteboard, 18-inches AFF.
   h. If the room has LCD monitor, place one (1) telecommunication outlet consisting of two (2) jacks behind each monitor, 12-inches offset horizontally and vertically from the monitor mount so as to not interfere with the display or display mount. three (3) jacks a floor box near the media lectern/podium.
   i. If the room has an Interactive Whiteboard, place one (1) telecommunication outlet consisting of three (3) jacks on the left and right of the whiteboard, 18-inches AFF.
   j. If the room has LCD monitor, place one (1) telecommunication outlet consisting of two (2) jacks behind each monitor, 12-inches offset horizontally and vertically from the monitor mount so as to not interfere with the display or display mount.
7. Training Rooms/Classrooms
   a. One telecommunication wall-phone outlet consisting of one (1) jack on a wall near the door.
   b. One telecommunication outlet consisting of three (3) jacks on each wall.
   c. One telecommunication floor outlet consisting of three (3) jacks per computer workstation area.
   d. One telecommunication floor outlet consisting of three (3) jacks per instructor media lectern/podium.
   e. One telecommunication outlet consisting for four (4) jacks per A/V media panel and cabinet.
   f. If the room has a media lectern/podium, place one (1) telecommunication outlet consisting of three (3) jacks a floor box near the media lectern/podium.
   g. If the room has an Interactive Whiteboard, place one (1) telecommunication outlet consisting of three (3) jacks on the left and right of the whiteboard, 18-inches AFF.
   h. If the room has LCD monitor(s), place one (1) telecommunication outlet consisting of two (2) jacks behind each monitor, 12-inches offset horizontally from the centerline of the monitor mount.

8. Wall mounted telephone outlets shall consist of the following, unless otherwise noted on the Drawings:
   a. One horizontal twisted pair cable per outlet.
   b. Single-gang metal cover plate with 1-port and two support studs.
   c. One RJ-45 connector jack for twisted pair terminations.

9. Courtesy Telephone area: One telecommunication outlet consisting of two (2) jacks for each courtesy telephone.

10. Fire Alarm Control Panel (FACP): One telecommunication outlet (on surface mount box) with two (2) jacks shall be installed in the Fire Alarm Control Panel (FACP) located in the electrical or mechanical room.

11. Elevator Room: One telecommunication outlet (on a surface mount box) with one jack shall be installed in each Elevator Control Panel.

12. Door Phone/Speaker Box: One telecommunication jack installed in each door phone/speaker box.

13. Building Environmental Automation System: One telecommunication outlet (on a surface mount box) shall be installed with a minimum of two (2) jacks in the Main Building Environmental Control Panel (TR):
   a. One telecommunication wall-phone outlet consisting of one (1) jack on a wall near the door.
   b. One telecommunication outlet consisting of two (2) jacks.

15. Electrical Room: One telecommunication outlet consisting of two (2) jacks.
16. Mechanical Room: One telecommunication outlet consisting of two (2) jacks.
17. Fire Control Rooms: One telecommunication outlet consisting of two (2) jacks.
18. Reception Area/Room:
   a. One telecommunication outlet consisting of three (3) jacks on each wall.
   b. Multiple telecommunication floor outlets consisting of three (3) jacks located on the Reception area.
19. Cafeteria Room/Area:
   a. One telecommunication outlet consisting of two (2) jacks on each wall (greater than 15 feet)
   b. One telecommunication outlet consisting of two (2) jacks in the ceiling (for WAP).
   c. One telecommunication outlet consisting of three (3) jacks at the cashier area.
   d. One telecommunication wall-phone outlet consisting of one (1) jack on a wall.
20. Break Rooms:
   a. One telecommunication outlet consisting of three (3) jacks on wall.
   b. One telecommunication wall-phone outlet consisting of one (1) jack on a wall.
21. Employee Computer Kiosk Area: One telecommunication outlet consisting of three (3) jacks per computer station.
22. Light Duty Shop Work Bays: One telecommunication outlet consisting of three (3) jacks per work bench.
23. Bank ATM Locations: One telecommunication outlet consisting of three (3) jacks on each wall.
24. Vending Machine Locations: Two (2) telecommunication outlet consisting of four (4) jacks on the wall.
25. Wheel Chair Elevator: One telecommunication outlet with one (1) jack for each wheel chair elevator phone.
26. Wireless Access Point (WAP): One telecommunication outlet consisting of two (2) jacks for each WAP location.
27. Dispatch Control Centers: Two (2) telecommunication outlets, consisting of four (4) jacks, per Dispatcher Console location.
28. Digital Signage Monitor: One telecommunication outlet shall be installed with a minimum of one UTP jack and one STP jack per display/monitor.
29. Indoor Fixed IP Cameras: One telecommunication outlet consisting of one (1) per camera
30. Indoor Mini-PTZ IP Cameras: One telecommunication outlet consisting of one (1) jack per camera.
31. Access Control Panels: One telecommunication outlet (on a surface mount box) consisting of one (1) jack in each Access Control Panel.
32. A/V Media Cabinets: One telecommunication outlet (on a surface mount box) consisting of two (2) jacks in each A/V Media Cabinet

33. A/V Lectern/Podium: One telecommunication outlet consisting of three (3) jacks in a floor box for the A/V Lectern/Podium

B. Refer to Drawings for complete documentation of above requirements and all additional requirements.

1.05 SUBMITTALS

A. Items specified under this Section are Priority 1. Refer to Section 270010: Basic Communications Requirements for specific Priority 1 requirements.

B. Submit in accordance with the requirements of Section 270010: Basic Communications 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. 

3. Furnish structural calculations for equipment anchorage as described in Section 270010: Basic Communications Requirements.

4. Submit Manufacturer's installation instructions.

5. Complete Bill of Material listing all components.

6. Final test results.

7. Warranty.

C. Dimensions and configurations of equipment 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.

1.06 OPERATION AND MAINTENANCE MANUALS

A. Supply operation and maintenance manuals in accordance with the requirements of Section 270010: Basic Communications 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.
1.07 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.

C. Manufacturer’s qualifications:

D. Installer’s qualifications:

1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery: Equipment 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 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.

1.10 SYSTEM START-UP

A. Upon completion of installation, a factory trained service technician shall perform initial start-up of the equipment. Sufficient time shall be allowed to properly check the system out and perform required minor adjustments before the Engineer’s witnessed test shall begin.

1.11 EXTRA MATERIAL:

A. Provide one spray can of matching finish paint for touching up damaged surfaces after installation.

1.12 MAINTENANCE

A. Maintenance:

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. Horizontal twisted pair and modular patch cord cable:

   a. Panduit
2. Horizontal twisted pair and modular patch cord terminations:
   a. Panduit

3. Test equipment:
   a. Corning Cable Systems
   b. Fluke Networks.
   c. Agilent Technologies WireScope 350 Test Set.
   d. Laser Precision.
   e. Tektronix.

B. Substitutions: Under provisions of Section 260010: Basic Electrical Requirements.

C. Horizontal management panels:
   1. Application: Suitable to horizontally support cord management within rack bay on front of patch panels.
   2. Configuration: The horizontal management panels shall be single-sided.
   3. Size: 2U high by 19" mounting width.

2.02 HORIZONTAL TWISTED PAIR CABLING

A. Horizontal cables:
   1. Application:
      a. Suitable for indoor installations, exposed within equipment rooms, above suspended ceilings and below raised floors in cable trays, hangers or on deck, or within walls. If space is used as an air plenum, cable shall either be plenum rated or installed in EMT conduit.
      b. Each cable run shall be continuous single cable, homogenous in nature, without splices.
      c. Cables shall meet CAT6 performance criteria.
      d. Cables shall be riser rated.

2. Conductors:
   a. Insulated conductors: Eight #23 AWG, solid copper wire.
   b. Twisted pairs: Two insulated conductors twisted together to form a pair and four such paired cables to form a unit with individually color-coded pairs to conform to industry standards (ANSI/ICEA Publication S-80-576-1994 and EIA-230).

3. Cable sheath:
   a. Outer jacket: Seamless outer jacket, flame-retardant applied to and completely covering the internal components (twisted pairs).
b. Flame rating: CMR according to NEC Article 800,


5. Indoor Cable
   a. General Cable: GenSpeed 6000

6. Outdoor Cable
   a. General Cable: GenSpeed 6 Outside Plant Category 6

B. Modular patch cords:

1. Application: Suitable for indoor installations within equipment rooms or workstation environments.

2. Cords assembled from a single, continuous length of cordage, homogenous in nature and terminated at both ends via 8-position modular plugs. Splices are not permitted anywhere.

3. Cordage:
   a. Insulated conductors: Eight #23 AWG, solid copper wire insulated with thermoplastic polyethylene or high-density polyolefin for non-plenum rated applications.
   b. Twisted pairs: Two insulated conductors twisted together to form a pair and four such paired cables to form a unit with individually color-coded pairs to conform to industry standards (ANSI/ICEA Publication S-80-576-1994 and EIA-230).

4. Cable sheath:
   a. Outer jacket: Seamless outer jacket, flame-retardant PVC, applied to and completely covering the internal components (twisted pairs).
   b. Flame rating: CM according to NEC Article 800, tested to UL listed as such.

5. Electrical performance: Meet or exceed TIA/EIA-568-C.2 Enhanced and ISO 11801 Class E specifications for CAT6 UTP cabling.

C. Modular patch panels:

1. Application:
   a. Modular patch panels shall be suitable for installation within a equipment room for the terminations of horizontal cables specified within this Section.
   b. Patch panels shall be horizontally oriented for rack-mounted configuration within a 19'' rack.
   c. Patch panels shall be capable of supporting, organizing, labeling and patching/crossconnecting between the horizontal termination field and the equipment termination field.

2. Modular patch panels shall have 110-type terminations on back for horizontal cabling.

3. Patch panels shall have 24 or 48 ports on front and each port shall be an 8-position modular jack, compliant to TIA/EIA 568-B.2 Chapter 5.
4. Each port shall be T568A wired.

5. Electrical performance: Meet or exceed TIA/EIA-568-C.2 Enhanced and ISO 11801 Class E specifications for CAT6 UTP cabling.

6. Also, include 24 or 48 port modular patch panels with pre-wired RJ-21C (50 Pin) connectors. Panels shall conform to all above requirements, except performance shall meet TIA/EIA-568-B.2 for CAT3 UTP cabling.

D. Modular connectors:

1. Modular connectors shall be 8-position jacks, compliant to TIA/EIA-568-C.2 Addendum 10, and shall be compatible with the specified cable within this Section, both electrically and physically.

2. Modular connectors shall be T568A wired.


E. Outlets:

1. Application:

   a. Outlet faceplates shall be suitable for indoor installations to standard single or double-gang flush wall mounted outlet box plaster rings, furniture partition outlets and floor boxes.

2. Standard wall mounted faceplates:

   a. Modular faceplates shall have 4-ports and shall include required accessories, such as icons, blank inserts, label windows and labels.

   b. Faceplates shall be single-ganged.

   c. Faceplates shall be flush mounted.

   d. Faceplates shall be single-gang decora-style to match power wiring devices.

3. Modular outlet frame:

   a. Modular outlet frame shall have 3-ports and shall include required accessories, such as icons, blank inserts, label windows and labels.

   b. Outlet frame shall be decora-style.

   c. Outlet frame shall attach like a duplex receptacle strap attaches to a box.

4. Wall mounted phone faceplates:

   a. Faceplate shall be single-gang, flush mounted with 1 port and shall include required accessories.

   b. Faceplate shall include two mounting studs for standard wall phone instrument.

   c. Faceplate shall be stainless steel.
5. Surface mounted outlets:
   a. Surface outlets shall be fully compatible with the specified modular connector/jacks.
   b. Surface outlets shall have 2-ports.

6. Partition furniture mounted faceplates:
   a. Faceplates shall be single-gang type with 3-ports and shall include required accessories, such as icons, blank inserts, label windows and labels.
   b. Faceplates shall be black.

F. Labels:
   1. Labels shall be machine printable with a laser printer, ink jet printer, thermal transfer printer or hand-held printer.
   2. Labels for horizontal cables:
      a. Adhesive backed labels and self-laminating feature.
      b. Fit the horizontal cables specified herein by fully wrapping around the cable jacket.
      c. Size: 2'' x .05'' printable area, minimum.

G. Miscellaneous components:
   1. Velcro cable ties:
      a. Width: 0.75''.
      b. Color: Velcro cable ties the same color as the cable to which it is applied.
   2. Plenum cable ties:
      a. Suitable for use in plenums or air handling spaces.
      b. Color: Maroon or other distinctive non-white color.

H. Twisted pair cabling:
   1. Backbone cable tester: Areas of test measurement shall be Wire Map for continuity, opens, shorts, crossed pairs and split pairs, as a minimum.
   2. Horizontal cable tester:
      a. Equipment shall meet TIA/EIA-568B.2 Addendum 1 requirements for Level III accuracy, as applicable for cable type specified herein.
      b. Test standards: ISO/IEC 11801 Class C and D; ISO/IEC 11801-2000 Class C and D; 1000Base-Y, 100Base-TX; IEEE 802.3 10Base-T; ANSI TP-PMD; IEEE 802.5.
      c. Areas of test measurement (minimum):
         1) Wire Map.
2) Length.
3) Insertion Loss.
4) The following at both master unit and remote unit:
   a) Near End Crosstalk (NEXT) loss.
   b) Power Sum NEXT (PSNEXT) loss.
   c) Equal Level Far End Crosstalk (ELFEXT).
   d) Power Sum ELFEXT.
   e) Return Loss (RL).
   f) Attenuation-to-Crosstalk Ratio (ACR).
   g) Power Sum ACR (PSACR).
5) Propagation Delay and Delay Skew.
6) Characteristic Impedance.
7) DC Loop Resistance.

PART 3 - EXECUTION

3.01 EXAMINATION
A. Contractor shall thoroughly examine Project site conditions for acceptance of the telecommunication cabling system installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.
B. Verify that pathways and supporting devices are properly and completely installed prior to cable installation.
C. Verify dimensions of pathways to include length, i.e. “true tape” conduit runs.
D. Prior to installation, verify that equipment rooms are ready to accept cables and terminations.

3.02 INSTALLATION
A. Horizontal twisted pair cabling:
   1. Horizontal cable installation and routing:
      a. Cable runs shall have continuous sheath continuity, homogenous in nature with no splicing.
      b. No cabling shall exceed a cable length of 295’ (90m) from the termination point at the equipment room to the termination at the workstation outlet, including service slack, when measured using test equipment.
      c. Place cables within the designated pathways, such as cable tray or basket tray, cable runway, cable hangers, etc. Do not fasten, support or attach cables to other building infrastructures (i.e. ducts, pipes, conduits, etc.), other systems (i.e. ceiling support wires, wall studs, etc.), or to the outside of conduits, cable trays and non0approved pathway systems.
d. Place and suspend cables during installation and termination in a manner to protect them from physical damage or interference. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables damaged during installation or termination at no additional cost.

e. Route cables at 90º angles, allowing for bending radius.

f. Do not exceed pulling tension of 25 lbs.

g. Do not use cable-pulling compounds.

h. Do not exceed a minimum bend radius of 6 times the cable diameter during and after installation.

i. Route cables beneath other building infrastructures (i.e. ducts, pipes, conduits, etc.) in above ceiling applications. Do not route cables over building infrastructures. The installation shall result in easy accessibility to the cables in the future.

j. Place cables 6” minimum away from power sources to reduce interference from EMI.

k. Do not set 360º service loops in place for slack storage. Instead, set slack as forward-and-back or as figure eights.

l. Place a pull string along with cables where run in conduits and spare capacity in conduit remains. Tie off ends of the pull string to prevent the string from falling onto the conduit.

m. When exiting the primary pathway, such as cable or basket tray, to the workstation outlets, exit via the top of the pathway. Secure the cables to the pathway using an approved cable tie.

2. Cable routing and dressing within equipment rooms:

a. Within equipment rooms, only use Velcro type straps.

b. Place cables within the overhead cable support system. When routing vertically on walls, fasten the cables onto vertical supports every 24” on center.

c. Provide 12” minimum sheath cable slack, length not to exceed permanent link maximum length requirement. Place the slack in the overhead cable support system.

d. At the rack bay, route and neatly dress cables from the overhead cable support system into the back of the vertical management sections. Divide the cables equally between both sides of an equipment rack such that a cable does not travel past the midpoint of the rack prior to termination. Fasten the cables to the cable support bar at the back of the patch panel using approved ties.

3. Termination in the equipment rooms:

a. Provide termination apparatus and accessories required for a complete installation. Install and assemble termination apparatus, accessories and associated management apparatus according to the manufacturer’s instructions.

b. Properly relieve strain from the cables to and at termination points per manufacturer’s instructions. Provide a strain relief bar at the back of the modular patch panels for proper strain relief.
c. Terminate cables and twisted pairs in accordance with manufacturer's latest installation requirements and TIA/EIA-568-B standard installation practices. Terminate cable pairs onto the termination apparatus compliant to T568A wiring.

d. Modular patch panels and horizontal management panels:

1) Provide quantity of modular patch panels to support the terminations of cables served from respective IDF. Provide quantity of horizontal management panels based on the quantity of patch panels.

2) Install and assemble modular patch panels and horizontal management panels according to the manufacturer’s instructions.

3) Install the patch panels and the horizontal management panels as shown on the Drawings.

4) Terminate cables in sequential order using the link’s identifier starting at the top left and completing a panel before moving to the next panel below.

4. Cable routing and dressing at workstations:

a. Provide 12” to 18” cable slack at each workstation outlet, length not to exceed permanent link maximum length requirement. Place the slack within ceiling space neatly on a cable hanger or other approved cable support device.

b. Route to partition furniture mounted faceplates:

1) Route cables from primary or secondary pathway within ceiling through the furniture partition feed pathway (stub from wall or floor box) into opening at bottom of furniture system. Exercise caution to prevent scraping, cutting or other damage to cable jacket.

2) Provide spiral wrap around cables from furniture-feed pathway to point where cables enter furniture.

5. Termination at the workstation outlets:

a. Provide device components, connectors, and accessories required for a complete installation. Install and assemble connectors, jacks, adapters, termination apparatus, accessories and associated management apparatus according to the manufacturer’s instructions.

b. Connector color shall match the faceplate.

c. Provide “fog white” connectors for data links and “dark blue” connectors for voice links.

d. Wall mounted standard devices:

1) Install devices at heights indicated on drawings.

2) Mount faceplates plumb, square and at the same level as adjacent power receptacles.

3) Patch gaps around faceplates so that faceplate covers the entire wall opening.
e. Partition furniture mounted devices:
   1) Coordinate installation of the faceplate adapters with the furniture contractor, including color.
   2) Mount faceplate adapters into the designated openings for horizontal cables.

f. Terminate cables and twisted pairs in accordance with the manufacturer's latest installation requirements and TIA/EIA-568-B standard installation practices. Terminate cable pairs onto the connector compliant to T568A wiring.

6. Patching and crossconnecting:
   a. In equipment rooms, provide one modular patch cord for the first data connector in each workstation outlet. Install from the horizontal termination field to the network switches/equipment. Neatly dress patch cords within the horizontal and vertical cable management components.
   b. In equipment rooms, provide one modular patch cord for the first voice connector in each workstation outlet. Install from the horizontal termination field to the voice field. Neatly dress patch cords within the horizontal and vertical cable management components.
   c. Provide one 1-pair crossconnect for each workstation outlet. Install from backbone twisted pair 110 terminal blocks to the pre-wired 110 terminal blocks. Neatly dress patch cords within the horizontal and vertical cable management components.

3.03 LABELING

A. General requirements:
   1. Labeling, label colors, and identifier assignments shall conform to EIA/EIA-606-A Administration Standards and as approved by the Owner.
   2. Provide permanent and machine-generated labels. Hand written labels will not be accepted.

B. Horizontal twisted pair labeling:
   1. Cables:
      a. Text color shall be black, #10 font size.
      b. Label installation:
         1) Provide labels on both ends of cable.
         2) Install labels such that they are visible by technician from a normal stance.
         3) Fully wrap label around the cable jacket (self lamination).
         4) Provide one label within 4" of the termination apparatus.
   2. Modular patch panels:
      a. Text color shall be black, #10 font size.
      b. Label installation:
         1) Provide labels at each port.
2) Install labels into label window.

3. Outlets:
   a. Text color shall be black, #10 font size.
   b. Label installation:
      1) At faceplates, provide labels above and below jacks.
      2) At surface boxes, provide labels on the top of the box.

3.04 FIELD QUALITY CONTROL AND TESTING

A. General:
   1. Calibrate test sets and associated equipment per the manufacturers instructions at the beginning of each day’s testing and after each battery charge. Fully charge the test sets prior to each day’s testing to ensure proper operation.

   2. Ensure test equipment and test cords are clean and undamaged during testing activities. Per the Engineer’s discretion, halt testing activity and clean testing equipment, test cords and related apparatus.

   3. Permanently record test results electronically within test equipment at the time of testing.

B. Twisted pair testing:
   1. Test for UTP cabling as follows:

<table>
<thead>
<tr>
<th>Subsystem</th>
<th>Type</th>
<th>Test</th>
<th>Configuration</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal</td>
<td>CAT6</td>
<td>Category 6</td>
<td>Permanent Link</td>
<td>Per TIA/EIA-568-C.2</td>
</tr>
</tbody>
</table>

   2. Precautions:
      a. Adhere to the equipment manufacturer’s instructions during all testing.
      b. Prior to any testing activity or any measurements taken, ensure the test equipment is at room temperature, approximately 70°F.
      c. Fully charge power sources before each day’s testing activity.

   3. Backbone twisted pair testing:
      a. The installation will be accepted when testing has indicated availability of 100% terminated pairs.
      b. Test continuity and wire map for all pairs.
      c. Test length for 2% of pairs of each cable. Pairs shall be from different 25 pair binder groups.
4. Horizontal twisted pair testing:

a. Test equipment set-up:

1) Set-up the tester to perform a full CAT6 test, as a Permanent Link configuration.

2) If the tester has the capability, set the cable type as product specific setting. If not, set as generic CAT6 cable.

3) Set the tester to save the full test results (all test points, graphs, etc.).

4) Save the test results with associated cable link identifier.

5) Calibrate the test set per the manufacturer’s instructions.

b. Acceptable test results measurements:

1) Overall test results:

a) Links which report a Fail, Fail or Pass for any of the individual tests shall result in an overall link Fail. All individual test results must result in a Pass to achieve an overall Pass.

b) Any reconfiguration of link components required as a result of a test Fail, must be re-tested for conformance.

b) Remove and replace any cabling links failing to meet the criteria described in this Specification, at no cost to the Owner, with cables that prove to meet the minimum requirements.

2) Wire map: Provide continuous pairs and terminate all of the cabling links correctly at both ends, no exceptions taken.

3) Length: Ninety-four meters (308 feet) is the maximum acceptable electrical length measurements for any cabling link measured under a Permanent Link configuration, including test cords.

4) Insertion loss: The acceptable insertion loss measurements for any horizontal cabling link is that which is no greater than that listed in TIA/EIA-568-C.2.

5) Worst pair-to-pair near end crosstalk (NEXT) loss: The acceptable worst pair-to-pair NEXT loss for any horizontal cable is that which is no greater than that listed in TIA/EIA-568-C.2.

6) Power sum NEXT loss: The acceptable power sum PS-NEXT loss for any horizontal cable is that which is no greater than that listed in TIA/EIA-568-C.2.

7) Worst pair-to-pair ELFEXT and FEXT loss: The acceptable worst pair-to-pair ELFEXT and FEXT loss for any horizontal cable is that which is no greater than that listed in TIA/EIA-568-C.2.

8) Power sum ELFEXT and FEXT loss: The acceptable PS-ELFEXT and PS-FEXT loss for any horizontal cable is that which is no greater than that listed in TIA/EIA-568-C.2.

9) Return loss: The acceptable return loss measurements for any horizontal cabling link is that which is no greater than that listed in TIA/EIA-568-C.2.
10) Propagation delay and delay skew: The acceptable propagation delay and delay skew measurements for any horizontal cabling link is that which is no greater than that listed in TIA/EIA-568-C.2.

C. Record documents:

1. Permanently record all test results.
2. Export test results’ numerical values to a single Microsoft Excel spreadsheet.
3. Submit test results in a format acceptable to the Owner, Owner’s Representative and the Engineer before system acceptance.
4. Cable, pair identifiers of the test reports shall match the identifiers as labeled in the field, i.e. use the same ID on the cable/termination label as what appears on the test report.
5. Measurements shall carry a precision through one significant decimal place, minimum.
6. Use feet for the units for measurements shown on the print of the test measurements.
7. Print report such that fiber strands of a given cabling link have matching axis scales. The “X” and the “Y” axis shall be the same from report-to-report.
8. The trace of the printed test report shall show the launch cord.
9. For each cabling link, include either a schematic graphic or a brief narrative accurately describing the test set-up. The description shall include test/launch cord (with length), expected events (connectors, slices, etc.) with expected distances, etc. This information will eliminate many questions the Engineer will have while reviewing the reports.
10. For each twisted pair backbone and horizontal cable test, report shall contain the following information:
   a. Project name and address.
   b. Test company’s and Operator’s name.
   c. Date measurements were taken.
   d. Test equipment type to include model and serial numbers.
   e. Cable identification number and pair number.
   f. Measurement results.

3.05 INSPECTION AND ADJUSTMENTS

A. Contractor shall inspect all installed Work in conjunction with the General Contractor and develop a “punchlist” for all items needing correction. Provide punchlist to the Engineer prior to their final walk of Project.

B. Punchlist work and the required remediation shall be performed prior to system final acceptance.

C. Replace or repair work completed by others that was defaced or destroyed during the installation of the telecommunication cabling system by this contractor.
D. Make changes to adjust the system to optimum operation for final use. Contractor is responsible for making changes to the system such that any defects in workmanship are correct and all cables and the associated termination hardware passes the minimum test requirements.

3.06 CLEANING

A. Remove all unused, excess and left over products, to include debris, spills, and installation equipment.
B. Leave finished work and adjacent surfaces in neat, clean conditions with no evidence of damage.
C. Legally dispose of debris.
D. Clean installed products in accordance with manufacturer’s instructions prior to final punchlist.

3.07 TRAINING

A. At the completion of all Work, a period of not less than 16 hours shall be allocated by the Contractor for instruction and training for the Owner Representative. The Cabling Contractor will need to describe how the cable from each coverplate is separated between different patch panels, how cross-connects are made and other basic cable plant management skills.
B. Contractor shall schedule training with a minimum of 7 days advance notice.

END OF SECTION
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. Equipment

2. Mixers.

3. Amplifiers.


5. Speakers.

6. 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. Division 09 - Acoustical Treatment: Slack Speaker 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. Electronic Industries Association (EIA):

   EIA REC 127-49; Power Supplies.

   EIA RS 160-51 Sound Systems.

   EIA RS 299-A; Loudspeakers, Dynamic Magnetic Structures and Impedance.

   EIA RS 310-A; Racks, Panels and Associated Equipment.

   EIA SE 101-A--49; Amplifiers for Sound Equipment.

   EIA SE 103-49; Speakers for Sound Equipment.

   EIA SE 105-A; Microphones for Sound Equipment.

2. Underwriters Laboratories, Inc. (UL):

   UL 13; Power-Limited Circuit Cables

   UL 50; Enclosures for Electrical Equipment.

   UL 813; Commercial Audio Equipment.
1.03 SYSTEM DESCRIPTION

A. This Section specifies the minimum requirements for a public address system.

B. Public address (PA) system shall be used for paging personnel and dissemination of emergency information. As a minimum, the system shall include paging console(s), speakers, line transformers, amplifiers power supplies, microphones, attenuators and signal distribution system necessary to satisfy the requirements of that specified herein.

1. Any equipment required to make this a complete working system, regardless of whether it is specified or not, shall be furnished and installed by the Contractor.

2. The sound system shall be a 70.7 constant voltage, low volume system, with sufficient speakers to provide uniform coverage of the entire zoned area. The sound must be low-level faithful reproduction of the input source.

3. The system shall be capable of access from microphone input(s) and telephone system input. The system shall consist of multiple zone(s) that operate as a whole.

4. An "all-call" page shall have priority over any page in progress in any or all zones. In addition, the "all-call" page shall be heard in all speakers controlled by volume attenuators. The telephone interface shall be designed on a "first-come", "first served" basis into any or all zones selected by an initial page originator.

5. The system must have the capability to access individually each zone at the same time from different microphones and telephones.

6. The system shall have capability for interfacing with any background music entertainment system. Interface requires not only a physical connection, but a matching of signals with regard to impedance and signal level.

1.04 SUBMITTALS

A. Submit in accordance with the requirements of Section 270010: Basic Communications 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, 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. Plot plans and building floor plans, showing location of all devices and conduit routing.
   b. Point-to-point wiring diagrams in block and riser format showing all components, conduit and cabling including wire type, size and quantities.
   c. Details for all custom remote control panel and receptacle plates.
   d. Equipment rack elevation details.
   e. AC line power connections.
   f. Grounding.
g. 1/4” scale equipment room floor plans showing equipment layout.

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 Materials listing all components.

8. Warranty.

B. Dimensions and configurations of 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.

1.05 OPERATION AND MAINTENANCE MANUAL

A. Supply operation and maintenance manuals in accordance with the requirements of Section 270010: Basic Communications 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. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.

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 specified equipment of the 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. Installer's qualifications: Firms with a minimum of 5 years of successful installation experience with Projects utilizing specified equipment similar to that of this Project.
1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery: PA system 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 shipping shall be replaced and returned to Manufacturer at no cost to Owner. Components shall be properly packaged in factory-fabricated containers.

B. Storage: Store in 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 components 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 1 year parts and labor warranty for malfunctions resulting from defects in materials and workmanship. Warranty shall begin upon acceptance by the Owner.

1.09 SYSTEM START-UP

A. Upon completion of installation, a factory trained dealer service representative shall perform initial start-up of the PA 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.

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. Bogen.
2. Dukane.
4. Valcom

B. Substitutions: Under provisions of Section 270010: Basic Communications Requirements.

2.02 GENERAL

A. While individual items of equipment may meet the Specifications and in fact, meet the system Specifications when electrically associated with other equipment, the total system shall perform so that the combination of equipment actually employed does not produce any undesirable effects such as signal distortions, noise pulses, transients and other impairments.

B. Electrical and Environmental Characteristics:

1. Input voltage: 105 to 130 volts.
2. Cycling Rate: 60 Hz.
3. Operating Temperature: Zero to 50 degrees C.

C. All electrical components shall be solid-state, except for switching relays.

D. Rate all equipment for continuous duty.

E. Single distribution wiring shall be a minimum of #18 AWG.

F. Color-code all distribution wiring. Clearly and permanently label all equipment wiring, terminals and cables to facilitate installation, maintenance and operation.

G. All components comprising the system, which utilize 105 - 125 AC, shall be provided with protection to prevent damage in case of short or open occurs.

2.03 PAGING MATERIALS

A. Power Amplifiers:

1. The amplifier shall be a compact mixer-amplifier that provides 40 watts of output power. The unit shall provide 4 inputs (3 balanced MIC/Line and 1 unbalanced AUX). Input 1 shall be able to mute other inputs, and muting shall be audio-activated or defeatable. Unit shall have individual phantom power for all MIC inputs.

2. The amplifier shall include bass and treble controls, peak and signal indicators, and a REC Output.

3. The amplifiers shall be compatible with 70V, 25V, 4-ohm, and 8-ohm speaker systems. An external 24V DC, 3A external supply input shall be included.

4. The units shall measure two rack spaces in height, and be no wider than 8-1/4" so as to allow two units to be placed side-by-side without requiring additional rack spaces. An optional rack mount adapter shall also be available for single and side-by-side configurations. The amplifier dimensions shall be 8-1/4" W x 3-1/2" H x 10-3/8" D, and shall weigh 10 pounds.

B. Horn Speakers:

1. 15W or 30W Horn Speakers 225 Hz to 14,000 Hz response.

2. Sound pressure level shall be a minimum 121 dB.

3. Impedence shall be 326 ohm for 15W and 163 ohms for the 30W.

4. Provide constant voltage transformers as required.

5. The loudspeaker shall be of weatherproof, all-metal construction. An all-purpose mounting bracket shall provide precise positioning in the vertical and horizontal planes with a single adjustment. The bracket shall include banding slots to permit mounting the loudspeaker on beams or pil-lars. Bracket and loudspeaker shall be finished in textured mocha enamel.

6. The driver shall be enclosed within a waterproof housing. The loudspeaker shall include a self-align-ing, field-replaceable diaphragm.

7. A plastic cover shall be provided to protect the connectors and stepped volume control, and provide strain relief for the audio line.

8. Bogen HSXXEZ Series or Equal
C. Wiring:
1. Provide stranded, 2-conductor, #16 AWG cables for speaker connections.
2. Provide twisted, shielded, stranded #18 AWG pair for line level signals.
3. Cables shall be listed for NEC, Class 2 or 3 circuits.

D. Microphone:
1. Dual-impedance, desktop microphone for industrial and commercial public address and paging applications.
2. Uni-directional pickup pattern
3. Push-to-talk or lift-to-talk operation
4. Locking mechanism with push-to-talk bar for long announcements
5. Rubberized black finish with die-cast base
6. Contact closure leads
7. Specifications
   a. MIC Type: Desktop
   b. Element: Dynamic
   c. Polar Pattern: Cardioid
   d. Impedance: Lo-Z, 500 ohms; Hi-Z, 50k ohms, (switch-selectable)
   e. Frequency Response: 45 Hz to 15 kHz
   g. Cable: 7' of 4-conductor, 2-shielded
   h. Switch: Locking push-to-talk, lift-to-talk, impedance selector
8. Bogen MBS1000A or equal

PART 3 - EXECUTION

3.01 EXAMINATION

A. Contractor shall thoroughly examine Project site conditions for acceptance of PA and intercom system installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.02 PREPARATION

A. Verify exact speaker locations with respect to light fixtures, mechanical diffusers, sprinkler head and fire alarm devices.

B. Review any conflicts with the Architect prior to installation.
3.03 INSTALLATION

A. General:
   1. Install communications systems in accordance with Manufacturer's written instructions, as indicated on the Drawings and as specified herein.
   2. Carefully match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.

B. Wiring:
   1. Provide manufacturers recommended cable for each system.
   2. Route wiring continuously between devices without splices.
   3. Size wiring to conform to the equipment Manufacturer's requirements.
   4. All wiring shall be installed in a continuous steel conduit system and shall be of the size recommended by the equipment Supplier.
   5. All riser wiring and major component connections shall be installed in a continuous steel conduit system sized as indicated on Drawings recommended by the equipment Supplier. All horizontal wiring of speakers, microphones, etc. shall be routed exposed above suspended "accessible" ceilings utilizing cable tray "J" hook hanger support system. Utilize plenum rated cable for exposed application where space is used for environmental air.
   6. Wiring within consoles, desks and counters shall be exposed.
   7. Provide adequate lengths for wiring within equipment enclosures to properly bundle, lace and train conductors to terminal points.
   8. Provide physical isolation from each other for microphone, line level, speaker and power wiring. Run in separate raceways or provide 12-inch minimum separation where exposed or in same enclosure. Provide additional physical separation as recommended by equipment Manufacturer.
   9. Make splices, taps and terminations on numbered terminal strips in junction, pull and outlet boxes, terminal cabinets and equipment enclosures. Identification of conductors and cables: use color coding of conductors and apply wire and cable marking tape to designate wires and cables so all media are identified in coordination with system wiring diagrams.

3.04 GROUNDING

A. Provide equipment-grounding connections for each system as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.

B. Ground equipment, conductor and cable shields to eliminate shock hazard and to minimize to the greatest extent possible, ground loops, common mode returns, noise pick-up, cross talk and other impairments. Provide 5-ohm ground at main equipment location. Measure, record and report ground resistance.

C. Provide a #6 insulated ground wire from the system ground bus in the equipment cabinets and racks to the nearest cold water pipe.

3.05 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
B. 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.

C. 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 connections.
   e. Check that all covers, barriers and doors are secure.

2. Electrical tests:
   a. Perform complete testing to determine conformance with the requirements of the Contract Documents.
   b. Operational test: Perform an operational test to verify conformance of system performance and conditions to Contract Document within Manufacturer's tolerances. Perform tests that include originating program and page material at microphone outlets, all preamplifier program inputs and all other inputs. Observe sound reproduction for proper volume levels and freedom from noise.
   c. Power output test: Measure the electrical power output of each power amplifier at normal gain setting at 50, 1,000 and 12,000 Hz. The maximum variation in power output at these frequencies must not exceed plus or minus 1 dB.
   d. Provide a list of final tap settings of speaker line matching transformers.

3. Test report:
   a. 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.
   b. Submit two typed copies of the test report in a neatly bound folder for review and approval. Failure to comply with this will result in a delay of final testing and acceptance.

D. 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.

E. Contractor shall replace at no cost to the Owner all devices which are found defective or do not operate within factory specified tolerances.

F. Contractor shall submit the testing final report to the Engineer 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.
3.06 CLEANING

A. Upon completion of Project prior to final acceptance the Contractor shall thoroughly clean the PA system components per Manufacturer’s approved methods and materials. Remove all paint splatters spots, dirt and debris.

3.07 TRAINING

A. Factory authorized service representative shall conduct a 4 hour training seminar for Owner’s representative upon completion and acceptance of system. Instructions shall include safe operation, maintenance and testing of equipment.

B. Contractor shall schedule training with a minimum of 7 days advance notice.

END OF SECTION
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 controller/communicator panel.
2. Passive infrared detector “PIR.”
3. Door position contact switches.
4. Digital keypad arming/disarming stations.
5. Remote terminal cabinets.

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. Division 08: Door Hardware.

1.02 REFERENCES

A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:

B. Agencies

1. ANSI American National Standards Institute
2. BICSI Building Industry Consulting Service International
3. EIA Electronic Industries Association
4. FCC Federal Communications Commission
5. FOTP Fiber Optic Testing Procedures
6. IEEE Institute of Electrical and Electronic Engineers, Inc
7. IBC International Building Code
8. NFPA National Fire Protection Agency
9. NEC National Electrical Code
10. TIA Telecommunications Industry Association
11. UL Underwriters Laboratories
C. Applicable Standards

1. Underwriters Laboratories, Inc. (UL):
   a. UL 13; Power-Limited Circuit Cables.
   b. UL 294; Access Control System Units.
   c. UL 603; Power Supplies for Use with Burglar-Alarm Systems.
   d. UL 639; Intrusion-Detection Units.
   e. UL 681 1990 (R 1999) Installation and Classification of Mercantile and Bank Burglar-
      Alarm Systems, Edition 13
   g. UL 1037 1999 (R 1999) Antitheft Alarms and Devices, Edition 5
   h. UL 1076: Proprietary Burglar Alarm Units and Systems.

2. Electronics Industries Alliance (EIA):
   a. EIA: Testing standards.

D. Applicable Publications

2. BICSI - Cabling Installation Manual
3. BICSI - LAN Design Manual
4. BICSI Customer-Owned Outside Plant Design Manual

E. Underwriters Laboratories, Inc. (UL):

   UL 13; Power-Limited Circuit Cables.
   UL 294; Access Control System Units.
   UL 603; Power Supplies for Use with Burglar-Alarm Systems.
   UL 639; Intrusion-Detection Units.
   UL 1076; Proprietary Burglar Alarm Units and Systems.

1.03 SYSTEM DESCRIPTION

A. General requirements:

1. Provide a complete security alarm monitoring/keypad access control system as described herein.

2. The system shall comprise all necessary supervision, processing, display and printout circuitry and/or devices.
3. The system shall comprise redundant circuitry to ensure that no single independent failure of any component or component group shall cause consequential failure of the system.

B. System overview:

1. This design shall be based on current industry standards card access control systems and associated intrusion alarm systems for buildings, open spaces and perimeter alarm systems. Additional Standards to be followed are those pertaining to security and access control systems from organizations such as BICSI, and ASIS Standards.

2. All cabling shall be installed in conduit to provide protection against tampering and unauthorized access to security systems. All security components, power supplies, controllers, relays, interfaces, etc. shall be installed in secured lockable enclosures with key access, complete with tamper proof hardware. All security cabinets shall be installed with tamper contacts to alert security personnel. Security systems components shall be manufactured by firms normally engaged in the security and controls industries and offer a proven track record of equipment which will meet the day to day operations of the AC TRANSIT. All cabling shall be installed to meet a maximum length at set forth by the manufacturer.

3. Power supplies for active equipment (ACAMS panels, card readers, REX, PIR, electric door strikes and latches, magnetic door locks, glass break sensors, RS485/Wiegand extenders, media converter, and etc) will be equipped with battery backup to last up to 4 hours minimum.

4. Active equipment shall be installed in the telecommunications rooms in each building to provide power to active devices, a place to locate door controllers and associated power supplies, aggregate cabling from field devices to active equipment and provide feed points to a central security MDF, which will house all access control head end. Each IDF is being provided with ladder racking around the room and over the racks to serve cabling and systems terminations on any of the four walls. Cable trays and ladder racks shall be designed to connect at rated sleeves at or above suspended ceiling levels and formed in a waterfall configuration to the ladder racking distributed around the room.

5. The system shall include connectivity by multi-strand fiber optic back bone and Category 6 cabling for all security systems connections. Security, access control and video monitoring system which are Ethernet based shall reside on a dedicated Ethernet network and not share hardware, IP addressing or VLAN schemes with any other network and shall be dedicated to security infrastructure between buildings. Coordinate with the Telecommunication Designer to connect all network attached devices with horizontal fiber optic and Category 6 cabling.

6. Card readers shall be provided to all employee entrances as indicated on drawings.

7. Card reader provisions shall be provided for all entry roadways and driveways into the facility. All exits shall be controlled by swing gates. The system shall utilize functions within the ACAMS to provide pre-emptive gate control for daily exiting activities so that employees will not need to present badges at the gates of employee parking areas, and utilize loop sensor technology during peak hours, and revert to normal operation when specified peak exiting time have expired.

8. Card readers and vehicle entry gates shall be provided on all main roads and driveway entrances in the site, and incorporate the necessary vehicle loop sensors to interface with motorized gate controls.

C. Intrusion Protection

1. Intrusion protection into the site and buildings will be accomplished through interfaces with the ACAMS. Devices such as door position contacts shall be connected to monitoring points within the ACAMS and programmed to generate local and remote alarms to security personnel.
2. In-building devices will consist of door position contacts. All active devices shall be powered from secured low voltage power supplies co-located in telecommunication rooms, and/or ancillary closets within the buildings.

D. Power Requirements

1. Equipment Hubs
   a. Coordinate power at each security equipment hub location, typically in the telecommunications rooms. Provide two 120 VAC, 20 amp dedicated circuits to each security equipment hub location. Connections to security equipment transformers or power supplies are hardwired unless a receptacle is specifically indicated.

2. Locking Hardware
   a. Review door locking hardware requirements on the latest door hardware schedule. Verify if any hardware requires a local power supply or booster, such as a Von Duprin PS 873. Power supplies are cabled no further than 25 feet from the electrified lock. Provide 120 VAC to each lock power supply.

3. Field Devices
   a. Coordinate power at field locations for remote security device power supplies.
   b. Provide a 120 VAC 20 amp circuit to each remote security power supply location, security power supplies used to power cameras, detection devices, or remote security panels.
   c. Provide power to any vehicular gate operator system.
   d. Provide 120 VAC power to camera power supplies supporting interior and exterior fixed and pan-tilt-zoom cameras. These cameras typically require a power supply within 50 feet of the camera location.

E. Pathways

1. Horizontal
   a. Horizontal pathways consist of device boxes, conduit, j-hangers, and cable tray used to home run the security cable from each device to the closest telecommunication room. Security equipment typically requires a 4-square device box installed on a wall or ceiling. Conduit is run from the device to the closest accessible ceiling or directly into a cable tray when tray is utilized. Dedicated security j-hangers are used in accessible ceilings to support all security cable. Coordinate main j-hanger runs with other trades to minimize interference issues. Pathways shall be concealed in walls and accessible ceiling wherever possible.
   b. Site conduit for remote security devices such as vehicle detection loops and cameras shall be coordinated with the security system Design Engineer. Plan for conduits to run underground in a joint trench into the closest telecommunications equipment room.
   c. Conduit is required between any elevator termination enclosures and the ACAMS equipment panels. The elevator termination enclosure is the termination point between the ACAMS and elevator controller.
2. **Riser/Equipment Rooms**
   a. Security cable in equipment rooms must always run in conduit. Security equipment hubs will utilize a 6” high x 6” deep x 4’ long screw cover metallic raceway above security equipment hub locations. Provide EMT conduit from the raceway to security equipment hub raceways above and below as needed. Provide the appropriate quantity of EMT conduit run from the raceway to the nearest accessible ceiling for security devices located on the same floor.
   b. Conduits penetrating through rated walls and slabs between floors, and roofs shall be sealed with fire resistant materials.

3. **OSP Conduit**
   a. The minimum size outdoor conduit for security cables shall be rigid trade size 2-inch.
   b. Any security conduits that leave the building and act as a feeder/trunk conduits shall consist of multiple 2-inch conduits or multiple 4-inch conduit.
   c. All outside plant conduit shall be galvanized rigid when above ground and PVC when below ground. Refer to Telecommunications Infrastructure Standards SD4802 for hand-hole, pull-box, man-hole specifications and installation requirements.

F. Owners facilities will utilize a system comprised of control software and hardware, complete with controllers, power supplies, card readers, door controls, door strikes, electronic lockset and associated hardware.

G. **Access Control & Monitoring System**
   1. An Access Control and Monitoring System (ACAMS) is required and designated to coordinate with existing owner systems.
   2. The owners existing system is the Kantech KT-400
   3. The system shall be equipped with battery standby, of sufficient capacity to operate the system in standby mode for a period of 4 hours, and have sufficient capacity to sound the signals for 30 minutes at the end of the standby period.
   4. The ACAMS controls access into the buildings and select interior doors. Intrusion alarm monitoring comprised of door contacts, is consolidated to the ACAMS system eliminating the need for a conventional burglar alarm panel.
   5. ACAMS electronic locks are used on doors that are deemed critical to security of expensive assets subject to a high possibility of theft, confidential records, or other areas of critical nature. These doors are typically locked at all times by the ACAMS.
   6. ACAMS locks may also be used on doors that are not deemed “critical”, but have other operational requirements that make ACAMS a good solution, such as building entrances. These doors are locked or unlocked based on a programmed schedule.
   7. Doors specified to have electronic access control must tie into the owners existing ACAMS remote system. Create schedules to automate the opening and closing of the building including unlocking doors, bypassing alarms and enabling the auto operator at main entrances.
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:
   
   a. Plot plans and building floor plans, showing location of and conduit routing to all devices.
   
   b. Point-to-point wiring diagram in block or riser formats showing all components, conduit and wire types and sizes with cable legend.
   
   c. Include elevations of control panel and remote terminal cabinet(s).

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 materials listing all components.

8. 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. Instructions for routine maintenance.

3. Pictorial parts list and part numbers.

4. Schematic Drawings of wiring system, including all devices, control panel, terminal cabinets, etc.

5. Telephone numbers for the authorized parts and service distributors.

6. 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.
1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery: Security monitoring and control system 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 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. The manufacturer listed is the Transit system standard and shall be provided with no alternates accepted

B. Kantech – Tyco Security system

2.02 DOOR CONTROLLER

A. The door controller shall be a Kantech Model:

1. KT-400

2.03 CONTROLLER FUNCTIONS

A. The door controller shall control all the functions of local components attached to it. It shall monitor the opening times of each of the doors after an authorized access and start the buzzer in pulse mode to signify a pre-alarm when half of the opening time has elapsed and in permanent mode when the entire time has elapsed.

B. The controller shall allow the local decoding and validation of at least 100,000 access cards and authorize entry without the intervention of the gateway.

C. The response time between the moment when a card is presented at the reader and when the door is unlocked shall not exceed half a second. If an access card that is not locally memorized is decoded by the local controller, it shall communicate with the gateway that will perform the verification and authorize entry if the card is valid for the door in question. In such a case, the response time between the time when a card is presented at the reader and when the door is unlocked shall not exceed one second.

D. In case of communication failure, the door controller shall execute all its functions normally, store the last 20,000 events or alarms and send them to the gateway when the communication link is restored.

E. The controller shall be equipped with flash memory. Any new configuration or upgrading of the program shall be capable of being done from an access system workstation. Sms shall automatically download the modifications without the need for the operator to manually download the data. The maximum time for completely charging all controllers shall not exceed five minutes.
F. The entire database can be stored in memory. In addition, the real-time clock will remain active even if the emergency power fails.

G. The door controller shall be modular in design, allowing it to be expandable by addition of entry/electronic modules. The door controller shall acquire alarms, monitor states, manage and provide electrical power to the following local components such as but not limited to:

1. Magnetic contacts
2. Electric strikes
3. Card readers
4. Exit request sensors
5. Buzzers
6. Motion sensors
7. Glass break detectors

H. The controller shall supervise up to 16 onboard monitoring points.

1. From the sms, it shall be possible to determine for each of the points if they are none, single or double end of line supervision.
2. All the onboard points shall be configured as the same supervision types or they shall be able to overwrite the default supervision setting and have other own.
3. Each of the points shall inform the sms during an alarm, a short circuit, grounding, an open circuit or upon return to normal when programmed as double end of line supervision.
4. The need to cut resistors or change jumper/dip switches on the controller to change the supervision type shall be unacceptable.
5. These points shall be located up to six hundred (600) meters away and be connected by a cable made up of 2 unshielded 22 gauge wires.
6. Additional inputs points may be added on the controller by using expansion modules.

I. The controller shall have onboard four form c relay.

1. Additional outputs or relays points may be added on the kt-400 by using expansion modules.

J. Each door controller shall be able to power the door opening devices such as strikes.

1. Each door lock output shall output 12 volts dc 250ma.
2. The controller shall supervise and report to the sms any fault or tampering with the lock devices.
3. The controller shall allow for additional power to be added for the lock outputs.
   a. On the dedicated external power input terminals on the controller, it shall have the possibility of providing a maximum of 12 to 24 volts dc 3 amps of power to the 4 lock outputs.
   b. External power supply and the four lock outputs including the door locking devices shall be supervised by the controller and report faults or tampering to the sms.
c. The need to have external relays wired to controller power supplies and locking devices shall be acceptable.

K. Each door shall be able to perform the following operations from the sms workstation or Webstation
   1. Lock and unlock door
   2. Temporarily unlock door using a customizable timer (ignores door contact) for up to 18 hours.
   3. Unlock a door as a “one time access”.
   4. Return the door back to schedule
   5. Enable and disable readers
   6. Arm and disarm doors with alarm integration

L. Each controller shall support 2 different wiegand card formats. The 2 card formats shall be functional on any of the 4 readers of the controller.
   1. From the sms, the operator can choose form an extensive list of already created drivers. If the driver is not existent new drivers can be created and then downloaded to the controller.

M. The controller shall be able to accommodate four readers or keypads and allow the integration of various types of readers such as proximity, magnetic, aba, wiegand or bar codes for each software configuration without using keypads or switches.
   1. Each reader shall be wired independently from the other readers so that in case of maintenance the technician shall only disconnect the appropriate reader only.
   2. Each reader terminal shall have the following input and output connections:
      a. Data 0 and data 1 terminals
      b. 5 volts 125ma output terminal
      c. 12 volt 125ma output terminal
      d. Ground terminal
      e. Four outputs (led, buzzer, out1, out2)
         1) These outputs shall be pre-programmed from the sms. The operator shall have the ability to change them.
   3. When using reader and/or keypads device, the controller shall be allowed to accept per reader/door:
      a. Only card
      b. Keypad pin numbers or card swipes
      c. Card and then keypad pin number
         1) This feature shall be enabled on a schedule.
2) This feature shall offer the possibility on activating it on certain card holders. All other card holders shall present their card and enter the door based on their access level.

N. Each door shall support Americans with Disabilities Act (ADA) settings.
   1. Each door shall have main door unlock timer and door opened contact timer.
   2. Each door shall have a secondary unlock timer and door opened contact timer.
   3. Doors shall be able to activate the lock output and a relay based when triggered as ADA.
   4. Card holder shall be programmed in the SMS as ADA.

O. For each door equipped with a card reader, the controller shall offer to connect two different supervision points as request to exit mechanisms (rex).
   1. At a minimal level, the rex device shall shunt the door contact so that no alarm is generated when person is exiting the door.
   2. Each rex shall be programmed independent from each other rex device, as it shall be possible to determine
      a. If the rex will unlock the door locking device to follow the unlock time programmed in the SMS door configuration
      b. In high traffic locations, the rex shall be programmed as a resettable rex, this function will reset the shunting time of the door contact.

P. The controller shall interface with any external alarm system thereby arming or disarming the system by presenting a valid card to an entry / exit door. It also shall be possible to associate a keypad with a reader forcing the cardholder to enter a number in the keypad after presenting a card. This integration shall only be possible with the use of a corporate gateway or entra-pass special edition. It shall be possible at a minimum to:
   1. Set a monitored input as an arming button.
   2. Associate a usage schedule with an arming button
   3. Set the exit and entry delay
   4. Determine whether the system must wait for a valid access to arm
   5. Determine whether the system must wait for a valid access card swipe and appropriate pin number to disarm.
   6. Determine whether the door must relock on arming request
   7. Associate a monitored input with an alarm panel condition.
   8. Lock a door unlocked by a schedule when armed
Q. The Controller shall allow interface with the dsc powerseries® intrusion panel thereby eliminating hardwired integration between the controller and the intrusion panel. The intrusion panel shall communicate directly to the controller using a data cable. This integration shall only be possible with the use of a corporate gateway or entrapass special edition the sms shall allow for:

1. Single / multiple partition arming and disarming via reader
   a. disarm via card only or forced valid card and pin
2. Single / multiple partition arming and disarming via operator commands
3. Receive events from intrusion panel
4. Receive partition names, user codes and zone names programming
5. Update user codes
6. Assign user codes to cardholders

R. The controller shall have the ability to connect via key switch arming and inputs to virtually any intrusion panel. The external intrusion integration shall allow for specific access levels to have the right to arm and disarm. The access levels can be different for arming and disarming if needed by the administrator.

S. The controller shall be able to control the elevator cab floors. Each reader and door shall have the ability of being programmed as an elevator cab.

1. Each elevator cab shall support using expansion modules
   a. 64 floor buttons via relays or output modules.
   b. 64 floor confirmation inputs via input modules.
2. Each elevator cab shall support at a minimum 2 unlock schedule. Each unlock schedule shall be attached to one unlock floor group.
3. The card shall follow the floor group and schedule assigned to their access level. When a card holder swipes their card, only the elevator cab floor buttons will activate base on the card’s access level.
4. The controller shall offer the possibility to activate elevator floor buttons by activating an input on the controller.
   a. The elevator floor button shall activate for the programmed unlock time when the input is activated.
   b. Input button shall only be functional during the dedicated schedule assigned to this feature.

T. In all communication methods, the door controller shall retain in its memory all necessary data such as but not limited to card numbers, access levels, schedules, holidays, door, relays and input programming. In case of communication failure, the door controller shall execute all its functions normally without going into a degraded mode.

U. Each controller shall have over 20 onboard led to indicate the status of various controller components such as relay status, door, ac and battery status. The led shall clearly indicate the spi, rs-232, rs-485 and network status. The controller shall have multi indication heartbeat led light that shall indicate the exact status of the kt-400 controller. There shall be 12 heart beat led statuses.
2.04 GLOBAL GATEWAY INTEGRATION

A. The controllers connected under a global gateway shall function in the same manner as mentioned in the document (unless specified as corporate gateway only). The controller shall be connected via ethernet devices or rs-485 to a global gateway or kt-ncc. The global gateway or kt-ncc shall receive all events and decide what commands the controllers will perform based on the events received or pre-defined tasks.

B. In the case of communication loss with the global gateway or kt-ncc, the controllers shall continue to work as mentioned in the document without any loss of controller features.

C. Refer to entrapass global architectural and engineering specification for complete functionality.

2.05 POWER REQUIREMENTS

A. The controller shall have its own power unit and be able to support components connected to it using direct current. The battery charge current shall be limited to a maximum of 300 milliamps.

B. In case of power failure, a 12 volt 7 amp/hour battery shall maintain all system functions for at least 4 hours. When power at power terminals falls below a critical threshold, the controller shall shut down. This will avoid an erratic performance of the system that could generate bad commands or information.

1. the battery backup shall be supervised by the controller and shall advise the Sms if the battery is defective, low or not present.

C. When a door controller is affected by failure of alternating current or by a defect in external batteries, the sms shall be informed immediately. In addition, the controller that is located on the printed circuit card shall be equipped with a green led indicating the status of the alternative power source.

D. Each controller shall have its own csa/ul certified 16 vac 75 va transformer.

E. To prevent any damage from external sources, each of the protected power outputs of the door controller shall be equipped with a resettable fuse device against power overload that requires no human intervention when the overload is removed.

F. The controller shall have a 64mb of ram memory to retain the programming data such as cards, schedule relays doors and others. In case of ac and battery backup failure the information shall be kept for a minimum of 75 hours.

2.06 INPUT AND OUTPUT FUNCTIONALITY

A. Inputs shall be programmed as any of the following functions but not limited to:

1. Door contacts
2. Rex (request to exit detector) buttons or sensors.
3. Interlock mantrap sensors and inputs
4. Floor Selection for Elevator Application
5. Elevator floor confirmation
6. External alarm system status (armed / disarmed)
7. External alarm system alarm (alarm / secure)
8. External alarm system zones
9. Relays to trigger on each input in alarm event

10. Input shunting: single or group of inputs can be permanently or temporarily 'shunted' to a secure state. Shunt method includes:
   
   a. Input shunting by another input - when an input in alarm is programmed to shunt another input / group of inputs.
   
   b. Input shunting on unlock - when an input is temporarily set to its actual state (alarm or secured) after an access granted.
   
   c. Manual shunt - operator can manually 'shunt' an input to a secure state.
   
   d. Disarmed door shunt - when alarm system is disarmed, some inputs may be 'shunted' to a secure state.
   
   e. Entry / exit delay shunt - when a user is in the process of disarming / arming the alarm system and entry / exit delay prevails, some inputs may be 'shunted' to a secure state.

11. Arming / Disarming Request

12. Postpone Arming Request

B. A built in tamper switch terminal shall be a non-programmable 'fixed-function' input. It shall used to identify tampering of the kt-400 cabinet.

C. Relays shall be programmed as any of the following functions limited to:

1. Each relay shall have the option of being programmed to follow the lock output terminals.

2. Each relay shall be have the option to, but not limited to:
   
   a. Follow an activation schedule to activate automatically during this schedule
   
   b. Follow a disable relay schedule. This schedule will disable the relay from functioning and being activated from other components such as inputs and door actions.
   
   c. Manual operations from the sms.

2.07 COMMUNICATION METHODS

A. The controller shall have be able to communicate via rs-232, rs-485 or encrypted ethernet

1. Encrypted ethernet communication
   
   a. The first controller of every loop shall have the possibility to communicate with the corporate gateway or entrappas special edition over a low bandwidth 128-bit aes encrypted network.
   
   b. When communicating via internet or gsm connection the communication shall be a secured 128-bit aes encrypted ethernet communication.
   
   c. The communication via internet connection shall be extremely low bandwidth, no more than 5kb/second when sending 10 messages and less than 1kb/minute during standby. The controllers shall be able to communicate to the sms via dns (domain name).
   
   d. The remote controller location shall not be required to have a static public ip address for their internet connection
e. The controller shall support:

1) tcp and udp protocols
2) dhcp for communication and initial communication
3) Default static ip address for initial programming to be used with non dhcp networks.
4) Domain name resolution (dns)

2. The controller shall communicate with the sms corporate gateway or entrapass special edition via local area network (lan) and wide area network (wan).
   a. If communicating over wan; there shall not be a need for ports to be opened on the controller side.
   b. The controller side of the network shall have a public dhcp ip address or static ip address.
   c. Controllers that require a public static ip address to communicate over wan shall not be permitted.

B. Rs-485
   1. The controllers shall communicate with the sms corporate gateway or entrapass special edition or global gateway computer via rs-485 using a vc-485 or usb-485.
   2. The controllers shall be wired in daisy chain using a rs-485 cable.

C. The controller shall be connected together on a loop that handles up to 32 controllers using two unshielded 24-gauge wires over a distance of 4,000 feet. They shall communicate at a speed of 115 200 bauds. (reference: Belden # 1227A)

2.08 TECHNICAL SPECIFICATIONS

A. The controller shall be powered by a 16vac 75va wire-in transformer.
B. The operating temperature shall be 2°c to 49°c (35°f to 120°f)
C. The controller shall support the following reader types: wiegand, proximity, bar code, magnetic integrated keypad, smartcards and other
D. The controller shall have 16 monitored input zones. The inputs shall be programmable no/nc. The inputs shall support no, single or double end of line resistance.
E. The door locking devices shall output up to 12vdc 250ma supervised per lock output device. The door locking power shall offer the possibility to share power between door locking devices for a total of 1amp for all four door locking devices
   1. With the use of external power terminals and using jp4 jumper the controller shall support a maximum of 750ma up to 24vdc per door locking device.
F. Reader power output shall be 5vdc or 12vdc 400ma for each readers
   1. The reader power shall be protected and supervised.
G. The controller auxiliary power output shall be shared with the spi expansion port shall output a maximum 12vdc 500ma.

H. The controller shall offer four auxiliary outputs per reader for the led and buzzer, out1 out2.
   1. Each led, buzzer, out1 and out2 output shall output 12vdc 25ma maximum.

I. The four onboard form c relay controlled outputs shall support current of a maximum 30vdc 3amps.

J. The kt-400 shall have the following certifications:
   1. En50133-1, en55022, en60950, en61000-6-1, en61000-6-2
   2. Fcc: class a
   3. Ul 294 listed
   4. Ul 1076 when connected with kt-ncc, entrapass global edition and using a redundant server.
   5. C-tick
   6. ROHS

2.09 EXPANSION MODULES

A. The door controller shall be equipped with a spi communication output to be used in connecting different expansion modules in order to increase the number of inputs, outputs and relays.

B. The spi communication output shall be able to provide sufficient power to meet the needs of the modules (500ma at 12 volts dc). However, envisage providing a separate power unit for external components that will be connected to these modules.

C. The expansion modules could be located up to 3 meters (36 inches) from the door controller. It shall be possible to combine several types of expansion modules on the same communication loop.

D. KT-MOD-INP16 INPUT MODULE
   1. The controller shall have 16 onboard inputs up to 240 more can be added through the addition of expansion modules, such as the kt-mod-inp16, for a total of 256 inputs, no or single end of line supervision, (120 inputs when configured as double as end of line supervision).

E. KT-MOD-REL8 RELAY MODULE
   1. The relay module shall convert and manage direct commands from the kt-400 controller to local components. The output shall be based on dry relay contact. Each of the relay shall be completely independent of the others so as to avoid a defective output from affecting the others. For a total of 256 relays per controller, they shall be added in groups of 8 relays at a time
   2. If doing elevator floor management, the relay expansion modules shall be programmed to manage elevator cabs buttons.

F. KT-MOD-OUT16 OUTPUT MODULE
   1. This module shall offer 16 independent low-voltage outputs (12vdc, 50ma). The output module shall convert and manage direct commands from the kt-400 controller. This module shall be directly powered by the door controller with no external power required.
2. If doing elevator floor management, the relay expansion modules shall be programmed to manage elevator cabs buttons.
   a. Each kt-mod-out16 shall offer 16 floors control per elevator or 8 floor controls for 2 elevators.

G. KT-MOD-CAB MOUNTING AND KT-400-CAB

1. Each of the controllers shall be mounted on a wall mounted cabinet with front access through a lockable door. A tamper switch shall be installed to monitor the opening of the door. The cabinet shall have a hinged door and shall be designed to contain all the equipment, modules, cabling and accessories required. No screw, bolt, attachment part or other shall be used on the external faces of cabinets. They shall be free of marks, scratches or defects.

2. The contractor shall provide the attachment parts for the assembly and anchoring of the cabinet on the wall. Input/output and power conduits shall be inserted from the top or bottom of the cabinet. The mounting of equipment shall be modular so as to facilitate maintenance and expansion. Adjustment and verification points shall be easy to access from the front. No equipment shall be mounted less than 500 mm or more than 1800 mm from the floor.

2.10 IP LINK

A. The IP Link shall be a encrypted network to RS-232 converted. The IP Link shall only communicate with the Corporate Gateway or EntraPass Special Edition is was connected to the first time. The IP Link shall be built on microprocessor-based technology.

B. IP Link Functions and communications

1. The IP Link is an encrypted Ethernet communication converter to RS-232.

2. The IP Link shall poll all the controllers attached to it for any kind of event. When an event occurs the IP Link shall in real time advise the SMS of the event.

3. During periods when no events are generated from the controllers; the IP Link shall send a 1kb acknowledgement to the SMS to confirm that the communication is still active; the SMS shall respond in kind. This acknowledgement shall occur every minute when no events are generated.

4. The SMS shall at any time send changes or commands to the IP link in real time.

5. SMS and devices that download information to the controllers every X minutes shall be permitted.

6. The IP link shall communicate with the Corporate Gateway or EntraPass Special Edition over a low bandwidth 128-bit AES Encrypted network.

7. When communicating via Internet or GSM connection the communication shall be a secured 128-bit AES Encrypted Ethernet communication.

8. The communication shall be extremely low bandwidth, no more than 5Kb/second when sending 10 messages and less than 1Kb/minute during standby. The controllers shall be able to communicate to the SMS via DNS (domain name).

9. The IP Link location shall not be required to have a static public IP address for their Internet connection.

10. The IP Link shall support:
    a. TCP and UDP protocols
b. DHCP for communication and initial communication

c. Default Static IP address for initial programming to be used with non DHCP networks

d. Domain Name Resolution (DNS)

11. The IP Link shall communicate with the SMS Corporate Gateway or EntraPass Special Edition via Local Area Network (LAN) and Wide Area Network (WAN).
   a. If communicating over WAN; there shall not be need for ports to be opened on the controller side.
   b. The controller side of the network shall have a public DHCP IP address or static IP address.

12. Communication devices that require a public static IP address to communicate over WAN shall not be permitted.

13. Each IP link shall have 3 onboard LED to indicate the status of network and 1 multi-indication heartbeat LED light that shall indicate the exact status of the KT-400 controller.

C. Power requirements

1. The IP link shall be powered by a 12Vdc 175mA device.

2. To prevent any damage from external sources, each of the protected power outputs of the door controller shall be equipped with a resettable fuse device against power overload that requires no human intervention when the overload is removed.

3. The KT-400 shall have an 8MB of ram memory to retain the programming data Ethernet settings. In case of AC and battery backup failure the information shall be kept for a minimum of 75 hours.

D. Local Communication Methods

1. The IP Link shall have be able to communicate via RS-232 or RS-485 to the local controllers via the provided cable
   a. RS-232
      1) The IP Link shall communicate directly to the controllers the RS-232 terminals
      2) The first controller shall be wired at a maximum of 100 feet from the IP Link
   b. RS-485
      1) The IP Link shall communicate on the RS-485 protocol via the VC-485 to the local controllers.

2. The controller shall be connected together on a loop that handles up to 32 controllers using two unshielded 24-gauge wires over a distance of 4,000 feet. They shall communicate at a speed of 115,200 bauds. (Reference: Belden # 1227A)

E. Technical Specifications

1. The IP Link shall be powered by 12Vdc 175mA power source.
   a. A KT-300 or KT-100 controller shall be used to power the IP link
2. The operating temperature shall be 2°C to 49°C (35°F to 122°F)

3. The KT-400 shall have the following certifications:
   a. CE EN50133-1, EN55022, EN55024, EN61000-6-1, EN61000-6-2,
   b. FCC: Class A
   c. UL 294 Listed
   d. RoHS
   e. WEEE

2.11 CARD READERS

   A. In this application the readers shall use proximity technology and satisfy the following conditions:

      1. The P225/P225KP (Proximity Reader)
         a. Dimensions, Model 1(H-W-D): 114.5 mm x 44 mm x 17.8 mm
         b. Minimum reading distance: Up to 12.5 cm
         c. 3. Power: 5 to 12 VDC, 45mA
         d. 4. Transmission frequency: 125 kHz
         e. 5. Operating temperature: -35 Celsius to +65 Celsius (-30° F to 150° F)
         f. 6. Color: Black
         g. 7. Reading: Unidirectional
         h. 8. Piezo: Incorporated (controlled by the door controller)
         i. 9. LED: Red/Green (controlled by the door controller)
         j. 10. Use: Indoor/outdoor
         k. 11. Location: One meter from the floor, on the handle side.
         l. 12. Maximum controller distance: 300 meters
         m. 13. Type of cable: 3 pairs twisted  22 AWG (Belden # 8742)

      2. The P325/P325KP (Proximity Reader)
         a. Dimensions, Model 1(H-W-D): 114.5 mm x 70 mm x 17.8 mm
         b. Minimum reading distance: Up to 12.5 cm
         c. 3. Power: 5 to 12 VDC, 45mA
         d. 4. Transmission frequency: 125 kHz
         e. 5. Operating temperature: -35 Celsius to +65 Celsius (-30° F to 150° F)
f. 6. Color: Black

g. 7. Reading: Unidirectional

h. 8. Piezo: Incorporated (controlled by the door controller)

i. 9. LED: Red/Green (controlled by the door controller)

j. 10. Use: Indoor/outdoor

k. 11. Location: One meter from the floor, on the handle side.

l. 12. Maximum controller distance: 300 meters

m. 13. Type of cable: 3 pairs twisted 22 AWG (Belden # 8742)

2.12 ACCESS CARDS

A. In the current application, cards shall use proximity technology, permit direct printing and satisfy the following conditions:

1. The cards shall be unique and the proposal shall be accompanied by an attestation from the manufacturer certifying that:

   a. The cards shall be unique and have never been produced before.

ii. Card types:

2. P20DYE Access Card

   a. Dimension (H-W-D): 8.6 cm x 5.4 cm x 0.079 cm b. Format: ISO (credit card size)

   b. Color: White

   c. Finish: Glossy/glossy

   d. Type: Direct printing on card

   e. Operating Temperature: -45°C to +70°C (-50 °F to 160 °F)

   f. Perforation for strap: Vertical or horizontal h. Card number: Printed on the card

2.13 T-REX-XL EXIT REQUEST SENSOR

A. An infrared exit request sensor shall be installed on the inner side of doors that are controlled or as per the instructions on the door grid to enable automatic unlocking of the retaining device and to momentarily suspend door supervision.

B. This sensor shall be linked to the door controller that will give the unlocking command for this information to be stored in the system's history.

C. Characteristics of the exit request sensor:

1. Passive infrared;

2. Digital signal processing filtered (DSP);

3. Microprocessor controlled;

4. Equipped with a 90 dB buzzer;
5. Red/green LCD visibility indicator;
6. Tamper proof contact (contact normally open)
7. Adjustable detection direction;
8. Vertical (barrel rotation)
9. Horizontal (individual component);
10. 12 to 28 volts DC 35mA
11. Dimensions: H: 4.5 cm; W: 19 cm; D: 4.75 cm
12. Maximum detection distance for the hand on the handle (3 meters);
14. The sensor shall be installed so as not to detect objects that could be slid under the door from outside.
15. It shall be located on the upper frame of the door and ideally on the hinged side. If a second relay is required in the sensor for a specific application, model TREX-XL2 shall be used.

2.14 TESTING AGENCIES

A. The following hardware have been tested and listed by Underwriters Laboratories (UL) for UL294 for Access Control System Units.

1. KT-400
2. IP link
3. P225W26
4. P225KPW2
5. P225XSF
6. P225KPXSF
7. P325W26
8. P325KPW26
9. P325XSF
10. P325KPXSF
11. KT-MOD-REL8
12. KT-MOD-INP16
13. KT-MOD-OUT16
14. KT-3LED-Plate
B. The hardware shall comply with the following regulatory requirements:

1. FCC Part 15 Class A
2. FCC Part 15 Class B
3. FCC Part 68 (TIA968)
4. ICES-003
5. CE
6. ECCN for AES 128 bit encryption for IP communication
   a. IP Link or KT-400 only

2.15 POWER SUPPLY

A. The power supply distributes and routes power to a variety of access control hardware devices: magnetic locks, electric latches, electric strikes, etc. It will convert an 115VAC 50/60Hz input into several (typically 4 to 8) independently controlled PTC protected class 2 power limited 12VDC or 24VDC outputs. Outputs are activated by an open collector sink or normally open (NO) dry trigger input from an Access Control System, Card Reader, Keypad, Push Button, PIR, etc.

B. Outputs will operate in both fail-safe and/or fail-secure modes. The controller Interface enables Emergency Egress, Alarm Monitoring, or may be used to trigger other auxiliary devices. The power supply shall be equipped with a backup battery with battery failure and battery presence supervision.

C. Approved Manufacturer:
   1. Kantech approved product

D. Battery
   1. 12V, 7 to 12AH Battery
   2. Approved Manufacturer:
      a. Altronix BT12/6 12VDC/7AH or approved equivalent
      b. Altronix BT12/12 12VDC/7AH or approved equivalent

2.16 RS485/WIEGAND EXTENDERS

A. If a card read cable exceeds its maximum distance, a RS485/Wiegand copper or fiber extenders shall be used. These modules shall be used particularly for vehicle motorized gate controllers, and exterior pedestrian gates which are greater than 500 feet from a building.

B. Approved Manufacturer:
   1. Cypress Computer SPX-1300–Supervised Reader Extender, for copper cable
   2. Cypress Computer EXP-1000–SUPREX Expansion Modules, for copper cable
4. Cypress Computer EXP-7400 – Supervised Reader Extender, for multimode fiber cable
5. Cypress Computer EXP-7410 – Supervised Reader Extender, for singlemode fiber cable
6. Cypress Computer SPX-7500 – Supervised Reader Extender, RS485, for copper cable

C. Wire & Cable
   1. All cable for each device in the access control system shall be per Kantech specifications
   2. Use Plenum cable in plenum areas and water-resistant jack in outdoor areas.
   3. Approved Manufacturer:
      a. West Penn Wire, Belden, or Carol

PART 3 - EXECUTION

3.01 EXAMINATION
   A. Contractor shall thoroughly examine Project site conditions for acceptance of the security system installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.02 COORDINATION
   A. Coordinate all installation requirements for door contacts with other trades prior to ordering of doors and frames.
   B. Install contacts, boxes, conduits and connections to doors and frames for complete operating installation. All connections shall be concealed.

3.03 INSTALLATION REQUIREMENTS
   A. Wiring & Conduit
      1. All communication and power to the individual door will come from the access control panel location. An exception to this will be made when specific hardware requires a localized power supply. When possible a trunk conduit/raceway should be established in common hallways to accommodate multiple "home run" cables.
      2. All wiring runs will be in a star configuration or home run from the access control panel to the access and alarm point devices (i.e. card reader, REX, door switches/contacts, etc).
      3. Devices must be hardwired, with all wiring installed in conduit in accordance with NEC and AC Transit standards for conduit and system installation.
      4. Wire connections to the access control panel are to be clearly labeled.
      5. Wiring which contacts metal edges will be buffered with bushings or rubber grommets to prevent damaged wires and shorts. Examples include wiring meeting conduit ends, panel and junction box holes.
6. Wire transfer hinges must match gauge capacity for the wires being passed to door hardware.

7. Conduits including flexible metal and armored cable shall terminate in the sensor or device enclosure. Ends of conduits shall be fitted with insulating bushings. Exposed conductors at the ends of conduits external to sensors and devices are not acceptable.

8. Conduit must be strapped within 24” of junction boxes.

9. All junction boxes must be covered and contents labeled when appropriate (ex. junction box with relay for handicap button).

10. Gang boxes must match device being mounted (ex. double gang reader mounted on a double gang box).

11. Set screw conduit fitting are not allowed. Compression fitting must be used.

12. Minimum EMT conduit size is ¾ inch. Minimum outdoor PVC conduit size will 2-inch.

13. Conduit can be 40% full of square inch capacity.

14. The conduit system and cabling installed must be distinct and separate from the wire way/conduit system housing voice/data cables.

15. Connections to devices must be secured, so that no cords may be easily disconnected from the devices and no cords are left exposed to unauthorized tampering.

B. Door Switches

1. Door switches will be surface or flush mounted on the opposing side of the door from the hinges. The switch will be mounted on the top of the door and will be no further than three inches from the interior portion of the doorframe.

2. Surface mount switches will have armored cable between the switch and the cable entrance hole in the door.

3. Surface mount switches will have tamper resistant screws to attach switch to door and doorframe.

4. A screw-locking adhesive such as ‘Loctite’ will be used to secure all screws.

5. Flush mount switches are to be mounted in the top portion (header) of the doorframe and in the adjoining portion of the door.

6. The holes for flush mounted door switches must be drilled the exact size for the switch being used. A tight friction fit must be achieved.

7. No hinge contacts are to be used.

C. Door Hardware

1. Door hardware will be fail-secure with mechanical manual egress from the secured side.

2. All electronic hardware will be 24V and powered via independent 24V power supply for door hardware.

3. Door switching and power will reside in the access control panel location. In the case of an electrified exit device (such as a Von Duprin EL crashbar) power supply (with battery backup) is to be located no more than 50 feet from door.
4. Power supply will be connected to building emergency circuits when possible.

5. Power supplies will be equipped with battery backup to provide 4 hours of operation in the event of a power outage.

6. No more than 2 doors with exit devices per independent 24V power supply unless approved by the manufacturer.

7. Request to exit switches shall be built-in to exit devices and door locking hardware on all new construction. The REX signals egress from the secured side. Unlocking will be a manual mechanical function following valid request to exit. The REX will electronically unlock hardware ONLY when used in conjunction with a handicap pushbutton/opener or magnetic locking hardware.

8. Door hardware will have key override and capable of accepting lock interchangeable core.

9. Door hardware power supplies will in have locking junction box.

D. Vehicle Gate Entrance Island

1. A raised vehicle gate entrance island shall be installed equally between the entry and exit lanes. These islands will be used to mount gate operators and pedestals for entry and card readers. The card reader pedestals shall either be a standard pedestal mount or a 4-inch diameter pipe, in which a card reader enclosure shall be mounted.

E. Card Reader Enclosure and Pedestal

1. All vehicle entrance/exit card readers shall be mounted on a non-ferrous material enclosure. An example enclosure material is marine grade polycarbonate. The enclosure shall also be fitted with an outdoor analog ringdown phone (or VoIP doorphone), LED light, terminal blocks, REX device, and Knox key lock.

2. The card reader enclosure shall be mounted on standard pedestal or on top of a 4-inch diameter pipe.

3.04 LABELING AND NAMING CONVENTIONS

A. Device Abbreviations

1. The standardization device names and abbreviations within the system facilitates operator training and allows for quicker identification of device locations when programming or in response to alarms or trouble signals. The table below is a list of device names and their abbreviation or code.

<table>
<thead>
<tr>
<th>Device Abbreviations</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR</td>
</tr>
<tr>
<td>C</td>
</tr>
<tr>
<td>DB</td>
</tr>
<tr>
<td>REX</td>
</tr>
<tr>
<td>EL</td>
</tr>
<tr>
<td>ES</td>
</tr>
<tr>
<td>GB</td>
</tr>
<tr>
<td>LA</td>
</tr>
<tr>
<td>MD</td>
</tr>
<tr>
<td>PS</td>
</tr>
<tr>
<td>PTH</td>
</tr>
</tbody>
</table>
PART 4 - TABLE: SECURITY DEVICE ABBREVIATIONS

<table>
<thead>
<tr>
<th>SACP</th>
<th>Security Access Control Panel</th>
</tr>
</thead>
<tbody>
<tr>
<td>SJB</td>
<td>Security Junction Box</td>
</tr>
<tr>
<td>WC</td>
<td>Window Contact</td>
</tr>
<tr>
<td>CF</td>
<td>Fixed Camera</td>
</tr>
<tr>
<td>PTZ</td>
<td>Pan Tilt Zoom Camera</td>
</tr>
</tbody>
</table>

4.01 LABELING

A. All panels and appropriate door hardware cables/wires must be clearly labeled and must have the corresponding door numbers identified in the labeling to assist with future maintenance.

B. All cabinets including JCI and Altronix Power Supply Cabinets must be clearly labeled with appropriate numbering indicating the enclosure number and corresponding Altronix power supply cabinet as per detail drawings to assist with future maintenance. All cabinet labeling must be placed on the exterior of the cabinet door on the bottom left corner so as not to be covered by any current or future board installation or wiring. Cabinet labeling on the interior of the door must also include the corresponding door numbers wired within the cabinet.

C. Power Supply cabinets are to be clearly labeled indicating the corresponding door numbers from the JCI cabinet so they can be quickly and easily identified for maintenance purposes. Power supplies are to be dedicated to ACAMS doors and are not to be shared with other doors or powered devices under any circumstances.

D. Wire and Cable labels shall be self-laminating adhesive laser labels and machine printable with a laser printer. Standard label color shall be white with black 12 point Arial text. Identify wire and cable clearly with permanent labels wrapped about the full circumference within one inch of each connection. Assign wire or cable designations consistently throughout a given system; i.e., each wire or cable shall carry the same labeled designation over its entire run, regardless of intermediate terminations. Additionally, provide labels where wire and cable first enter and exit from conduit, junction or distribution boxes; labels shall be located within six (6) inches of the point of exit.

E. Label Security equipment enclosures, junction boxes, and power supplies associated with the security system with adhesive backed phenolic label. Use 12 point Arial text.

4.02 PROGRAMMING & TESTING

A. The owner facilities representative, owners Telecommunications, owners Security Department, Design Engineer, and Installation Contractor/Integrator shall hold several meetings prior to the completion of construction to discuss the configuration criteria for each ACAMS controlled door. Discuss the following topics:

1. Door Names / Label Schedule
2. Card Reader Names/ Labels
3. Device Names
4. Alarm groups
5. Schedules and time codes
6. Action/responses from individual input points
7. Action response from card commands
B. The Installation Contractor/Integrator is NOT allowed to use or operate the production ACAMS Server during configuration and testing of the new installed ACAMS panel and sensors. Instead, the Installation Contractor/Integrator shall provide a temporary stand-alone workstation/laptop with a copy of the ACAMS server software to be used for panel configuration and testing. Acceptance testing will be performed on the using the temporary workstation.

C. During installation and testing, the Installation Contractor shall program and setup all system hardware according to customer requirements for unit, system and acceptance testing.

D. The Installation Contractor shall provide a detailed acceptance test plan for the customer to review. The acceptance test shall cover, but not limited to, the following:

1. Card Reader Testing
   a. Upon presenting an invalid badge to a card reader, the system shall do the following:
      1) Card Reader illuminates its red LED
      2) Door(s) stay locked
      3) ACAMS Server reports an invalid badge; no access granted.
      4) Upon presenting a valid badge to a card reader and entering an invalid PIN, the system shall do the following:
         a) Card Reader illuminates its red LED
         b) Door(s) stay locked
         c) ACAMS Server reports an invalid badge; no access granted.
   b. Upon presenting an valid badge to a card reader, the system shall do the following:
      1) Card Reader illuminates its green LED
      2) Door(s) latch/strike unlocks
      3) ACAMS Server reports a valid badge, and access is granted.
   c. Upon presenting a valid badge to a card reader and entering an valid PIN, the system shall do the following:
      1) Card Reader illuminates its green LED
      2) Door(s) latch/strike unlocks
      3) ACAMS Server reports a valid badge, and access is granted.

2. Propped & Forced Door Alarm
   a. After badging in and leaving the door open for more than 10 seconds, the system shall do the following:
      1) ACAM Server reports a Propped Door alarm.
b. After leaving a the building (existing a card reader door), and propping the door open for more than 10 seconds, the system shall do the following:
   1) ACAM Server reports a Propped Door alarm.

c. Using mechanical key access on a card reader door or breaking into the door, the system shall do the following:
   1) ACAMS server reports a Forced Door alarm.

d. Upon approaching the door (on the secure side), the system shall do the following:
   1) The door REX/PIR will detect the person and send a relay output to the ACAMS system to shunt/disable the Forced Door alarm.

3. Remote Operation of sending a command to unlock a card reader door.

4. Verify Forced Door alarms on non-card read doors

5. Verify tamper alarms are functional on all ACAMS panel doors

6. Verify glass break sensors are working and reports an alarm to the ACAMS server.

7. Verify that the ACAMS client can also view status and alarms from the new devices and panels installed.

8. Verify Timed Doors; Schedule door unlock and lock

9. Verify Battery Backup – Disconnect AC power to the ACAMS panel and power supplies, and verify if pane operates for 4 hours.

10. Verify functionality of ACAMS panel door locks

11. Verify communication link from ACAMS panel to Server.

12. Verify operation of card reader if communication to ACAMS server is lost.

E. After the acceptance test is completed and passed, the Installation Contractor/Integrator shall provide configuration documents related to all card readers, REX devices, gate controllers, door/window contacts, PIR sensor, and other related ACAMS devices to the owners Telecommunication Engineer.

F. After receipt of the configuration documents, the owners Telecommunications Technician will interface the new panels to the owners Security Network, and configure all the new panels and devices on the production ACAMS server.

4.03 COORDINATION

A. The ACAMS can interface many different disciplines making coordination extremely important. Reference all other disciplines (Mechanical-Building Management System, Electrical-Lighting Controller, etc) covered in this document and coordinate ACAMS requirements for each project. Attend design team coordination meetings during design and hold a construction kick off meeting at the start of construction.

4.04 EXTRA MATERIALS

A. Contractor shall provide extra materials, also referred to as “equipment spares” of installed equipment depending on each project. Small projects consisting of less than five ACAMS doors shall not receive any equipment spares other than fuses. Standard projects with five or more ACAMS doors shall receive one of each installed device listed below.
1. Provide equipment consisting of modules, devices, and accessories including:
   a. Network Interface Module
   b. Card Reader module
   c. Input/Output Module
   d. Card Readers (each type)
   e. Door Contact
   f. Glass Break Sensor
   g. Request-to-Exit Sensor
   h. Duress Button/Switch
   i. Door Power Supply
   j. Fuses (5 of each type in each enclosure required)

B. Equipment spare items on each building shall be replenished as soon as stock has been depleted. Equipment spares shall not exceed five of each item listed above.

C. Contractor shall not provide spares stock of equipment that could potentially become obsolete within 3-5 years such as security equipment panels and batteries.

4.05 COMMISSIONING AND CLOSEOUT

A. The purpose of system commissioning and closeout is to ensure the security system operates properly when it is needed most. Security systems are very complex from both equipment and programming standpoints, and thorough testing is necessary to ensure correct operation prior to the building’s occupancy.

1. Perform a 100% pre-test of all system aspects to verify correct operation prior to scheduling the final test or punch walk. The pre-test results shall be documented and submitted to the District’s Project Manager. Once the Project Manager has determined the security system is ready for testing, the Design Engineer shall perform the final test or punch walk. The Contractor should be present and demonstrate the security system functionality during the punch walk.

4.06 FIELD QUALITY CONTROL

A. Refer to Specification Section 260080: Electrical Commissioning.

B. 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 security system.

C. Pretesting objectives shall be to:

1. Assure security 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 security system control panel upon satisfactory completion of tests and results.

5. Verify settings and make final adjustments.

D. Engineer witnessed testing: Allow a period of 8 hours for Engineer review and final check.

E. 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.

F. 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. Electrical tests:
   a. The system shall be completely tested prior to final acceptance testing. All points shall be tested from point of initiation to the final point or points of annunciation. All circuits shall be tested for continuity and ability to transmit the required signal correctly to the controller. Any problem due to wrong wire type, wire twist, impedance, mismatches, noise filtering or shielding shall be completely corrected during pretesting and prior to any final acceptance tests.
   b. Testing shall include each and every device in the system. Coordinate with other trades as necessary for testing.
      1) Door contact switches: Verify alarm signal received and annunciacted at control panel.
      2) PIR detection devices: Adjust device sensitivity as required for coverage and location. Verify alarm signal received and annunciacted at control panel.
      3) Keypads: Ensure that keypads function properly to "arm" and "disarm" the system.
      4) Remote station monitoring: Verify that the alarm condition is transmitted via telephone lines to remote monitoring station from auto-dialer/modem device within the control panel.
   c. Test report:
      1) 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.
      2) Submit two typed copies of the test report in a neatly bound folder for review and approval. Failure to comply with this will result in a delay of final testing and acceptance.
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.

4.07 TRAINING

A. Factory authorized service representative shall conduct a 2 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
PART 1 - GENERAL

1.01 SECTION INCLUDES
   A. IP Video Intercom.

1.02 RELATED SECTIONS
   A. Section 26 05 26 - GROUNDING AND BONDING
   B. Section 26 05 29 - ELECTRICAL HANGERS AND SUPPORTS
   C. Section 26 05 31 - CONDUIT
   D. Section 26 05 33 - BOXES
   E. Section 27 10 00 - Basic Communications Requirements
   F. Section 27 15 00 - Communications Horizontal Cabling
   G. Section 28 13 00 – Security Systems
   H. Section 28 23 00 – Video Surveillance System

1.03 REFERENCES

1.04 SYSTEM DESCRIPTION
   A. IP Network Compatible Video Intercom System: A network-based communication and security system featuring video entry security, internal communication, emergency stations, and paging. All units and app in the systems shall be able to unlock doors remotely on a network, assist onsite visitors from an offsite location, broadcast emergency announcements, and communicate using a PoE network.

   1. Power Source: Power over Ethernet (802.3af).
   2. Network Interface: 10 BASE-T / 100 BASE-TX Ethernet (RJ-45).
   3. Network Protocols: IPv4, IPv6, TCP, UDP, SIP, HTTP, HTTPS, MJPEG, RTSP, RTP, RTCP, IGMP, MLD, SMTP, DHCP, NTP, DNS.
   4. Bandwidth Usage:
      a. G.711: 64Kbps x 2 per video call.
      b. 64Kbps per monitor.
      c. H.264: 24Kbps ~ 2,048Kbps.
   5. Communication: Hands-free (VOX), push-to-talk (simplex), or handset (full-duplex).
6. Video Display: 3-1/2 inches (89 mm) color LCD.

7. Camera: Type:
   a. 1/4 inch (6 mm) color CMOS.
   b. View Area: 2 feet 2 inches (660 mm) vertical x 3 feet 1 inch (940 mm) horizontal at 20 inches (508 mm).

8. Video Stream: ONVIF Profile S.

9. Door Release: Programmable Form C dry contact, 24V AC/ DC, 500mA - use EL-12S (use RY-24L for larger contact rating, which requires 24V DC power supply) or use RY-IP44 with 4 multipurpose relays.

10. Wire Type: CAT-5e or CAT-6.

11. Distance:
   a. Door Station/Gate Station to Network Node: 330 feet (100 meters).
   b. Master Station to Network Node: 330 feet (100 meters).

1.05 SUBMITTALS

A. Submit under provisions of Section 01 30 00 - Administrative Requirements.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Shop Drawings: Submit the following:
   1. Wiring Diagrams: Indicate wiring for each item of equipment and interconnections between items of equipment.
   2. Include manufacturer's names, model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.

D. Installation and Operation Manuals:
   1. Submit manufacturer's installation and operation manual, including operation instructions and component wiring diagrams.
   2. Provide detailed information required for Owner to properly operate equipment.

E. Warranty: Submit manufacturer's standard warranty.

F. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

G. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.
1.06 QUALITY ASSURANCE
   B. Installer Qualifications: Factory trained and experienced with system installations of scope and size required for the Project.

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

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

PART 2 - PRODUCTS

2.01 MANUFACTURERS
   A. Acceptable Manufacturer: Aiphone Corp. or approved equal
   B. Substitutions: Substitutions shall meet or exceed the product in this specification. The contractor shall show compliance with the specified product/s prior to approval of the substituted product.
   C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.
   D. IP Video Intercom System: IX Series Intercom System as manufactured by Aiphone Corporation.

2.02 SYSTEM DESIGN
   A. Master Station(s): Provide 1 master station.
   B. Audio Video Door/Gate Stations:
   C. Provide Selective Door/Gate Release.
   D. Provide Audio/video streaming via ONVIF Profile S.
   E. Provide ONVIF Profile S camera input (max 50).
   F. Provide Contact input at door station.
2.03 FUNCTIONAL COMPONENTS:

A. As indicated on the drawings or as required to complete system.

1. Video Master Station Model IX-MV:
   a. An IP addressable video master station with a 3.5 inch (89 mm) color LCD monitor. It can be wall or desk mounted (desk stand included). The IX-MV offers handset (duplex) and hands-free (VOX/PTT) communication and call up to 500 other IX units. It connects directly to a network using CAT-5e/6 cable. This station requires a 802.3af compliant Power-over-Ethernet network.

2. Audio/Video Door Station Model IX-DF-HID:
   a. Flush mount unit connects to a PoE network using CAT-5e/6 cable. The IX-DF-HID will call up to 20 IX-MV masters or instances of the IX MOBILE. The door station features a stainless steel face plate, an embedded ProxPoint HID card reader, a form C contact for door release, a 600 ohm output for paging or an amplified speaker, call placed/answered indication, and a contact input.

3. RY-IP44 IP Programmable Relay Adaptor (If Required)
   a. With 4 contact inputs and 4 relay outputs (compatible with the IX Series)

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas to receive integrated security and communication system.

B. Notify Architect of conditions that would adversely affect installation or subsequent use.

C. Do not begin installation until unacceptable conditions are corrected.

3.02 PREPARATION

A. Verify the following compliance before starting installation.

1. The unit turns inoperative during power failure.

2. Keep the intercom wires at least 1 foot (30 cm) away from strong electrical wiring (AC 100-240 V) including, in particular, wiring for inverter electrical appliances. Noise and malfunction could result.

3. If a strong light shines on the main unit screen, the picture may turn white or only silhouettes will be visible.

4. Other manufacturer's devices (such as sensor, detectors, door releases) used with this system, comply with the manufacturer's installation requirements.

5. The LCD panel is manufactured with very high precision techniques, inevitably will have a very small portion of its picture elements always lit or not lit at all. This is not considered a unit malfunction. Please be aware of this in advance.

3.03 INSTALLATION

A. Install integrated security and communication system in accordance with manufacturer's instructions at locations indicated on the Drawings.
B. Mount equipment plumb, level, square, and secure. For video entrance stations and video door stations, comply with manufacturer's design requirements to provide optimum picture quality of station monitoring.

3.04 SET-UP AND ADJUSTING

A. Adjust integrated security and communication system for proper operation in accordance with manufacturer's instructions.

3.05 DEMONSTRATION AND TRAINING

A. Demonstration:
   1. Demonstrate that integrated security and communication system functions properly.
   2. Perform demonstration at final system inspection by qualified representative of manufacturer.

B. Instruction and Training:
   1. Provide instruction and training of Owner's personnel as required for operation of integrated security and communication system.
   2. Provide hands-on demonstration of operation of system components and complete system, including user-level program changes and functions.
   3. Provide instruction and training by qualified representative of manufacturer.

3.06 PROTECTION

A. Protect installed integrated security and communication system from damage during construction.

END OF SECTION
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. This section provides the requirements for the surveillance camera system. The system shall include, but not be limited to, devices, panels, terminal cabinets, power supplies, backboards, programming, conduit/raceway, wire/cabling, junction cans, terminal strips, testing and verification of a complete, operable and approved camera system.

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 13; Power-Limited Circuit Cables.
   - UL 938; Surveillance Camera Units.
   - UL 2044; Commercial Closed-Circuit Television Equipment.
   - UL 3044; Surveillance Closed Circuit Television Equipment.

2. Federal Communications Commission (FCC):

3. Electronics Industries Alliance (EIA):
   - EIA: Testing standards.

4. Related Specifications:
   a. Section 271500 Communications Horizontal Cabling

1.03 ALTERNATES

A. Refer to section 012300 - Alternates, for description of work under this Section affected by alternates.

1.04 SYSTEM DESCRIPTION

A. The surveillance camera system is comprised of new IP cameras and recording system.

B. Provide a new IP fixed focus cameras, housings, and supports as shown on drawings.

C. Provide a Network Video Recorder/Server and required Software.
D. Provide a Power Over Ethernet (PoE) Network Switch for network connection of surveillance cameras and the Network server. The cameras will be powered with PoE.

E. Provide Category 6 data patch cords for interconnection of the surveillance components and cabling system.

F. Network Server shall be compatible with Windows 7

1.05 SUBMITTALS

A. Submit in accordance with the requirements of Section 260010: Basic Electrical Requirements, the following items:
   1. California State Contractors License (C7 or C10 required)
   2. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
   3. Describe system operation, equipment and dimensions and indicate features of each component.
   4. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
   5. Submit Manufacturer's installation instructions.
   6. Complete bill of materials listing all components.
   7. Warranty.

B. Record Drawings:
   1. Furnish Record Drawings as described in Section 2760010: Basic Camera and Cable Systems Requirements.
   2. Final acceptance will not be made until the Engineer has approved the Record Drawings.

1.06 OPERATION AND MAINTENANCE MANUAL

A. Supply operation and maintenance manuals 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 Drawings of wiring system, including all peripheral devices, host computers, monitors, control devices, etc.
   5. Telephone numbers for the authorized parts and service distributors.
   6. Final testing reports.

1.07 QUALITY ASSURANCE

A. All construction shall be performed by a California State Licensed Contractor. C7 or C10.

B. All materials, equipment and parts comprising the units specified herein shall be new, unused and currently under production.
C. 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: Surveillance system 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.

1.09 WARRANTY

A. The security system as described in this Specification shall be covered by a 3 year parts and service warranty at no additional cost to the Owner.

B. The warranty package shall include but not necessarily be limited to the following:

1. Emergency maintenance service on regular working hour basis.

2. Service by factory trained and employed service representatives of system Manufacturer.

C. Maintain regular service facilities and provide a qualified technician familiar with this Work at the Project site within four (4) hours of receipt of a notice of malfunction including weekends and holidays. Provide all material, devices equipment and personnel necessary for repairs. Install approved temporary, alternate equipment if required by the Owner, complete and operational within twenty four (24) hours after notification of a malfunction, at no additional cost.

D. Conduct all warranty repairs and service at the Project site unless in violation of Manufacturer's warranty; in the latter event, provide substitute systems, equipment and/or devices, acceptable to the Owner, for the duration of such off-site repairs. Transport warranty substitute and/or test systems, equipment, devices, material, parts and personnel to and from the Project site at no additional cost.

1.10 SYSTEM START-UP

A. Upon completion of installation, a factory trained dealer service representative shall perform initial start-up of the surveillance 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.

PART 2 - PRODUCTS

2.01 GENERAL

A. All equipment and materials used shall be standard components that are regularly manufactured and used in the manufacturer's system.

B. All systems and components shall have been thoroughly tested and proven in actual use.

C. All systems and components shall be provided with the availability of a toll free 24- hour technical support phone number from the manufacturer. This no charge service shall be available to dealers, installers and end users.
2.02 MANUFACTURERS

A. The following manufacturers products shall be considered:

1. Axis
2. Pelco
3. Bosch

2.03 FIXED IP CAMERA DOME

A. Fixed dome 1080p network camera

1. The fixed network camera shall meet or exceed the following design specifications:
   a. The camera shall operate on an open source; Linux-based platform, and including a built-in web server.
   b. The camera shall be equipped with an IR-sensitive progressive scan sensor.
   c. The camera shall provide a removable IR-cut filter, providing day/night functionality.
   d. The camera shall be equipped with a varifocal lens with P-iris.
   e. The camera shall provide local video storage utilizing a microSD/microSDHC/microSDXC memory card expansion, supporting memory up to 64 GB.
   f. The camera shall be manufactured with an IP66- and NEMA 4X-rated, IK10 impact-resistant casing providing encapsulated electronics.
   g. The camera shall provide a manual 3-axis (pan/tilt/rotation) positioning to allow adjustment for optimum camera rotation and placement.
   h. The camera shall incorporate remote zoom functionality.
   i. The camera shall incorporate remote focus functionality.

2. The fixed dome network camera shall meet or exceed the following performance specifications:
   a. Illumination
      1) The camera shall meet or exceed the following illumination specifications:
         a) HDTV 1080p 25/30 fps with WDR - Forensic Capture - Color: 0.25 lux, B/W: 0.05 lux
         b) HDTV 1080p 50/60 fps - Color: 0.5 lux, B/W: 0.1 lux
   b. Resolution
      1) The camera shall be designed to provide at least two video streams in HDTV 1080p (1920x1080) at up to 30 frames per second (60Hz mode) or 25 frames per second (50Hz mode) using H.264 or Motion JPEG with WDR enabled.
      2) The camera shall be designed to provide at least two video streams in HDTV 1080p (1920x1080) at up to 60 frames per second (60Hz mode) or 50 frames per second (50Hz mode) using H.264 or Motion JPEG without WDR enabled.
3) The camera shall be designed to provide 2 individually cropped out view areas.

4) The camera shall support video resolutions including:
   a) 1920x1200
   b) 1920x1080 (HDTV 1080p)
   c) 1600x1200
   d) 1400x1050
   e) 1280x720 (HDTV 720p)

5) The camera shall provide both landscape format (4:3 and 16:9 aspect ratio) as well as corridor format (3:4 and 9:16 aspect ratio).

c. Encoding

1) The camera shall support the following video encoding algorithms:
   a) Motion JPEG encoding in a selectable range from 1 up to 25/30 frames per second in all resolutions with WDR enabled.
   b) Motion JPEG encoding in a selectable range from 1 up to 50/60 frames per second in all resolutions without WDR enabled.
   c) Baseline Profile H.264 encoding with motion estimation in up to 25/30 frames per second with WDR enabled.
   d) Baseline Profile H.264 encoding with motion estimation in up to 50/60 frames per second without WDR enabled.
   e) Main Profile H.264 encoding with motion estimation and context-adaptive binary arithmetic coding (CABAC) in up to 25/30 frames per second with WDR enabled.
   f) Main Profile H.264 encoding with motion estimation and context-adaptive binary arithmetic coding (CABAC) in up to 50/60 frames per second without WDR enabled.
   g) Support High Profile H.264 encoding with motion estimation up to 25/30 frames per second with WDR enabled.
   h) Support High Profile H.264 encoding with motion estimation up to 50/60 frames per second without WDR enabled.
   i) Support H.264 with automatic scene adaptive bitrate control in up to 50/60 frames per second.

2) The camera shall provide independently configured simultaneous H.264 and Motion JPEG streams.

3) The camera shall support both Maximum Bit Rate (MBR) and Variable Bit Rate (VBR) in H.264.

4) The camera shall provide configurable compression levels.
5) Support standard baseline profile H.264 with motion estimation.

6) Support motion estimation in H.264/MPEG-4 Part 10/AVC.

7) The camera shall for its H.264 implementation support scene adaptive bitrate control with automatic dynamic ROI to reduce bitrate in unprioritized regions in order to lowering bandwidth and storage requirements.

d. Transmission

1) The camera shall allow for video to be transported over:
   a) HTTP (Unicast)
   b) HTTPS (Unicast)
   c) RTP (Unicast & Multicast)
   d) RTP over RTSP (Unicast)
   e) RTP over RTSP over HTTP (Unicast)

2) The camera shall support Quality of Service (QoS) to be able to prioritize traffic.

e. Image


2) The camera shall incorporate an electronic shutter operating in the range of 1/142850s to 2s.

3) The camera shall incorporate Wide Dynamic Range - Forensic Capture functionality providing up to 120dB dynamic range.

4) The camera shall provide backlight compensation functionality.

5) The camera shall support manually defined values for:
   a) Color level
   b) Brightness
   c) Sharpness
   d) Contrast

6) The camera shall incorporate a function for optimization of low light behavior.

7) The camera shall allow for rotation of the image in steps of 90°.

8) The camera shall incorporate local contrast functionality.

f. IR Illumination

1) The camera shall be equipped with built-in IR LEDs with adjustable angle of illumination and intensity.
a) The IR LEDs shall have a range of up to 25 m (82 ft).
b) The IR LEDs shall emit light with a wavelength of 850 nm.

g. User Interface

1) Web server
   a) The camera shall contain a built-in web server making video and configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software.
   b) Optional components downloaded from the camera for specific tasks, e.g. Active X, shall be signed by an organization providing digital trust services, such as Verisign, Inc.

2) Language Specification
   a) The camera shall provide a function for altering the language of the user interface, and shall include support for at least 10 different languages.

3) IP addresses
   a) The camera shall support both fixed IP addresses and dynamically assigned IP addresses provided by a Dynamic Host Control Protocol (DHCP) server.
   b) The camera shall allow for automatic detection of the camera based on UPnP and Bonjour when using a PC with an operating system supporting this feature.
   c) The camera shall provide support for both IPv4 and IPv6.

h. PTZ functionality

1) The camera shall provide:
   a) Pan ± 180°
   b) Tilt -5 to +75°
   c) Rotation ± 95°

i. Event functionality

1) The camera shall be equipped with an integrated event functionality, which can be triggered by:
   a) Live Stream Accessed
   b) Day/Night Mode
   c) Camera tampering
   d) Heater malfunctioning
e) Manual Trigger/Virtual Inputs
f) PTZ functionality
g) Embedded third party applications
h) Edge storage disruption detection

2) Response to triggers shall include:
   a) Send notification, using HTTP, HTTPS, TCP or email
   b) Send images, using FTP, HTTP, HTTPS, network share or email
   c) Send video clip, using FTP, HTTP, HTTPS, network share or email
   d) Send SNMP trap message
e) Activate/Deactivate IR Illumination
f) DAY/Night Vision Mode
g) WDR Mode
h) Recording to local storage and/or network attached storage
i) PTZ control functionality

3) The camera shall provide memory for pre & post alarm recordings.

j. Edge storage
   1) The camera shall support continuous and event controlled recording to:
      a) Local memory added to the cameras SD-card slot
      b) Network attached storage, located on the local network
   2) The camera shall be able to detect and notify Edge storage disruptions.

k. Protocol
   1) The camera shall incorporate support for at least IPv4/v6, HTTP, HTTPS, SSL/TLS, QoS Layer 3 DiffServ, TCP, ICMP, SNMPv1/v2c/v3 (MIB-II), RTSP, RTP, UDP, IGMP, RTCP, SMTP, FTP, DHCP, UPnP, ARP, DNS, DynDNS, SOCKS, SSH, NTP, CIFS/SMB and Bonjour.
   2) The SMTP implementation shall include support for SMTP authentication.

l. Text overlay
   1) The camera shall:
      a) Provide embedded on-screen text with support for date & time, and a customer-specific text, camera name, of at least 45 ASCII characters.
b) To ensure accuracy, the camera shall accept external time synchronization from an NTP (Network Time Protocol) server.

c) Provide the ability to apply privacy masks to the image.

d) Allow for the overlay of a graphical image, such as a logotype, into the image.

m. Security

1) The camera shall support the use of HTTPS and SSL/TLS, providing the ability to upload signed certificates to encrypt and secure authentication and communication of both administration data and video streams.

2) The camera shall provide centralized certificate management, with both pre-installed CA certificates and the ability to upload additional CA certificates. The certificates shall be signed by an organization providing digital trust services.

3) The camera shall support IEEE 802.1X authentication.

4) The camera shall provide support for restricting access to pre-defined IP addresses only, so-called IP address filtering.

5) The camera shall restrict access to the built-in web server by usernames and passwords at three different levels.

n. API support

1) The camera shall be fully supported by an open and published API (Application Programmers Interface), which shall provide necessary information for integration of functionality into third party applications.

2) The camera shall support relevant ONVIF profiles as defined by the ONVIF Organization.

o. Embedded applications

1) The camera shall provide a platform allowing the upload of third party applications into the camera.

p. Installation and maintenance

1) The camera shall be supplied with Windows-based management software which allows the assignment of IP addresses, upgrade of firmware and backup of the cameras' configuration.

2) The camera shall support the use of SNMP-based management tools according to SNMP v1, 2c & 3 / MIB-II.

3) The camera shall allow updates of the software (firmware) over the network, using FTP or HTTP.

4) The camera shall provide the ability to apply a rectangle of customer-defined number of pixels to the image, which can be used as a pixel counter identifying the size of objects in number of pixels.

5) The camera shall store all customer-specific settings in a non-volatile memory that shall not be lost during power cuts or soft reset.
q. **Access log**

1) The camera shall provide a log file, containing information about the 250 latest connections and access attempts since the unit’s latest restart. The file shall include information about the connecting IP addresses and the time of connecting.

2) Provide a connection list of all currently connected viewers. The file shall include information about connecting IP address, time of connecting and the type of stream accessed.

r. **Camera diagnostics**

1) The camera shall be equipped with LEDs, capable of providing visible status information. LEDs shall indicate the camera’s operational status and provide information about power, communication with receiver, the network status and the camera status.

2) The camera shall be monitored by a Watchdog functionality, which shall automatically re-initiate processes or restart the unit if a malfunction is detected.

3) The camera shall send a notification when the unit has re-booted and all services are initialized.

s. **Hardware interfaces**

1) **Network interface**

   a) The camera shall be equipped with one 100BASE-TX Fast Ethernet-port, using a standard male RJ45 connector and shall support auto negotiation of network speed (100 MBit/s and 10 MBit/s) and transfer mode (full and half duplex).

 t. **Enclosure**

1) Be manufactured with an IP66- and NEMA 4X-rated, IK10 impact-resistant casing providing encapsulated electronics.

 u. **Power**

1) Power over Ethernet IEEE 802.3af/802.3at Type 1 Class 3

 v. **Environmental**

1) Operate in a temperature range of -30 °C to +50 °C (-22 °F to 122 °F).

2) Operate in a humidity range of 10–100% RH (condensing).

### 2.04 SURVEILLANCE CONTROL AND MANAGEMENT SYSTEM

**A.** The video management system shall:

1. Support live view and recording of at least 50 network video sources, in H.264, MPEG-4 Part 2 or Motion JPEG.

2. Support replay of up to 16 recorded network video streams in H.264, MPEG-4 Part 2 or Motion JPEG.
3. Utilize server software for recording and management of video and audio.
4. Be provided with client software used to access information from the server.
5. Be able to fast instant replay recorded material.
6. Provide enhancing image on live view.
7. Provide the capability to add action buttons to the live view interface and trig actions/events.
8. Provide the ability to drag and drop individual cameras and split views to the live view area at any time when live view mode across multiple monitors.

B. Hardware

1. The video management system shall support full functionality for the supported number of cameras when operated on a computer platform with the following specification:
   a. Be equipped with at least Intel Core i7 processor.
   b. 16GB RAM.
   c. Dedicated graphic card with full Direct X 9.0 hardware acceleration and at least 1GB onboard video memory
   d. 1000BaseT Ethernet network port.
   e. Hard drives with NTFS-file system and SATA 6Gb/sec.

2. The client software shall support full functionality when operated on a computer platform with the following specification:
   a. Be equipped with at least Intel Core i7 processor.
   b. 8GB RAM.
   c. Dedicated graphic card with full Direct X 9.0 hardware acceleration and at least 1GB onboard video memory
   d. 1000BaseT Ethernet network port.

C. Software requirements

1. The video management system shall support full functionality when operated in the following environment.
   a. One of the following versions of Microsoft Windows 32 & 64-bit
      1) Windows 8 Pro
      2) Windows 7 Professional
      3) Windows Server 2012
      4) Windows 2008 Server R2
      5) Windows 2008 Server
b. Microsoft .Net runtime environment

2. The client software shall support full functionality when operated on a computer platform with the following specification:
   a. One of the following versions of Microsoft Windows 32 & 64-bit
      1) Windows 8 Pro
      2) Windows 7 Professional

b. Microsoft .Net runtime environment

D. Video

1. The video management system shall accept video and audio from network cameras and video encoders compliant with the VAPIX open API as published by Axis Communications.

2. The video management software shall support traditional network cameras and video encoders as well as thermal network cameras.

3. The video management system shall, when operating in a fully supportive environment, be able to record at least 50 individually configured full frame rate video streams in Full HDTV 1080p (1920x1080 pixels) over IP networks.

4. The video management system shall provide a total recording capacity of at least 3000 frames per second.

5. The video management system shall, for each channel:
   a. Support Motion JPEG recording in a selectable range up to 30 fps (60Hz), 25 fps (50Hz) in all resolutions.
   b. Support MPEG4 Part 2 recording in a selectable range up to 30 fps (60Hz), 25 fps (50Hz) in all resolutions.
   c. Support H.264 recording in a selectable range up to 30 fps (60Hz), 25 fps (50Hz) in all resolutions.

6. Transmission
   a. The video management system shall allow for video to be transported over:
      1) Multipart HTTP (Unicast)
      2) RTP over RTSP over HTTP (Unicast)

E. Audio

1. The video management system shall support simplex audio encoded with the video stream.

2. Audio quality
   a. The video management system shall support:
      1) AAC LC at 8/16 kHz
      2) G.711 PCM at 8 kHz
3) G.726 ADPCM at 8 kHz

F. I/O functionality

1. The video management system shall accept notifications and alarms from an unlimited number of auxiliary devices connected to the network.

2. Received notifications and alarms shall be able to generate events within the video management system.

G. Access control

1. The video management system shall accept notifications and alarms from an unlimited number of access control units connected to the network.

2. Received notifications and alarms shall be able to generate events within the video management system.

H. User Interface

1. The video management shall be equipped with a graphical user interface, providing the following functionality:
   
a. Be able to display up to 25 different video streams.
   
b. Be able to display up to 100 different video streams using multiple split views.
   
c. Provide the functionality to quickly jump between multi-views using a quick view button.
   
d. Support drag and drop of video sources within the user interface.
   
e. Support multiple screens when operating on a computer supporting this.
   
f. Provide map-based interface, allowing cameras to be selected based upon location of maps over the facility.
   
g. Be available in at least 15 different languages, including English, French, Italian, German, Spanish, Polish, Russian, Korean, Japanese, Chinese, Swedish, Danish, Turkish, Arabic, Persian and Brazilian Portuguese.

I. Functionality

1. The following functionality shall be available from both server and client software, when operating in a fully supportive environment.

   a. Live view functionality
      
      1) Single camera live view
      
      2) Multi-views
      
      3) Sequence views

   b. Recording functionality
      
      1) Continuous recording
      
      2) Scheduled recording
3) Event driven recording
4) Manually initiated recording

c. Provide individually and configurable resolution and frame rate for each video source.
d. The duration of recorded material shall only be limited by the amount of available storage capacity.

2. Video and audio shall be recorded using a non-standard format preventing manipulation of the content and shall contain information about date, time and source of the recorded material.

J. Replay functionality
1. The video management system shall be able to provide synchronized replay of at least 4 different recorded video streams.
2. The video management system shall be able to replay at least 8 simultaneous full frame rate Full HDTV 1080p (1920x1080 pixels) video streams.
3. Provide an ability to export multiple selected video and audio sequences to ASF-formats together with standalone player.

K. Search functionality
1. The video management system shall provide an ability to search for video based upon the following criteria’s:
   a. Time & Date
   b. By camera
   c. Motion detection within a customizable area of the video
   d. Video streaming content

L. Map-based graphical user interface
1. The video management system shall be able to display facility maps with interactive camera icons, which can be used to call up live video and audio from the selected camera.
2. The video management system shall be able to import graphical map data in the following formats:
   a. JPEG
   b. BMP
   c. PNG
   d. GIF

M. IP addresses
1. The video management system shall operate using static or dynamic IP addresses.
2. The video management system shall provide support for addresses provided by a Dynamic Name Server (DNS).
3. The video management system shall allow for automatic detection of cameras and encoders using UPnP and Bonjour

N. PTZ functionality

1. The video management system shall for each video channel
   a. Provide the ability to control Pan, Tilt and Zoom functionality directly from the user interface.
   b. Provide at least 100 present positions, camera depending.
   c. Support guard tour functionality, which allows the PTZ device to automatically move between selected presets using an individual viewing time for each preset.

O. Event functionality

1. The video management system shall be equipped with integrated event functionality, which can be trigged by:
   a. Event triggered in a camera, encoder or other network connected device, including:
      1) - Video Motion Detection
      2) - Audio Detection
      3) - Camera Tampering
      4) - Cross Line Detection
   b. Lost Connection to network camera or encoder
   c. Schedule
   d. Failover recording recovery - recovery of local recordings in camera or encoder after connection disruption

2. Response to triggers shall include:
   a. Selecting predefined live-view
   b. Recording of video at defined image quality and frame rate
   c. Storing of pre-alarm video at the captured frame rate
   d. Activating external output
   e. Notification of event via email

3. The video management system shall provide an event history list, containing up to 1 year of history.

P. Protocol support

1. The video management system shall incorporate support for at least IP, HTTP, TCP, ICMP, RTSP, RTP, RTCP, SMTP, FTP, DHCP, UPnP, DNS, and Bonjour.
2. The SMTP implementation shall include support for SMTP authentication.
Q. Time

1. The video management system shall utilize NTP as provided by the server.

R. Security

1. The video management system shall provide the following:
   a. Authentication of nodes using Kerberos
   b. Authentication using Microsoft Active Directory
   c. Restrict access to the systems by usernames and passwords at a minimum of three different levels.

S. API support / Customization and Integration

1. The video management system shall be fully supported by an open and published API (Application Programmers Interface), which shall provide necessary information for integration with third party applications.

T. Maintenance and configuration functionality

1. The video management system shall:
   a. Provide the ability to create multiple users of the system, either from local PC users or through Active Directory, each with individual definable user rights.
   b. Provide the ability to assign IP address and configure new and replaced cameras and encoders.
   c. Provide an ability to back up system configuration.
   d. Provide the ability to upgrade firmware in individual cameras and encoders.
   e. When connected to Internet, be able to locate suitable firmware updates and download these

U. Supplied system

V. The video management system shall be an AXIS Camera Station Network Video Management system or equal.

2.05 WIRE AND CABLE

A. Category 6 Data Cable:

   a. Refer to Section 27 15 00

B. Patch Cords

1. For connection to each camera, Network Switch Ports and NVR.

2. Category 6, 4 pair, RJ45 - RJ45, Length as required

3. Color: Green
PART 3 - EXECUTION

3.01 EXAMINATION

A. Contractor shall thoroughly examine Project site conditions for acceptance of the surveillance system installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

B. Examine the surfaces, anchors and ground that are to receive materials, fixtures, assemblies, components and equipment. Report the unsatisfactory conditions in writing to the Architect.

3.02 COORDINATION

A. Coordinate and disconnect existing electronic/electrical equipment, services and/or controls to items being removed by others.

B. Maintain a competent supervisor and supporting technical personnel, acceptable to the Engineer during the entire installation.

3.03 INSTALLATION

A. General:

1. The Contractors or subcontractors main resources within the project shall carry proper professional certification issued by the manufacturer and verified by a third party organization to confirm sufficient product and technology knowledge.

2. All equipment shall be tested and configured in accordance with instructions provided by the manufacturer prior to installation.

3. All firmware found in products shall be the latest and up-to-date provided by the manufacturer, or of a version as specified by the provider of the Video Management Application (VMA) or Network Video management system (NVR).

4. All equipment requiring users to log on using a password shall be configured with user/site-specific password/passwords.

5. Install surveillance camera systems in accordance with Manufacturer's written instructions, as indicated on the Drawings and as specified herein.

6. Use methods and lubricating compounds on cables and wires to prevent damage to cables and wires during pulling. Provide compounds that are not injurious to the cable and wire jackets and do not harden or become adhesive.

7. Perform this Work in accordance with acknowledged industry and professional standards and practices and the procedures specified herein.

8. A complete, operating system shall be provided. Include all devices specified including basic components and accessories, interconnecting wiring and other equipment and installation devices necessary for a complete system as specified.

9. Provide wire, system devices, etc., shall be in accordance with applicable codes for systems as specified. Label all wiring and equipment.

10. The equipment and wiring shall be installed in a neat and workmanlike manner by trained surveillance camera installers.
B. Wire and Cable:

1. Identify all wire and cable clearly with permanent labels wrapped about the full circumference within one (1) inch of each connection. Indicate the number designated on the associated field or Shop Drawings or run sheet, as applies. Assign wire or cable designations consistently throughout a given system; i.e., each wire or cable shall carry the same labeled designation over its entire run, regardless of intermediate terminations. Additionally, provide labels where wire and cable first enter and exit from conduit, junction or distribution boxes; labels shall be located within six (6) inches of the point of exit. Labels shall be by Brady or Thomas and Betts.

2. Secure all wire and cable run vertically in conduit for continuous distances greater than thirty (30) feet at the vertical run terminations. Cables shall be secured by screw-flange nylon cable ties or similar approved devices, Thomas and Betts or equivalent. Symmetrical clamping devices with split, circular or other wire conforming, nonmetallic bushings shall be provided for all other cables.

3. All wire and cable shall be continuous and splice-free for the entire length of run between designated connections or terminations.

4. Lace, tie or harness wire or cable as required herein and in accordance with accepted professional practice. Dress, lace or harness all wire and cable to prevent mechanical stress on electrical connections; no wire or cable shall be supported by a connection point.

5. Wiring for shielding certain conductors from others or routing in separate raceways, shall be as recommended by the Manufacturer's current requirements.

6. Label all cables at both ends of a run and within all pull and junction boxes using machine generated wrap-around labels.

C. Boxes:

1. Install all boxes square and plumb. Set "flush mounted" units so that the face of the cover, bezel or escutcheon shall be in the same place as the surrounding finished surface. Mount boxes and trim so that there are no gaps, cracks or obvious lines between the trim and the adjacent finished surface and ready them to receive final finish, as applicable.

2. Install insulating terminations in signal circuit boxes, and wire ways of this Section.

D. Labeling:

1. Label each device in a concealed location with the system point number and address.

3.04 PROGRAMMING

A. Prior to the completion of construction the Contractor shall schedule a meeting with the Owner to determine all of the programming criteria. The issues that shall be discussed are as follows:

1. CCTV camera call-up & recording features (including video motion detection)

B. The Contractor shall document the results of the meeting and perform all necessary programming to achieve the Owner’s requests.

C. All programming shall be Windows 7 compatible.

3.05 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 surveillance 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/adjustments and inspection required herein. Testing Agencies objectives shall be to:

1. Assure Camera 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. Verify settings and make final adjustments.

C. At least five days 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.

1. Testing:
   a. Perform a 100% pretest of the system prior to final Engineer testing. Provide the Engineer with the contractor testing and the independent testing results prior to final punch.

D. Contractor shall replace at no costs to the Owner all devices which are found defective or do not operate within factory specified tolerances.

E. 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.

3.06 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
SECTION 31 23 00
EXCAVATION AND FILL

PART 1 - GENERAL

1.01 SECTION INCLUDES
A. Excavation and/or embankment from existing ground to subgrade, including soil sterilant, for roadways, driveways, parking areas, walks, paths, or trails and any other site improvements called for on the Plans.

1.02 SECTION EXCLUDES
A. Earthwork related to underground utility installation, see Section 31 23 33 – Trenching and Backfilling.

1.03 RELATED SECTIONS
A. Section 31 11 00 – Clearing and Grubbing
B. Section 31 23 33 – Trenching and Backfilling
C. Section 31 31 19 – Vegetation Control

1.04 RELATED DOCUMENTS
A. Geotechnical Report.
B. ASTM:
   1. D 1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.
   2. D 1586, Method for Penetration Tests and Split-Barrel Sampling of Soils.
   3. D 2487, Classification of Soils for Engineering Purposes.
D. Caltrans Standard Specifications:
   1. Section 17, Watering.
   2. Section 19, Earthwork.
E. CAL/OSHA, Title 8.

1.05 DEFINITIONS
A. Borrow: Approved soil material imported from off-site for use as Structural Fill or Backfill.
B. Excavation: Removal of material encountered above subgrade elevations.
1. **Authorized Over-Excavation**: Excavation below subgrade elevations or beyond indicated horizontal dimensions as shown on plans or authorized by the Geotechnical Consultant.

2. **Unauthorized Over-Excavation**: Excavation below subgrade elevations or beyond indicated horizontal dimensions without authorization by the Geotechnical Consultant. Unauthorized excavation shall be without additional compensation.

C. **Geotechnical Testing Agency**: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock definition testing, as documented according to ASTM D 3740 and ASTM E 548.

D. **Structural Backfill**: Soil materials approved by the Geotechnical Consultant and used to fill excavations resulting from removal of existing below grade facilities, including trees. See Section 31 23 33 – Trenching and Backfilling.

E. **Structural Fill**: Soil materials approved by the Geotechnical Consultant and used to raise existing grades.

F. **Rock**: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material \( \frac{3}{4} \)-cubic yards or more in volume that when tested by an independent geotechnical testing agency, according to ASTM D 1586, exceeds a standard penetration resistance of 100 blows/2-inches.

G. **Structures**: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man made stationary features constructed above or below grade.

H. **Subgrade**: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, base or topsoil materials.

I. **Unsuitable Material**: Any soil material that is not suitable for a specific use on the Project. The Geotechnical Consultant will determine if a soil material is unsuitable.

J. **Utilities**: Onsite underground pipes, conduits, ducts and cables.

1.06 **SUBMITTALS**

A. **Follow submittal procedures outlined in Section 01 33 00 – Submittal Procedures**.

B. **Submit material certificates signed by the material producer and the Contractor, certifying that each material item complies with, or exceeds the specified requirements**.

1.07 **QUALITY ASSURANCE**

A. **Conform all work and materials to the recommendations or requirements of the Geotechnical Report and meet the approval of the Geotechnical Consultant**.

B. **Conform all work to the appropriate portion(s) of Caltrans Standard Specifications, Section 17 and 19**.

C. **Percentage of compaction specified shall be the minimum acceptable. The percentage represents the ratio of the dry density of the compacted material to the maximum dry density of the material as determined by the procedure set forth in ASTM D 1557**.

D. **Perform excavation, filling, compaction and related earthwork under the observation of the Geotechnical Consultant. Materials placed without approval of the Geotechnical Consultant will be presumed to be defective and, at the discretion of the Geotechnical Consultant, shall be removed and replaced at no cost to the Owner. Notify the Geotechnical Consultant at least 24-hours prior to commencement of earthwork and at least 48 hours prior to testing**.

E. **The Geotechnical Consultant will perform observations and tests required to enable him to form an opinion of the acceptability of the Project earthwork. Correct earthwork that, in the opinion of the Geotechnical Consultant, does not meet the requirements of these Technical Specifications and the Geotechnical Report**.

F. **Upon completion of the construction work, certify that all compacted fills and foundations are in place at the correct locations, and have been constructed in accordance with sound construction practice. In addition, certify that the...**
materials used are of the types, quality and quantity required by these Technical Specifications and the Geotechnical Report. The Contractor shall be responsible for the stability of all fills and backfills constructed by his forces and shall replace portions that in the opinion of the Geotechnical Consultant have been displaced or are otherwise unsatisfactory due to the Contractor’s operations.

G. Finish soil grade tolerance at completion of grading:
   1. Building and paved areas: +0.05
   2. Other areas: ±0.10 feet.

1.08 PROJECT CONDITIONS

A. Promptly notify the Owner of surface or subsurface conditions differing from those disclosed in the Geotechnical Report. First notify the Owner verbally to permit verification and extent of condition and then in writing. No claim for conditions differing from those anticipated in the Contract Documents and disclosed in the Geotechnical Report will be allowed unless the Contractor has notified the Owner in writing of differing conditions prior to the Contractor starting work on affected items.

B. Protect open excavations, trenches, and the like with fences, covers and railings to maintain safe pedestrian and vehicular traffic passage.

C. Prevent erosion of freshly graded areas during construction and until such time as permanent drainage and erosion control measures have been installed.

D. Temporarily stockpile fill material in an orderly and safe manner and in a location approved by the Owner.

E. Provide dust and noise control in conformance with Division 1 General Requirements.

F. Environmental Requirements: When unfavorable weather conditions necessitate interrupting earthwork operation, areas shall be prepared by compaction of surface and grading to avoid collection of water. Provide adequate temporary drainage to prevent erosion. After interruption, compaction specified in last layer shall be re-established before resuming work.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from on-site excavations.

B. Obtain approval of on-site soil materials and borrow materials to be used for structural fill or structural backfill from the Geotechnical Consultant.

C. On-Site Structural Fill and Structural Backfill: Soil or soil-rock mixture from on site excavations, free from organic matter or other deleterious substances. On-site structural fill and backfill shall not contain rocks or rock fragments over 6 inches in greatest dimension and not more than 15 percent shall be over 2-1/2 inches in greatest dimension and with an organic content less than 3.0 percent by weight.

D. Imported Structural Fill and Structural Backfill: Conform to the requirements of on-site structural fill. Material shall also be a non-expansive and predominantly granular soil or soil-rock mixture with plasticity index of 15 or less in accordance with ASTM D 4318 and an R-Value of 25 or greater.

PART 3 - EXECUTION

3.01 GENERAL

A. Conform to Section 19, Earthwork, Caltrans Standard Specifications as modified by the Contract Documents.

B. Placement and compaction of material by flooding, ponding, or jetting will not be permitted.
C. The use of explosives will not be permitted.

3.02 CONTROL OF WATER AND DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding the site and surrounding area. Provide dewatering equipment necessary to drain and keep excavations and site free from water.

B. Dewater during backfilling operation so that groundwater is maintained at least one foot below level of compaction effort.

C. Obtain the Geotechnical Consultant’s approval for proposed control of water and dewatering methods.

D. Protect subgrades from softening, undermining, washout and damage by rain or water accumulation.

E. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations.

F. Maintain dewatering system in place until dewatering is no longer required.

3.03 WET WEATHER CONDITIONS

A. Do not prepare subgrade, place or compact soil materials if above optimum moisture content.

B. If the Geotechnical Consultant allows work to continue during wet weather conditions, conform to supplemental recommendations provided by the Geotechnical Consultant.

3.04 BRACING AND SHORING

A. Conform to California and Federal OSHA requirements.

B. Place and maintain such bracing and shoring as may be required to support the sides of the excavations for the proper protection of workmen; to facilitate the work; to prevent damage to the facility being constructed; and to prevent damage to adjacent structures or facilities. Remove all bracing and shoring upon completion of the work.

C. Be solely responsible for all bracing and shoring and, if requested by the Owner, submit details and calculations to the Owner. The Owner may forward the submittal to the Geotechnical Consultant, the Consulting Engineer and/or the California Division of Industrial Safety for their review. The Contractor's submittal shall include the basic design, assumed soils conditions and estimation of forces to be resisted, together with plans and specifications of the materials and methods to be used, and shall be prepared by a civil engineer or structural engineer registered in California. No excavations related to the proposed facility shall precede a response to the submittal by the Owner.

D. Be solely responsible for installing and extracting the sheathing in a manner which will not disturb the position or operation of the facility being constructed or adjacent utilities and facilities.

3.05 EXCAVATION

A. Excavate earth and rock to lines and grades shown on drawings and to the neat dimensions indicated on the Plans, required herein or as required to satisfactorily compact backfill.

B. Remove and dispose of large rocks, pieces of concrete and other obstructions encountered during excavation.

C. Where forming is required, excavate only as much material as necessary to permit placing and removing forms.

D. Provide supports, shoring and sheet piles required to support the sides of excavations or for protection of adjacent existing improvements.

3.06 REMOVAL OF EXISTING FILLS AND UNSUITABLE MATERIAL

A. Over-excavate areas of existing fills and other unsuitable material encountered during mass grading as directed by the Geotechnical Consultant.
B. Compensation for increased removal widths and depths that are not required by the Geotechnical Consultant will not be considered, except when such increase is necessary for protection of life and property as determined by and approved by the Owner.

C. The Geotechnical Consultant will provide written approval for each excavation prior to placement of fill. Allow adequate time after excavation and before filing for the Geotechnical Consultant's review and written approval and, if necessary, time for the Owner to conduct as-built survey prior to placing fill. Basis for calculating the quantity of material excavated or placed may be the difference between the grading shown on the Plan and an as-built survey of the grading.

3.07 GRADING

A. Uniformly grade the Project to the elevations shown on plans.

B. Finish ditches, gutters and swales to the sections, lines and grades indicated and to permit proper surface drainage.

C. Round tops and bottoms of slopes as indicated or to blend with existing contours.

3.08 SUBGRADE PREPARATION

A. Install underground utilities and service connections prior to final preparation of subgrade and placement of base materials for final surface facilities. Extend services so that final surface facilities are not disturbed when service connections are made.

B. Prepare subgrades under paved areas, curbs, gutters, walks, structures, other surface facilities and areas to receive structural fill.

C. Prepare subgrades for paved areas, curbs and gutters by plowing or scarifying surface at least 6 inches below final subgrade elevations and 5-feet beyond edge of pavement unless specified otherwise by the Geotechnical Consultant. Uniformly moisture condition to obtain optimum moisture contents. Break clods and condition surface by harrowing or dry rolling. Remove boulders, hard ribs and solid rock. Prepare earth uniform for full depth and width of subgrade.

D. Protect utilities from damage during compaction of subgrades and until placement of final pavements or other surface facilities.

E. Obtain the Geotechnical Consultant's approval of subgrades prior to placing pavement.

3.09 PLACEMENT OF STRUCTURAL FILL

A. Obtain the Geotechnical Consultant’s approval of surface to receive structural fill prior to placement of structural fill material.

B. Place structural fill on prepared subgrade.

C. Spread structural fill material in uniform lifts not more than 8-inches in un-compacted thickness and compact.

D. Place structural fill material to suitable elevations above grade to provide for anticipated settlement and shrinkage.

E. Overbuild fill slopes, as required by the Geotechnical Consultant, to obtain required compaction. Remove excess material to lines and grades indicated.

F. Do not drop fill on structures. Do not backfill around, against or upon concrete or masonry structures until structure has attained sufficient strength to withstand loads imposed and the horizontal structural system had been installed.

3.010 KEYWAYS AND BENCHES
A. Provide keyways as indicated for fill slopes steeper than 6 horizontal to 1 vertical. Extend keyway 5-feet minimum into competent, undisturbed soil or 3-feet minimum into competent, undisturbed rock as directed by the Geotechnical Consultant.

B. Place subsurface drains in bottom of keyway in conformance with Section 33 46 00 – Subdrainage.

C. Bench subgrade as indicated above toe of fill.

D. Place subsurface drains at benches every 20 vertical feet or as directed by the Geotechnical Consultant.

3.011 LOT FINISH GRADING

A. Blade finish lots to lines and grades indicated.

3.012 COMPACTION AND TESTING

A. Do not compact by ponding, flooding or jetting.

B. Compact soils at optimum water content. Aerate material if it is too wet. Add water to material if it is too dry. Thoroughly mix lifts before compaction to ensure uniform moisture distribution.

C. Perform compaction using rollers, pneumatic or vibratory compactors or other equipment and mechanical methods approved by the Geotechnical Consultant.

D. Compaction requirements:

1. Compact structural fills less than 5-feet thick to 90 percent compaction.

2. Compact structural fill 5-feet thick or greater to 95 percent compaction.

3. Compact the upper 6 inches of subgrade soils beneath pavements, curbs and gutters to 95 percent compaction. Extend compaction 5-feet beyond pavement edges unless specified otherwise by the Geotechnical Consultant.

4. Compact the upper 6-inches of subgrade soils under walks, structures and areas to receive structural fill to 90 percent compaction.

3.013 DISPOSAL

A. Lawfully dispose of all unsuitable and excess or surplus material off-site at no cost to the Owner.

END OF SECTION
PART 1 - GENERAL

1.01 SECTION INCLUDES
   A. Excavation, bedding, and backfill for underground storm drain, sanitary sewer, and water piping and associated structures.

1.02 SECTION EXCLUDES
   A. Drainage fill material and placement around subdrains.
   B. Trenching and backfill for other utilities such as underground HVAC piping, electrical conduit, telephone conduit, gas piping, cable TV conduit, etc.

1.03 RELATED SECTIONS
   A. Section 31 23 00 – Excavation and Fill
   B. Section 33 30 00 – Sanitary Sewerage
   C. Section 33 40 00 – Storm Drainage

1.04 RELATED DOCUMENTS
   A. Geotechnical Report.
   B. ASTM:
      1. C 33, Specification for Concrete Aggregates.
      7. D 2487, Classification of Soils for Engineering Purposes.
   D. Caltrans Standard Specifications:
1. Section 19, Earthwork.
2. Section 26, Aggregate Bases.
3. Section 68, Subsurface Drains.
4. Section 88, Engineering Fabrics.

E. CAL/OSHA, Title 8.
F. City of Vacaville Construction Standard CS 2, Trench Excavation.
G. City of Vacaville Construction Standard CS 3, Trench Foundation, Bedding and Backfill.

1.05 DEFINITIONS

A. AC: Asphalt Concrete.
C. Bedding: Material from bottom of trench to bottom of pipe.
D. CDF: Controlled Density Fill.
E. DIP: Ductile Iron Pipe.
F. Initial Backfill: Material from bottom of pipe to 12-inches above top of pipe.
G. PCC: Portland Cement Concrete.
H. RCP: Reinforced Concrete Pipe.
I. Springline of Pipe: Imaginary line on surface of pipe at a vertical distance of \( \frac{1}{2} \) the outside diameter measured from the top or bottom of the pipe.
J. Subsequent Backfill: Material from 12-inches above top of pipe to subgrade of surface material or subgrade of surface facility or to finish grade.
K. Trench Excavation: Removal of material encountered above subgrade elevations and within horizontal trench dimensions.

1. Authorized Trench Over-Excavation: Excavation below trench subgrade elevations or beyond indicated horizontal trench dimensions as shown on plans or authorized by the Geotechnical Consultant.

2. Unauthorized Trench Over-Excavation: Excavation below trench subgrade elevations or beyond indicated horizontal trench dimensions without authorization by the Geotechnical Consultant. Unauthorized excavation shall be without additional compensation.

L. Utility Structures:

1. Storm drainage manholes, catch basins, drop inlets, curb inlets, vaults, etc.

2. Sanitary sewer manholes, vaults, etc.

3. Water vaults, etc.

1.06 SUBMITTALS

A. Follow submittal procedures outlined in Section 01 33 00 – Submittal Procedures.

B. Product Data:
1. Grading and quality characteristics showing compliance with requirements for the Work.

2. Certify that material meets requirements of the Project.

C. Samples:

1. If required by the Geotechnical Consultant, provide 40-pound samples of all imported trench bedding and backfill material sealed in airtight containers, tagged with source locations and suppliers of each proposed material. Do not import materials to Project without written approval of the Geotechnical Consultant.

2. Provide materials from same source throughout work. Change of source requires approval of the Geotechnical Consultant and the Owner.

1.07 QUALITY ASSURANCE

A. Conform all work and materials to the recommendations or requirements of the Geotechnical Report and meet the approval of the Geotechnical Consultant.

B. Conform all work to the appropriate portion(s) of the Caltrans Standard Specifications, Section 19.

C. Percentage of compaction specified shall be the minimum acceptable. The percentage represents the ratio of the dry density of the compacted material to the maximum dry density of the material as determined by the procedure set forth in ASTM D 1557.

D. The Geotechnical Consultant will perform observations and tests required to enable him to form an opinion of the acceptability of the trench backfill. Correct the trench backfill that, in the opinion of the Geotechnical Consultant, does not meet the requirements of these Technical Specifications and the Geotechnical Report.

1.08 PROJECT CONDITIONS

A. Promptly notify the Owner of surface or subsurface conditions differing from those disclosed in the Geotechnical Report. First notify the Owner verbally to permit verification and extent of condition and then in writing. No claim for conditions differing from those anticipated in the Contract Documents and disclosed in the Geotechnical Report will be allowed unless Contractor has notified the Owner in writing of differing conditions prior to contractor starting work on affected items.

B. Protect open, trenches, and utility structure excavations with fences, covers and railings to maintain safe pedestrian and vehicular traffic passage.

C. Stockpile on-site and imported backfill material temporarily in an orderly and safe manner.

D. Provide dust and noise control in conformance with Section 02000, Supplemental General Requirements for Civil Improvements.
PART 2 - PRODUCTS

2.01 PIPE BEDDING AND INITIAL BACKFILL

A. ASTM D 2321, Class IA, IB or II.
   1. Clean and free of clay, silt or organic matter.

B. Permeable Material: Conform to Section 68-1.025 of Caltrans Standard Specifications, Class 1, Type A or Class 2.

C. Class 2 Aggregate Base: Conform to Section 26 of Caltrans Standard Specifications, ¾-inch maximum.


2.02 WARNING TAPE

A. See Section 33 10 00 – Water Utilities.

2.03 SUBSEQUENT BACKFILL

A. Conform to on-site or imported structural backfill in Section 31 23 00 – Excavation and Fill.

2.04 CONTROLLED DENSITY FILL (CDF) (IN TRENCHES)

A. Provide non-structural CDF, from bottom of trench to finish subgrade of subbase or base material, that can be excavated by hand and produce unconfined compressive 28-day strengths from 50-psi to a maximum of 150-psi. Provide aggregate no larger than 3/8-inch top size. The 3/8-inch aggregate shall not comprise more than 30% of the total aggregate content.

B. Cement: Conform to the standards as set forth in ASTM C-150, Type II Cement.

C. Fly Ash: Conform to the standards as set forth in ASTM C-618, for Class F pozzolan. Do not inhibit the entrainment of air with the fly ash.

D. Air Entraining Agent: Conform to the standards as set forth in ASTM C-260.

E. Aggregates need not meet the standards as set forth in ASTM C-33. Any aggregate, producing performances characteristics described herein will be accepted for consideration. The amount of material passing a #200 sieve shall not exceed 12% and no plastic fines shall be present.

F. Provide CDF that is a mixture of cement, Class F pozzolan, aggregate, air entraining agent and water. CDF shall be batched by a ready mixed concrete plant and delivered to the job site by means of transit mixing trucks.

G. The Contractor shall determine the actual mix proportions of the controlled density fill to meet job site conditions, minimum and maximum strengths, and unit weight. Entrained air content shall be a minimum of 4.0%. The actual entrained air content shall be established for each job with the materials and aggregates to be used to meet the placing and unit weight requirements. Entrained air content may be as high as 20% for fluidity requirements.

H. Mix design shall meet the Geotechnical Consultant’s approval.

2.05 CONCRETE STRUCTURE BEDDING AND BACKFILL

A. Precast Structures: Same materials to the same heights as specified for pipe bedding and backfill, or other material approved by the Geotechnical Consultant.

B. Poured-in-Place Structures:
   1. Bedding: Bedding shall meet the approval of the Geotechnical Consultant. In general, bedding is not required, pour bases against undisturbed native earth in cut areas and against engineered fill compacted to 90% relative compaction in embankment areas.
2. Side Backfill: On-site or imported structural fill meeting the requirements given in Section 31 23 00 – Excavation and Fill.

2.06 FILTER FABRIC

A. Filter Fabric:
   2. Mirifi 140N (Mirifi Inc., Charlotte, NC) (Tel. 800-438-1855) or equal.

PART 3 - EXECUTION

3.01 TRENCHING AND EXCAVATION

A. Existing PCC or AC Areas: Cut PCC or AC to full depth at a minimum distance of 12-inches beyond the edge of the trench.

B. Excavate by hand or machine. For gravity systems begin excavation at the outlet end and proceed upstream. Excavate sides of the trench parallel and equal distant from the centerline of the pipe. Hand trim excavation. Remove loose matter.

C. Excavation Depth for Bedding: Minimum of 4-inches below bottom of pipe or as otherwise allowed or required by the Geotechnical Consultant, except that bedding is not required for nominal pipe diameters of 2-inches or less.

D. Excavation Width at Springline of Pipe:
   1. Up to a nominal pipe diameter of 24-inches: Minimum of twice the outside pipe diameter, or as otherwise allowed or required by the Geotechnical Consultant.
   2. Nominal pipe diameter of 30-inches through 36-inches: Minimum of the outside pipe diameter plus 2-feet, or as otherwise allowed or required by the Geotechnical Consultant.
   3. Nominal pipe diameter of 42-inches through 60-inches: Minimum of the outside pipe diameter plus 3-feet, or as otherwise allowed or required by the Geotechnical Consultant.

E. Over-Excavations: Backfill trenches that have been excavated below bedding design subgrade, with approved bedding material.

F. Comply with the Owner’s limitations on the amount of trench that is opened or partially opened at any one time. Do not leave trenches open overnight without the approval of the Owner.

G. Where forming is required, excavate only as much material as necessary to permit placing and removal of forms.

H. Bottoms of trenches will be subject to testing by Geotechnical Consultant. Correct deficiencies as directed by the Geotechnical Consultant.

I. Grade bottom of trench to provide uniform thickness of bedding material and to provide uniform bearing and support for pipe along entire length. Remove stones to avoid point bearing.

3.02 CONTROL OF WATER AND DEWATERING

A. Be solely responsible for dewatering trenches and excavations and subsequent control of ground and surface water. Provide and maintain such pumps or other equipment as may be necessary to control ground water and seepage to the satisfaction of the Geotechnical Consultant and the Owner until backfilling is completed.

B. Dewater during backfilling operation so that groundwater is maintained a least one foot below level of compaction effort.
C. Obtain the Geotechnical Consultant's approval for proposed control of water and dewatering methods.

D. Reroute surface water runoff away from open trenches and excavations. Do not allow water to accumulate in trenches and excavations.

E. Maintain dewatering system in place until dewatering is no longer required.

3.03 BRACING AND SHORING

A. Conform to California and Federal OSHA requirements.

B. Place and maintain such bracing and shoring as may be required to support the sides of the excavations for the proper protection of workmen; to facilitate the work; to prevent damage to the pipes and appurtenances being constructed; and to prevent damage to adjacent structures or facilities. Remove all bracing and shoring upon completion of the work.

C. Be solely responsible for all bracing and shoring and, if requested by the Owner, submit details and calculations to the Owner. The Owner may forward the submittal to the Geotechnical Consultant, the Consulting Engineer and/or the California Division of Industrial Safety for their review. The Contractor's submittal shall include the basic design, assumed soils conditions and estimation of forces to be resisted, together with plans and specifications of the materials and methods to be used, and shall be prepared by a civil engineer or structural engineer registered in California. No excavations in trench section or around structures shall precede a response to the submittal by the Owner.

D. Be solely responsible for installing and extracting the sheathing in a manner which will not disturb the line, grade, or backfill compaction or operation of the utility being installed or adjacent utilities and facilities.

3.04 PIPE BEDDING

A. Obtain approval of bedding material from the Geotechnical Consultant.

B. Accurately shape bedding material to the line and grade called for on the Plans. Carefully place and compact bedding material to the elevation of the bottom of the pipe in layers not exceeding 8-inches in loose thickness. Compact bedding material at optimum water content to 90% relative compaction unless specified otherwise on the Plans or by the Geotechnical Consultant. Compact by pneumatic tampers or other mechanical means approved by the Geotechnical Consultant. Jetting or ponding of bedding material will not be permitted.

C. Upon completion of bedding operations, and prior to the installation of pipe, notify the Geotechnical Consultant, who will inspect the bedding layer. Do not commence pipe laying until the Geotechnical Consultant has approved the bedding.

3.05 WARNING TAPE

A. Install in accordance with Section 33 10 00 – Water Utilities.

3.06 BACKFILLING

A. Obtain approval of backfill material from Geotechnical Consultant.

B. Bring initial backfill up simultaneously on both sides of the pipe, so as to prevent any displacement of the pipe from its true alignment. Carefully place and compact initial backfill material to an elevation of 12-inches above the top of the pipe in layers not exceeding 8-inches in loose thickness. Compact bedding material at optimum water content to 90% relative compaction unless specified otherwise on the Plans or by the Geotechnical Consultant. Compact by pneumatic tampers or other mechanical means approved by the Geotechnical Consultant. Jetting or ponding of initial backfill material will not be permitted.

C. Bring subsequent backfill to subgrade or finish grade as indicated. Carefully place and compact subsequent backfill material to the proper elevation in layers not exceeding 8-inches in loose thickness. Compact bedding material at optimum water content to 90% relative compaction, except that the upper 36-inches in areas subject to vehicular
traffic shall be compacted to at least 95% relative compaction, unless specified otherwise on the Plans or by the Geotechnical Consultant. Compact by pneumatic tampers or other mechanical means approved by the Geotechnical Consultant. Jetting or ponding of subsequent backfill material will not be permitted.

D. Do not use compaction equipment or methods that produce horizontal or vertical earth pressures that may cause excessive pipe displacement or damage the pipe.

E. Utility backfill shall be inspected and tested by the Geotechnical Consultant during placement. Cooperate with the Geotechnical Consultant and provide working space for such tests in operations. Backfill not compacted in accordance with these specifications shall be re-compacted or removed as necessary and replaced to meet the specified requirements, to the satisfaction of the Geotechnical Consultant and the Owner prior to proceeding with the Project.

3.07 CLEANUP

A. Upon completion of utility earthwork all lines, manholes catch basins, inlets, water meter boxes and other structures shall be thoroughly cleaned of dirt, rubbish, debris and obstructions of any kind to the satisfaction of the Owner.

B. See Section 01 74 00 – Cleaning and Waste Management for further cleanup requirements.

END OF SECTION
SECTION 31 31 19

VEGETATION CONTROL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Application of soil sterilant on subgrades for roadways, driveways, parking areas, walks, paths, trails and any other site improvements called for on the plans.

1.02 RELATED SECTIONS

A. Section 31 23 00 – Excavation and Fill.

1.03 RELATED DOCUMENTS

A. CAL/OSHA, Title 8.

1.04 SUBMITTALS

A. Follow submittal procedures outlined in Section 01 33 00 – Submittal Procedures.

PART 2 - PRODUCTS

2.01 SOIL STERILANT

A. Commercial chemical for weed control, registered by EPA. Provide granular, liquid or wet-able powder form.

PART 3 - EXECUTION

3.01 SOIL STERILIZATION

A. Apply soil sterilant to areas indicated, such as beneath asphalt concrete pavement, brick pavement, concrete pavement and at grade concrete slabs, including sidewalks, curbs and gutters. Also where indicated apply soil sterilant below expansion and control joints and at areas where pipes, ducts or other features penetrate slabs.

B. Apply soil sterilant uniformly and at the rates recommended by the manufacturer.

C. Apply soil sterilant to prepared subgrade, or after installation of aggregate base as recommended by the manufacturer.

3.02 DISPOSAL

A. Lawfully dispose of all unsuitable and excess or surplus material off-site at no cost to the Owner.

END OF SECTION
SECTION 32 05 23
CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Materials for portland cement concrete.
B. Aggregate and aggregate grading for portland cement concrete.
C. Water for portland cement concrete.
D. Admixtures for portland cement concrete.
E. Proportioning for portland cement concrete.
F. Mixing and transporting portland cement concrete.
G. Formwork for cast in place portland cement concrete.
H. Embedded materials for portland cement concrete.
I. Steel reinforcement for portland cement concrete.
J. Placing and finishing portland cement concrete.
K. Curing portland cement concrete.
L. Protecting portland cement concrete.

1.02 RELATED SECTIONS

A. Section 31 23 00, Excavation and Fill
B. Section 31 31 19, Vegetation Control
C. Section 32 13 00, Rigid Paving
D. Section 32 16 13, Concrete Curbs and Gutters
E. Section 33 05 16, Utility Structures

1.03 RELATED DOCUMENTS

A. ASTM Standards
1. A 82, Cold Drawn Steel Wire for Concrete Reinforcement.
2. A 185, Steel Welded Wire Fabric, Plain for Concrete Reinforcement.
3. A 615, Deformed and Plain Billet Steel Bars, for Concrete Reinforcement.
7. C 618, Fly Ash and Raw or Calcined Natural Pozzolan for use as Natural Admixture in Portland Cement.

B. Caltrans Standard Specifications:
   1. Section 51: Concrete Structures.
   2. Section 73: Concrete Curbs and Sidewalks.

1.04 DEFINITIONS

1.05 SUBMITTALS
A. Follow submittal procedures outlined in Section 01 33 00 – Submittal Procedures.
B. Design Mixes: Have all concrete mixes designed by a testing laboratory and approved by the Consulting Engineer. Conform all mixes to the applicable building code requirement, regardless of other minimum requirements listed herein or on the drawings. Submit mix designs for review before use. Show proportions and specific gravities of cement, fine and coarse aggregate, and water and gradation of combined aggregates.

1.06 QUALITY ASSURANCE
A. Concrete shall be subject to quality assurance in accordance with Section 90 of the Standard Specifications.
   1. Slump tests: Have available, at job site, equipment required to perform slump tests. Make one slump test for each cylinder sample, from same concrete batch. Allowable maximum slump shall be 4 inches for walls and 3 inches for slabs on grade and other work.
B. Certifications:
   1. Provide Owner’s Representative at the time of delivery with certificates of compliance signed by both Contractor and Supplier containing the following statements:
   2. Materials contained comply with the requirements of the Contract Documents in all respects.
   3. Proportions and mixing comply with the design mix approved by the Consulting Engineer. Design mix shall have been field tested in accordance with the herein requirements of the Caltrans Standard Specifications and produces the required compressive strength under like conditions.
   4. Statement of type and amount of any admixtures.
   5. Provide Owner’s Representative, at time of delivery, with certified delivery ticket stating volume of concrete delivered and time of mixing, or time of load-out in case of transit mixers.
C. Conform to the applicable provisions of Section 51, 73 and 90 of the Caltrans Standard Specification and these Technical Specifications.
   1. Conform construction of portland cement concrete surface improvements (including curbs, gutters, medians, valley gutters, walks) to the requirements of Section 73 of the Caltrans Standard Specifications unless otherwise required in these Technical Specifications or shown on the Plans.
   2. Construct "V" ditches in accordance with Section 72-4 of the Standard Specifications; except that finishing shall be in accordance with Standard Specification Section 73 instead of 53, or as otherwise required in these Technical Specifications or shown on the Plans.
3. Conform other construction of portland cement concrete items to the requirements of Section 51 of the Caltrans Standard Specifications unless otherwise required in these Technical Specifications or shown on the Plans.

1.07 DESIGNATION

A. General: Whenever the 28-day compressive strength is designated herein or on the plans is greater than 3,600 psi, the concrete shall considered to be designated by compressive strength. The 28-day compressive strength shown herein or on the plans which are 3,600 psi or less are shown for design information only and are not considered a requirement for acceptance of the concrete. Whenever the concrete is designated by class or as minor concrete herein or on the plans, the concrete shall contain the cement per cubic meter shown in section 90-1.01 of the Caltrans Standard Specifications.

B. Unless specified otherwise herein or on the Plans, Portland Cement Concrete for this Project shall be Class “2” as specified in Section 90-1.01 of the Caltrans Standard Specifications.

PART 2 - PRODUCTS

2.01 PORTLAND CEMENT

A. General: Type V or type II (modified) cement conforming to the requirements of ASTM C 150, with the following modifications:

1. Cement shall not contain more than 0.60% by weight of alkalies, calculated as the percentage of Na₂O plus 0.658 times the percentage of K₂O when determined by either 4 intensity flame photometry or by the atomic absorption method. The instrument and procedure used shall be qualified as to precision and accuracy in accordance with the requirements of ASTM C 114.

2. The autoclave expansion shall not exceed 0.50%.

3. Mortar containing the Portland Cement to be used and the sand, when tested in accordance with Test Method No. Calif. 527, shall not expand in water more than 0.010% and shall have an air content less than .048%.

4. Allowable tri-calcium Aluminate (C₃A) by weight shall not exceed 5%. Allowable tetracalcium alumino ferrite plus twice the tricalcium aluminate (C₄AF+2C₃A) by weight shall not exceed 25%. The sulfate expansion test (ASTM C 452) may be used in lieu of the above chemical requirements, provided the sulfate expansion does not exceed 0.040% at 14 days (max.).

5. Contractor may substitute pozzolan for Portland Cement in amounts up to 15% of the required mix unless high early strength concrete is specified. Pozzolan shall consist of Class F Fly Ash meeting the requirements of ASTM C 618.

2.02 AGGREGATE AND AGGREGATE GRADING

A. General: Conform to the requirements of Section 90-2.02, 2.02A and 2.02B of the Caltrans Standard Specifications.

B. Aggregate Size and Gradation: Conform to the requirements of section 90-3 of the Caltrans Standard Specifications for 25-mm (1-inch) maximum combined aggregate.

2.03 WATER

A. General: Conform to the requirements of section 90-2.03 of the Caltrans Standard Specifications, for mixing and curing portland cement concrete and for washing aggregates.

2.04 CLASSIFICATION OF PORTLAND CEME
A. Concrete for the following items shall be designated by the following classes per Section 90-1.01 of the Caltrans Standard Specifications:

2. Curbs, Gutters, and Sidewalks: Minor Concrete.
3. Cast in place Concrete Pipe: The concrete shall consist of a minimum of 564 pounds of Portland cement per cubic yard of concrete.
4. Thrust Blocks: The concrete shall have a minimum compressive strength of 3,000 psi.
5. Sign and Fence Footings: The concrete shall consist of a minimum of 376 pounds of Portland cement per cubic yard of concrete.

2.05 EXPANSION JOINT MATERIAL

A. Material for expansion joints in Portland cement concrete improvements shall be premolded expansion joint fillers conforming to the requirements of ASTM Designation D 1751. Expansion joint material shall be shaped to fit the cross section of the concrete prior to being placed. Suppliers certificates showing conformance with this specification shall be delivered with each shipment of materials delivered to the job site. Unless noted otherwise herein or on the Plans expansion joint thickness shall be as follows:

2. Concrete Slope Protection, Gutter Lining, Ditch Lining and Channel Lining: ½-inch.
3. Structures: As indicated.

2.06 REINFORCEMENT AND DOWELS

A. Bar reinforcement for concrete improvements shall be deformed steel bars of the size or sizes called for on the plans conforming to the requirements of ASTM Designation A 615 for Grade 60 bars. Size and shape for bar reinforcement shall conform to the details shown or called for on the Plans. Substitution of wire mesh reinforcement for reinforcing bars will not be allowed.

B. Slip dowels, where noted or called for on the plans or detail drawings shall be smooth billet-steel bars as designated and conforming to the requirements of ASTM Designation A 615 for Grade 60 bars. Ends of bars inserted in new work shall be covered with a cardboard tube sealed with cork; no grease or oil shall be used.

C. Mesh for reinforcement for concrete improvements shall be cold drawn steel wire mesh of the size and spacing called for on the plans conforming to the requirements of ASTM Designation A 82 for the material and ASTM Designation A 185 for the mesh. Size and extent of mesh reinforcement shall conform to the details shown or called for on the plans.

D. Tie wire for reinforcement shall be eighteen (18) gauge or heavier, black, annealed conforming to the requirements of ASTM Designation A 82.

E. Suppliers certificates showing conformance with this specification shall be delivered with each shipment of materials delivered to the job site.

2.07 ACCESSORY MATERIALS

A. Conform water stops and other items required to be embedded in of Portland Cement Concrete structures to the applicable requirements of Section 51 of the Caltrans Standard Specifications unless otherwise specifically noted or called for on the Plans or detail drawings.
B. Curing Compounds:

1. Regular Portland Cement Concrete: "Non-Pigmented Curing Compound - chlorinated Rubber Base-Clear" conforming to the requirements contained in Section 90-7.01B, of the Caltrans Standard Specifications.

2. Color Conditioned Decorative Portland Cement Concrete: LITHOCHROME colorwax as manufactured by the L. M. Scofield Company or approved equal.

2.08 FORMS

A. Conform to the requirements of Section 51-1.05 of the Caltrans Standard Specifications.

2.09 PRECAST CONCRETE STRUCTURES

A. Conform to the following Sections of Caltrans Standard Specifications:

1. 51-1.02, Minor Structures.

2. 70-1.02C, Flared End Sections.

3. 70-1.02H, Precast Concrete Structures.

2.010 PORTLAND CEMENT CONCRETE VEHICULAR PAVEMENT

A. General: See Section 32 13 00 – Rigid Paving.

PART 3 - EXECUTION

3.01 STRUCTURAL EXCAVATION

A. Structural excavation may be either by hand, or by machine and shall be neat to the line and dimension shown or called for on the plans. Excavation shall be sufficient width to provide adequate space for working therein, and comply with CAL-OSHA requirements.

B. Where an excavation has been constructed below the design grade, refill the excavation to the bottom of the excavation grade with approved material and compact in place to 95% of the maximum dry density.

C. Remove surplus excavation material remaining upon completion of the work from the job site, or condition it to optimum moisture content and compact it as fill or backfill on the site, if the material is approved by the Geotechnical Consultant.

3.02 SOIL STERILANT

A. Furnish and apply to areas indicated in accordance with Section 31 31 19 – Vegetation Control.

3.03 BRACING AND SHORING

A. Conform to California and Federal OSHA requirements.

B. Place and maintain such bracing and shoring as may be required to support the sides of the excavations for the proper protection of workmen; to facilitate the work; to prevent damage to the facility being constructed; and to prevent damage to adjacent structures or facilities. Remove all bracing and shoring upon completion of the work.

C. Be solely responsible for all bracing and shoring and, if requested by the Owner’s Representative, submit details and calculations to the Owner’s Representative. The Owner’s Representative may forward the submittal to the Geotechnical Consultant, the Consulting Engineer and/or the California Division of Industrial Safety for their review. The Contractor’s submittal shall include the basic design, assumed soils conditions and estimation of forces to be
resisted, together with plans and specifications of the materials and methods to be used, and shall be prepared by a civil engineer or structural engineer registered in California. No excavations related to the proposed facility shall precede a response to the submittal by the Owner’s Representative.

D. Be solely responsible for installing and extracting the sheathing in a manner which will not disturb the position or operation of the facility being constructed or adjacent utilities and facilities.

3.04 PLACING CONCRETE FORMS

A. Form concrete improvements with a smooth and true upper edge. Side of the form with a smooth finish shall be placed next to concrete. Construct forms rigid enough to withstand the pressure of the fresh concrete to be placed without any distortion.

B. Thoroughly clean all forms prior to placement and coat forms with an approved form oil in sufficient quantity to prevent adherence of concrete prior to placing concrete.

C. Carefully set forms to the alignment and grade established and conform to the required dimensions. Rigidly hold forms in place by stakes set at satisfactory intervals. Provide sufficient clamps, spreaders and braces to insure the rigidity of the forms.

D. Provide forms for back and face of curbs, lip of gutters and edge of walks, valley gutters or other surface slabs that are equal to the full depth of the concrete as shown, noted or called for on the Plans. On curves and curb returns provide composite forms made from benders or thin planks of sufficient ply to ensure rigidity of the form.

3.05 PLACING STEEL REINFORCEMENT

A. Bars shall be free of mortar, oil, dirt, excessive mill scale and scabby rust and other coatings of any character that would destroy or reduce the bond. All bending shall be done cold, to the shapes shown on the plans. The length of lapped splices shall be as follows:

1. Reinforcing bars No. 8, or smaller, shall be lapped at least 45 bar diameters of the smaller bar joined, and reinforced bars Nos. 9, 10, and 11 shall be lapped at least 60 bar diameters of the smaller bars joined, except when otherwise shown on the plans.

2. Splice locations shall be made as indicated on the plans.

B. Accurately place reinforcement as shown on the plans and hold firmly and securely in position by wiring at intersections and splices, and by providing precast mortar blocks or ferrous metal chairs, spacers, metal hangers, supporting wires, and other approved devices of sufficient strength to resist crushing under applied loads. Provide supports and ties of such strength and density to permit walking on reinforcing without undue displacement.

C. Place reinforcing to provide the following minimum concrete cover:

1. Surfaces exposed to water: 4-inches.

2. Surfaces poured against earth: 3-inches.

3. Formed surfaces exposed to earth or weather: -inches.

4. Slabs, walls, not exposed to weather or earth: 1-inch.

D. Minimum spacing, center of parallel bars shall be two and one half (2-1/2) times the diameter of the larger sized bar. Accurately tie reinforcing securely in place prior to pouring concrete. Placing of dowels or other reinforcing in the wet concrete is not permitted.

3.06 MIXING AND TRANSPORTING PORTLAND CEMENT CONCRETE

A. Transit mix concrete in accordance with the requirements of ASTM Designation C94. Transit mix for not less than ten (10) minutes total, not less than three (3) minutes of which shall be on the site just prior to pouring. Mix
continuous with no interruptions from the time the truck is filled until the time it is emptied. Place concrete within one hour of the time water is first added unless authorized otherwise by the Owner’s Representative.

B. Do not hand mix concrete for use in concrete structures.

3.07 PLACING PORTLAND CEMENT CONCRETE

A. Thoroughly wet subgrade when concrete is placed directly on soil. Remove all standing water prior to placing concrete.

B. Do not place concrete until the subgrade and the forms have been approved.

C. Convey concrete from mixer to final location as rapidly as possible by methods that prevent separation of the ingredients. Deposit concrete as nearly as possible in final position to avoid re-handling.

D. Place and solidify concrete in forms without segregation by means of mechanical vibration or by other means as approved by the Owner’s Representative. Continue vibration until the material is sufficiently consolidated and absent of all voids without causing segregation of material. The use of vibrators for extensive shifting of fresh concrete will not be permitted.

E. Concrete in certain locations may be pumped into place upon prior approval by the Owner's Representative. When this procedure requires redesign of the mix, such redesign shall be submitted for approval in the same manner as herein specified for approval of design mixes.

3.08 PLACING ACCESSORY MATERIALS

A. Place water stops and other items required to be embedded in Portland cement concrete structures at locations shown or required in accordance with Section 51 of the Caltrans Standard Specifications unless otherwise specifically noted or called for on the Plans.

B. Curing Compounds:
   1. Regular Portland Cement Concrete: Apply "Non-Pigmented Curing Compound - chlorinated Rubber Base-Clear" in accordance with Section 90-7.01B, 7.01D and 7.03 of the Caltrans Standard Specifications.

3.09 EXPANSION JOINTS

A. Construct expansion joints incorporating premolded joint fillers at twenty (20) foot intervals in all concrete curbs, gutters, sidewalks, median/island paving, valley gutters, driveway approaches and at the ends of all returns. At each expansion joint install one-half inch by twelve inch (1/2" x 12") smooth slip dowels in the positions shown or noted on the detail drawings.

B. Orient slip dowels at right angles to the expansion joint and hold firmly in place during the construction process by means of appropriate chairs.

3.010 WEAKENED PLANE JOINTS

A. Construct weakened plane joints in concrete curbs, gutters, sidewalks, median/island paving and valley gutters between expansion joints at ten (10) foot intervals throughout, or as otherwise indicated. Depth of joint score depth to be one-fourth (25%) the thickness of the concrete.
   1. Grooved Joints: Form weakened plane joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8-inch. Repeat grooving of weakened plane joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

3.011 FINISHING CONCRETE

A. Finish curb and gutter in conformance with the applicable requirements of Section 73-1.04 and 73-1.05A of the Caltrans Standard Specifications as modified herein.
B. Where monolithic curb, gutter and sidewalk is specified, separate concrete pours will not be allowed.
C. Provide a medium broom finish to all horizontal surfaces unless otherwise shown.

3.012 FORM REMOVAL
A. Remove forms without damage to the concrete. Remove all shores and braces below the ground surface, before backfilling.
B. Do not backfill against concrete until the concrete has developed sufficient strength to prevent damage.
C. Leave forms for cast-in-place walls in place at least 72 hours after pouring.
D. Leave edge forms in place at least 24 hours after pouring.

3.013 CONSTRUCTION
A. Form, place and finish concrete walkways, island paving, valley gutters and driveway approaches in conformance with the applicable requirements of Section 73-1.04 and 73-1.06 of the Caltrans Standard Specifications as modified herein.
B. Construct new concrete curb, curb and gutter and valley gutters against existing asphalt concrete by removing a minimum of 12-inches of the asphalt concrete to allow placement of curb or gutter forms. Patch pavement with a 6-inch deep lift of asphalt concrete after gutter form is removed.

3.014 CONNECTING TO EXISTING CONCRETE IMPROVEMENTS
A. New curb, gutter, or sidewalk is to connect to existing improvements to remain by saw cutting to existing sound concrete at the nearest score line, expansion joint or control joint. Drill and insert ½-inch diameter by 12-inch long dowels at 24-inches on center into existing improvements. Install pre-molded expansion joint filler at the matching joint.
B. A cold joint to the existing curb is not acceptable.

3.015 DECORATIVE SURFACING CONSTRUCTION
A. Decorative surfacing concrete walks, concrete median islands or other installations shall be formed and placed as a concrete slab conforming to the details shown or noted on the Plans.

3.016 FIELD QUALITY CONTROL
A. Finish subgrade for concrete improvements shall be subject to approval prior to placement of forms.
B. No concrete shall be placed prior to approval of forms.
C. Concrete improvements constructed shall not contain "bird baths" or pond water and shall be smooth and ridge free.
D. Conform the finish grade at top of curb, flow line of gutter, and the finish cross section of concrete improvements to the design grades and cross sections.
E. Variation of concrete improvements from design grade and cross section as shown or called for on the plans shall not exceed the tolerances established in Sections 73-1.05 and/or 73-1.06 of the Caltrans Standard Specifications.

3.017 RESTORATION OF EXISTING IMPROVEMENTS
A. Replace in kind all pavement or other improvements removed or damaged due to the installation of concrete improvements.
B. Remove, landscaping or plantings damaged or disturbed due to the installation of concrete improvements.
Replace in kind.

END OF SECTION
PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Aggregate subbase.
B. Aggregate base.

1.02 RELATED SECTIONS

A. Section 31 23 00 – Excavation and Fill
B. Section 32 12 00 – Flexible Paving
C. Section 32 13 00 – Rigid Paving

1.03 RELATED DOCUMENTS

A. Geotechnical Report.
B. ASTM:
   1. D 3740, Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
C. Caltrans Standard Specifications:
   1. Section 24, Lime Stabilization.
   2. Section 25, Aggregate Subbases.
   3. Section 26, Aggregate Bases.
   4. Section 27, Cement Treated Bases.

1.04 DEFINITIONS

A. Geotechnical Testing Agency: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock definition testing, as documented according to ASTM D 3740 and ASTM E 548.
B. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material ¾-cubic yards or more in volume that when tested by an independent geotechnical testing agency, according to ASTM D 1586, exceeds a standard penetration resistance of 100 blows/2-inches.
C. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man made stationary features constructed above or below grade.
D. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, base or topsoil materials.

1.05 SUBMITTALS
A. Follow submittal procedures outlined in Section 01 33 00 – Submittal Procedures.
B. Submit material certificates signed by the material producer and the Contractor, certifying that each material item complies with, or exceeds the specified requirements.

1.06 QUALITY ASSURANCE
A. Conform all work and materials to the recommendations or requirements of the Geotechnical Report and meet the approval of the Geotechnical Consultant.
B. Percentage of compaction specified shall be the minimum acceptable. The percentage represents the ratio of the dry density of the compacted material to the maximum dry density of the material as determined by the procedure set forth in ASTM D 1557.
C. Perform installation of base materials under the observation of the Geotechnical Consultant. Materials placed without approval of the Geotechnical Consultant shall be removed and replaced at no cost to the Owner. Notify the Geotechnical Consultant at least 24-hours prior to commencement of base material installation and at least 48 hours prior to testing.
D. Do not mix or place cement treated base when the temperature is below 36 degrees F or when the ground is frozen.
E. Finish surface of material to be stabilized prior to lime treatment shall be as specified in Section 24-1.04 of Caltrans Standard Specifications.
F. Finish surface of the stabilized material after lime treatment shall be as specified in Section 24-1.08 of Caltrans Standard Specifications.
G. Finish surface of cement treated base shall be as specified in Section 27 of Caltrans Standard Specifications.
H. Do not project the finish surface of aggregate subbase above the design subgrade.
I. Finish grade tolerance at completion of base installation: +0.05

1.07 PROJECT CONDITIONS
A. Protect open excavations, trenches, and the like with fences, covers and railings to maintain safe pedestrian and vehicular traffic passage.
B. Temporarily stockpile material in an orderly and safe manner and in a location approved by the Owner.
C. Provide dust and noise control in conformance with Division 1 General Requirements.

PART 2 - PRODUCTS

2.01 AGGREGATE SUBBASE
   1. Class 1, 2, or 3: Section 25-1.02A.
   2. Class 4: Section 25-1.02B.
   3. Class 5: Section 25-1.02C.

2.02 AGGREGATE BASE
1. Class 2, 1-1/2-inch Maximum: Section 26-1.02A.
2. Class 2, 3/4-inch Maximum: Section 26-1.02A.
3. Class 3: Section 26-1.02B.

PART 3 - EXECUTION

3.01 GENERAL
   A. Placement and compaction of material by flooding, ponding, or jetting will not be permitted.

3.02 WET WEATHER CONDITIONS
   A. Do not place or compact subgrade if above optimum moisture content.
   B. If the Geotechnical Consultant allows work to continue during wet weather conditions, conform to supplemental recommendations provided by the Geotechnical Consultant.

3.03 AGGREGATE SUBBASE
   A. Spreading and Compacting: Sections 25-1.04 and 25-1.05 of Caltrans Standard Specifications.

3.04 AGGREGATE BASE
   A. Watering, Spreading and Compacting: Section 26-1.035, 26-1.04 and 26-1.05 of Caltrans Standard Specifications.

3.05 DISPOSAL
   A. Lawfully dispose of all unsuitable and excess or surplus material off-site at no cost to the Owner.

END OF SECTION
PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnishing, placing, spreading, compacting and shaping portland cement concrete pavement with undoweled transverse weakened plane joints, for vehicular traffic.

B. Form construction and use in placing portland cement concrete pavement.

C. Joints for portland cement concrete pavement.

D. Finishing portland cement concrete pavement.

E. Curing and protecting portland cement concrete pavement.

1.02 RELATED SECTIONS

A. Section 31 31 19 – Vegetation Control

B. Section 32 05 23 – Cement and Concrete for Exterior Improvements

1.03 RELATED DOCUMENTS

A. Geotechnical Report.

B. AASHTO Standard Specifications

1. T 53: Softening Point of Bitumen (Ring-and-Ball Apparatus).

C. ASTM Standards

1. A 615: Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

2. A 775: Epoxy Coated Reinforcing Steel Bars.

3. A 934: Epoxy-Coated Prefabricated Steel Reinforcing Bars.


6. D 2835: Lubricant for Installation of Preformed Compression Seals in Concrete Pavements.

7. D 3405: Joint Sealants, Hot Poured, for Concrete and Asphalt Pavements.

8. D 3963: Fabrication and Jobsite Handling of Epoxy-Coated Reinforcing Steel.

D. Caltrans Standard Specifications:

1. Section 40, Portland Cement Concrete Pavement.

2. Section 52, Reinforcement.

3. Section 90, Portland Cement Concrete.

4. Section 95, Epoxy.
E. Caltrans Standard Plans:
   2. Plan A35C: Portland Cement Concrete Pavement Joint and End Anchor Details.

1.04 DEFINITIONS

A. AASHTO: American Association of State Highway and Transportation Officials.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
   1. Manufacturer must be certified according to the National Ready Mix Concrete Plant Certification Program.

B. Installer Qualification: An experienced installer who has completed pavement work similar in material, design and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer’s plant and each aggregate from one source.

1.06 SUBMITTALS

A. Follow submittal procedures outlined in Section 01 33 00 – Submittal Procedures.
B. Design Mixes: For each concrete pavement mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results or other circumstances warrant adjustments.
C. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements.
   1. Cementitious materials and aggregates.
   2. Steel reinforcement and reinforcement accessories.
   3. Admixtures.
   4. Curing compound.
   5. Applied finish material.
   7. Joint filler.
   10. Epoxy.
PART 2 - PRODUCTS

2.01 PORTLAND CEMENT CONCRETE
   A. General: Conform to Caltrans Standard Specifications, Section 90. Use Class 2 Concrete.

2.02 TIE BARS
   A. Deformed reinforcing steel bars conforming to the requirements of ASTM Designation A615/A (615M), Grade 40 or 60 (Grade 300 or 420).
   B. Epoxy-coat in conformance with the provisions in Section 52-1.02B of Caltrans Standard Specifications, except that references made to ASTM Designation D 3963/D 3963M shall be deemed to mean ASTM Designation A 934/A 934M or A 775/775M.
   C. Do not bend tie bars.

2.03 EPOXY
   A. Bond tie bars to existing concrete with epoxy resin conforming to Section 95-2.03, "Epoxy Resin Adhesive for Bonding New Concrete to Old Concrete," of the Caltrans Standard Specifications.

2.04 SILICONE JOINT SEALANT
   A. Furnish low modulus silicone joint sealant in a one-part silicone formulation. Do not use acid cure sealants. Compound to be compatible with the surface to which it is applied and conform to the following requirements:
   B. Formulate the silicon joint sealant to cure rapidly enough to prevent flow after application on grades of up to 15 percent.
C. Furnish to the Owner a Certificate of Compliance. Accompany certificate with a certified test report of the results of the required tests performed on the sealant material within the previous 12 months prior to proposed use. Provide the certificate and accompanying test report for each lot of silicone joint sealant prior to use on the project.

2.05 ASPHALT RUBBER JOINT SEALANT

A. Conform to the requirements of ASTM Designation: D 3405 as modified herein or to the following:

1. Provide a mixture of paving asphalt and ground rubber. Ground rubber to be vulcanized or a combination of vulcanized and de-vulcanized materials ground so that 100 percent will pass a 2.36-mm sieve and contain not less than 22 percent ground rubber, by mass. Modifiers may be used to facilitate blending.

2. The Ring and Ball softening point shall be 57°C minimum, when tested in conformance with the requirements in AASHTO Designation: T 53.

3. Provide asphalt rubber sealant material capable of being melted and applied to cracks and joints at temperatures below 204°C.

B. The penetration requirement of Section 4.2 of ASTM Designation: D 3405 do not apply. The required penetration at 25°C, 150g, 5s, shall not exceed 120.
C. The resilience requirement of Section 4.5 of ASTM Designation: D 3405 do not apply. The required resilience, when tested at 25°C, shall have a minimum of 50 percent recovery.

D. Accompany each lot of asphalt rubber joint sealant shipped to the job site, whether as specified herein or conforming to the requirements of ASTM Designation D 3405, as modified herein, by a Certificate of Compliance, storage and heating instructions and precautionary instructions for use.

E. Heat and place in conformance with the manufacturer's written instructions and the details shown on the plans. Provide manufacturer's instructions to the Owner. Do not place when the pavement surface temperature is below 10°C.

2.06 PREFORMED COMPRESSION JOINT SEALANT

   1. Number of cells: 5 or 6.
   3. Install compression seals along with lubricant adhesive according to the manufacturer's recommendations. Submit manufacturer's recommendations to the Owner's Representative.

B. Accompany each lot of compression seal and lubricant adhesive by a Certificate of Compliance, storage instructions and precautionary instructions for use. Also submit the manufacturer's data sheet with installation instructions and recommended model or type of preformed compression seal for the joint size and depth as shown on the plans. Show evidence that the selected seal is being compressed at level between 20 and 50 percent at all times for the joint width and depth shown on the plans.

2.07 BACKER RODS

A. Provide backer rods that have a diameter prior to placement at least 25 percent greater than the width of the saw cut after sawing and are expanded, crosslinked, closed-cell polyethylene foam that is compatible with the joint sealant so that no bond, adverse reaction occurs between the rod and sealant. In no case use a hot pour sealant that will melt the backer rod. Submit a manufacturer's data sheet verifying that the backer rod is compatible with the sealant to be used.

PART 3 - EXECUTION

3.01 WATER SUPPLY

A. Conform to Section 40-1.02 of Caltrans Standard Specifications.

3.02 SUBGRADE

A. Conform to Section 40-1.04 of Caltrans Standard Specifications.

3.03 SOIL STERILANT

A. Furnish and apply to areas indicated in accordance with Section 31 31 19 – Vegetation Control.

3.04 PLACING

A. Conform to Section 40-1.06 of Caltrans Standard Specifications.

3.05 SPREADING COMPACTING AND SHAPING

A. Conform to Section 40-1.07 of Caltrans Standard Specifications.

3.06 INSTALLING TIE BARS

A. Install at longitudinal contact joints, longitudinal weakened plane joints, and transverse contact joints as shown on the plans. In no case, shall any consecutive width of new Portland cement concrete pavement tied together with tie bars exceed 15 meters. In no case shall tie bars be used at a joint where Portland cement concrete and asphalt concrete pavements abut.

B. Tie bars shall be installed at longitudinal joints by one of the three following methods:

1. Drilling and bonding in conformance with the details shown on the plans. Provide a two-component, epoxy resin, conforming to the requirements of ASTM Designation: C 881, Type V. Grade 3 (Non-Sagging). Class shall be as follows:

<table>
<thead>
<tr>
<th>Temperature of Concrete</th>
<th>Required Class of Epoxy Resin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower than 40° F (4.5 °C)</td>
<td>A</td>
</tr>
<tr>
<td>40° F (4.5 °C) through 60° F (15.5 °C)</td>
<td>B</td>
</tr>
<tr>
<td>Above 60° F (15.5 °C)</td>
<td>C</td>
</tr>
</tbody>
</table>

2. Provide, at least 7 days prior to start of work, a Certificate of compliance and a copy of the manufacturer's recommended installation procedure. The drilled holes shall be cleaned in accordance with the epoxy manufacturer's instructions and shall be dry at the time of placing the epoxy and tie bars. Immediately after inserting the tie bars into the epoxy, the tie bars shall be supported as necessary to prevent movement during the curing and shall remain undisturbed until the epoxy has cured a minimum time as specified by the manufacturer. Tie bars that are improperly bonded, as determined by the Owner, will be rejected. If rejected, adjacent new holes shall be drilled, as directed by the Owner, and new tie bars shall be placed and securely bonded to the concrete. All work necessary to correct improperly bonded tie bars shall be performed at the Contractor's expense.

3. Insert the tie bars into the plastic slip-formed concrete before finishing the concrete. Inserted tie bars shall have full contact between the bar and the concrete. When tie bars are inserted through the pavement surface, the concrete over the tie bars shall be reworked and refinished to such an extent that there is no evidence on the surface of the completed pavement that there has been any insertion performed. Any loose tie bars shall be replaced by drilling and grouting into place with epoxy as described in method 1 above at the Contractor's expense.

4. By using threaded dowel splice couplers fabricated from deformed bar reinforcement material, free of external welding or machining. Threaded dowel splice couplers shall be accompanied by a Certificate of Compliance and installation instructions. Installation of threaded dowel splice couplers shall conform to the requirements of the manufacturer's recommendations.

3.07 JOINTS

A. Conform to Section 40-1.08 of Caltrans Standard Specifications, Except that tie bars shall be as specified under Part 2, Products.

1. Transverse Contact Joints: Section 40-1.08A of Caltrans Standard Specifications.

a. Construct a transverse contact (construction) joint at the end of each day's work, or where concrete placement is interrupted for more than 30 minutes, to coincide with the next weakened plane joint location.

b. If sufficient concrete has not been mixed to form a slab to match the next weakened plane joint, when an interruption occurs, the excess concrete shall be removed and disposed of back to the last preceding joint. The cost of removing and disposing of any excess concrete
shall be at the Contractor's expense. Any excess material shall be become the property of the Contractor and shall be properly disposed of.

c. A metal or wooden bulkhead (header) shall be used to form the joint. The bulkhead shall be designed to accommodate the installation of tie bars.

2. Weakened Plane Joints: Section 40-1.08B, except that the insert method of forming joints in pavement shall not be used.

3.08 FINISHING

A. Conform to Sections 40-1.09 and 40-1.10 of Caltrans Standard Specifications.

3.09 CURING

A. Conform to Section 40-1.11 of Caltrans Standard Specifications.

3.010 SEALING JOINTS

A. Liquid Joint Sealant Installation.

1. The joint sealant detail for transverse and longitudinal joints, as shown on the plans, shall apply only to weakened plane joints. Construct weakened plane joints by the sawing method. Should grinding or grooving be required over or adjacent to any joint after sealant has been placed, completely remove the joint material and disposed of, and replace at the Contractor's expense. Recess sealant below the final finished surface as shown on the plans.

2. At the Contractor's option, transverse weakened plane joints shall be either Type DSC or Type SSC as shown on the plans. Longitudinal weakened plane joints shall be Type SSC only as shown on the plans.

3. Seven days after the concrete pavement placement and not more than 4 hours before placing backer rods and joint sealant materials, clean the joint walls by the dry sand blast method and other means as necessary to completely remove from the joint all objectionable material such as soil, asphalt, curing compound, paint and rust. After cleaning the joint, remove all traces of sand, dust and loose material from and near the joint for a distance along the pavement surfaces of at least 50 mm on each side of the joint by the use of a vacuum device. Remove surface moisture at the joints by means of compressed air or moderate hot compressed air or other means approved means. Do not use drying procedures that leave a residue or film on the joint walls. Sandblasting equipment shall have a maximum nozzle diameter size of 6 ± 1 mm and a minimum pressure of 0.62-MPa.

4. Install backer rod as shown on the plans. Provide an expanded, closed-cell polyethylene foam backer rod that is compatible with the joint sealant so that no bond or adverse reaction occurs between the rod and sealant. Install backer rod when the temperature of the portland cement concrete pavement is above the dew point of the air and when the air temperature is 4°C or above. Install backer rod when the joints to be sealed have been properly patched, cleaned and dried. Do not use a method of placing backer rod that leave a residue or film on the joint walls.

5. Immediately after placement of the backer rod, place the joint sealant in the clean, dry, prepared joints as shown on the plans. Apply the joint sealant by a mechanical device with a nozzle shaped to fit inside the joint to introduce the sealant from inside the joint. Apply adequate pressure to the sealant to ensure that the sealant material is extruded evenly and that full continuous contact is made with the joint walls. After application of the sealant recess the surface of the sealant as shown on the plans.

6. Any failure of the joint material in either adhesion or cohesion of the material will be cause for rejection of the joint. Conform the finished surface of joint sealant to the dimensions and allowable tolerances shown on the plans. Rejected joint materials or joint material whose finished surface does not conform to the dimensions shown on the plans shall be repaired or replaced, at the Contractor's expense, with joint material that conforms to the requirements.
7. After each joint is sealed, remove all surplus joint sealer on the pavement surface. Traffic shall not be permitted over the sealed joints until the sealant is tack free and set sufficiently to prevent embedment of roadway debris into the sealant.

B. Preformed Compression Joint Seal Installation

1. The compression seal alternative joint detail for transverse and longitudinal joints, as shown on the plans, shall apply only to weakened plane joints. Construct weakened plane joints by the sawing method. Should grinding or grooving be required over or adjacent to any joint after the compression seal has been placed, completely remove the joint materials and disposed of, and replace at the Contractor's expense. Compression seal shall be recessed below the final finished surface as shown on the plans.

2. At the Contractor's option, transverse weakened plane joints shall be either Type DSC or Type SSC as shown on the plans. Longitudinal weakened plane joints shall be Type SSC only as shown on the plans.

3. Seven days after the concrete pavement placement and not more than 4 hours before placing preformed compression joint seals, the joint walls by the dry sand blast method and other means as necessary to completely remove from the joint all objectionable material such as soil, asphalt, curing compound, paint and rust. After cleaning the joint, remove all traces of sand, dust and loose material from and near the joint for a distance along the pavement surfaces of at least 50 mm on each side of the joint by the use of a vacuum device. Remove surface moisture at the joints by means of compressed air or moderate hot compressed air or other means. Do not use drying procedures that leave a residue or film on the joint wall. Sandblasting equipment shall have a maximum nozzle diameter size of 6 ± 1 mm and a minimum pressure of 0.62-MPa.

### PROTECTING CONCRETE PAVEMENT

#### A. Conform to Section 40-1.12 of Caltrans Standard Specifications.

END OF SECTION
PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Portland Cement Concrete curbs and gutters.

1.02 RELATED SECTIONS

A. Section 31 23 00 – Excavation and Fill
B. Section 31 31 19 – Vegetation Control
C. Section 32 11 00 – Base Courses
D. Section 32 13 00 – Rigid Paving
E. Section 32 05 23 – Cement and Concrete for Exterior Improvements

1.03 RELATED DOCUMENTS

A. American Concrete Institute (ACI):
   1. ACI 301 - Specifications for Structural Concrete for Buildings.
   2. ACI 308 - Standard Practice for Curing Concrete.
B. American society for Testing and Materials (ASTM):
   1. ASTM A 185 - Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement.
   2. ASTM A 615 - Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
C. Caltrans Standard Specifications:
   1. Section 73: Concrete Curbs and Sidewalks.
   2. Section 90: Portland Cement Concrete.

1.04 DEFINITIONS

A. ASTM: American Society for Testing Materials

1.05 SUBMITTALS

A. Submittal procedures shall be as outlined in Section 01 33 00 – Submittal Procedures.
B. Concrete Mix Design: Have all concrete mixes designed by a testing laboratory and approved by the Owner. Conform all mixes to the applicable building code requirement, regardless of other minimum requirements listed herein or on the drawings. Submit mix designs for review before use. Show proportions and specific gravities of cement, fine and coarse aggregate, and water and gradation of combined aggregates.

1.06 QUALITY ASSURANCE

A. Concrete shall be subject to quality assurance in accordance with Section 90 of the Standard Specifications.
B. Certifications:

1. Provide Owner at the time of delivery with certificates of compliance signed by both Contractor and Supplier containing the following statements:
   
   a. Materials contained comply with the requirements of the Contract Documents in all respects.
   
   b. Proportions and mixing comply with the design mix approved by the Consulting Engineer. Design mix shall have been field tested in accordance with the herein requirements of the Caltrans Standard Specifications and produces the required compressive strength under like conditions.
   
   c. Statement of type and amount of any admixtures.

2. Provide Owner, at time of delivery, with certified delivery ticket stating volume of concrete delivered and time of mixing, or time of load-out in case of transit mixers.

C. Conform to the applicable provisions of Section 51, 73 and 90 of the Caltrans Standard Specification and these Technical Specifications.

   1. Conform construction of portland cement concrete surface improvements (including curbs, gutters, medians, valley gutters, walks) to the requirements of Section 73 of the Caltrans Standard Specifications unless otherwise required in these Technical Specifications or shown on the Plans.

   2. Construct "V" ditches in accordance with Section 72-4 of the Standard Specifications; except that finishing shall be in accordance with Standard Specification Section 73 instead of 53, or as otherwise required in these Technical Specifications or shown on the Plans.

1.07 DESIGNATION

A. General: Whenever the 28-day compressive strength is designated herein or on the Plans is 3,500 psi or greater, the concrete shall considered to be designated by compressive strength. The 28-day compressive strength shown herein or on the plans which are less than 3,500 psi are shown for design information only and are not considered a requirement for acceptance of the concrete. Whenever the concrete is designated by class or as minor concrete herein or on the Plans, the concrete shall contain the cement per cubic yard shown in Section 90-1.01 of the Caltrans Standard Specifications.

PART 2 - PRODUCTS

2.01 GENERAL

A. Comply with requirements of Section 32 05 23 – Cement and Concrete for Exterior Improvements.

2.02 PORTLAND CEMENT CONCRETE

A. Unless specified otherwise herein or on the Plans, Portland Cement Concrete for items in this section shall be Minor Concrete as specified in Section 90-1.01 of the Caltrans Standard Specifications.

2.03 CURBS AND GUTTERS FORMS

A. Use flexible spring-steel forms or laminated boards to form radius bends. Tolerance: Not to deviate more than 1/4 inch in 10 feet in grade and alignment.

2.04 EXPANSION JOINT MATERIAL

A. Material for expansion joints in portland cement concrete improvements shall be premolded expansion joint fillers conforming to the requirements of ASTM Designation D 1751. Expansion joint material shall be shaped to fit the cross section of the concrete prior to being placed. Suppliers certificates showing conformance with this specification shall be delivered with each shipment of materials delivered to the job site.
B. Unless noted otherwise herein or on the Plans expansion joint thickness shall be as follows:


PART 3 - EXECUTION

3.01 GENERAL

A. Comply with requirements of Section 32 05 23 – Cement and Concrete for Exterior Improvements.

B. Form, place and finish concrete walkways, island paving, valley gutters and driveway approaches in conformance with the applicable requirements of Section 73-1.04 and 73-1.06 of the Caltrans Standard Specifications as modified herein.

C. Construct new concrete curb, curb and gutter and valley gutters against existing asphalt concrete by removing a minimum of 12-inches of the asphalt concrete to allow placement of curb or gutter forms. Patch pavement with a 6-inch deep lift of asphalt concrete after gutter form is removed.

3.02 SUBGRADE

A. Conform to Section 40-1.04 of Caltrans Standard Specifications.

3.03 SOIL STERILANT

A. Furnish and apply to areas indicated in accordance with Section 31 31 19 – Vegetation Control.

3.04 PLACING CONCRETE FORMS

A. Form concrete improvements with a smooth and true upper edge. Side of the form with a smooth finish shall be placed next to concrete. Construct forms rigid enough to withstand the pressure of the fresh concrete to be placed without any distortion.

B. Thoroughly clean all forms prior to placement and coat forms with an approved form oil in sufficient quantity to prevent adherence of concrete prior to placing concrete.

C. Carefully set forms to the alignment and grade established and conform to the required dimensions. Rigidly hold forms in place by stakes set at satisfactory intervals. Provide sufficient clamps, spreaders and braces to insure the rigidity of the forms.

D. Provide forms for back and face of curbs, lip of gutters and edge of walks, valley gutters or other surface slabs that are equal to the full depth of the concrete as shown, noted or called for on the Plans. On curves and curb returns provide composite forms made from benders or thin planks of sufficient ply to ensure rigidity of the form.

3.05 PLACING STEEL REINFORCEMENT

A. Bars shall be free of mortar, oil, dirt, excessive mill scale and scabby rust and other coatings of any character that would destroy or reduce the bond.

B. Accurately place reinforcement as shown on the plans and hold firmly and securely in position by wiring at intersections and splices, and by providing precast mortar blocks or ferrous metal chairs, spacers, metal hangers, supporting wires, and other approved devices of sufficient strength to resist crushing under applied loads. Provide supports and ties of such strength and density to permit walking on reinforcing without undue displacement.

C. Place reinforcing to provide the following minimum concrete cover:

1. Surfaces exposed to water: 4-inches.

2. Surfaces poured against earth: 3-inches.

3. Formed surfaces exposed to earth or weather: 2-inches.
4. Slabs, walls, not exposed to weather or earth: 1-inch.

D. Minimum spacing, center of parallel bars shall be two and one half (2-1/2) times the diameter of the larger sized bar. Accurately tie reinforcing securely in place prior to pouring concrete. Placing of dowels or other reinforcing in the wet concrete is not permitted.

3.06 PLACING PORTLAND CEMENT CONCRETE

A. Thoroughly wet subgrade when concrete is placed directly on soil. Remove all standing water prior to placing concrete.

B. Do not place concrete until the subgrade and the forms have been approved.

C. Convey concrete from mixer to final location as rapidly as possible by methods that prevent separation of the ingredients. Deposit concrete as nearly as possible in final position to avoid re-handling.

D. Place and solidify concrete in forms without segregation by means of mechanical vibration or by other means as approved by the Owner. Continue vibration until the material is sufficiently consolidated and absent of all voids without causing segregation of material. The use of vibrators for extensive shifting of fresh concrete will not be permitted.

E. Concrete in certain locations may be pumped into place upon prior approval by the Owner. When this procedure requires redesign of the mix, such redesign shall be submitted for approval in the same manner as herein specified for approval of design mixes.

3.07 EXPANSION JOINTS

A. Construct expansion joints incorporating premolded joint fillers at twenty (20) foot intervals in all concrete curbs, gutters, median/island paving, valley gutters, driveway approaches and at the ends of all returns. At each expansion joint install one-half inch by twelve inch (1/2" x 12") smooth slip dowels in the positions shown or noted on the detail drawings.

3.08 WEAKENED PLANE JOINTS

A. Construct weakened plane joints in concrete curbs, gutters, median/island paving and valley gutters between expansion joints at ten (10) foot intervals throughout, or as otherwise indicated. Depth of joint score depth to be one-fourth (25%) the thickness of the concrete.

B. Grooved Joints: Form weakened plane joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8-inch. Repeat grooving of weakened plane joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

3.09 FINISHING CONCRETE

A. Finish curb and gutter in conformance with the applicable requirements of Section 73-1.04 and 73-1.05A of the Caltrans Standard Specifications as modified herein.

B. Where monolithic curb, gutter and sidewalk is specified, separate concrete pours will not be allowed.

C. Provide a medium broom finish to all horizontal surfaces unless otherwise shown.

3.010 FORM REMOVAL

A. Remove forms without damage to the concrete. Remove all shores and braces below the ground surface, before backfilling.

B. Do not backfill against concrete until the concrete has developed sufficient strength to prevent damage.

C. Leave edge forms in place at least 24 hours after pouring.
3.011 CONNECTING TO EXISTING CONCRETE IMPROVEMENTS

A. New curb or gutter is to connect to existing improvements to remain by saw cutting to existing sound concrete at the nearest score line, expansion joint or control joint. Drill and insert ½-inch diameter by 12-inch long dowels at 24-inches on center into existing improvements. Install pre-molded expansion joint filler at the matching joint.

B. A cold joint to the existing curb is not acceptable.

3.012 FIELD QUALITY CONTROL

A. Conform the finish grade at top of curb, flow line of gutter, and the finish cross section of concrete improvements to the design grades and cross sections.

B. Variation of concrete improvements from design grade and cross section as shown or called for on the plans shall not exceed the tolerances established in Sections 73-1.05 and/or 73-1.06 of the Caltrans Standard Specifications.

3.013 RESTORATION OF EXISTING IMPROVEMENTS

A. Replace in kind all pavement or other improvements removed or damaged due to the installation of concrete improvements.

B. Remove, landscaping or plantings damaged or disturbed due to the installation of concrete improvements. Replace in kind.

END OF SECTION
SECTION 32 17 13

PARKING BUMPERS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing the following type(s) of parking bumpers:

1. Precast concrete parking bumpers.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Precast Concrete Parking Bumpers: Standard precast-concrete units of 3,500-psi air-entrained concrete, approximately 6-inches high, 9-inches wide, 6-feet long.


2. Exposed Surfaces: Smooth, free from pits and holes, with smooth and rounded corners and edges.

3. Reinforcing: Two steel bars each unit.


PART 3 - EXECUTION

3.01 INSTALLATION

A. Do not install parking bumpers until pavements are thoroughly cured.

B. Clean substrates free from dirt, dust, and other foreign matter.

C. Install one parking bumper for each parking stall where indicated or where required to protect equipment or the building. Secure bumpers to paving surfaces with two reinforcing dowels per bumper, drilled into paving surface. Do not drill into post-tensioned concrete slabs.

D. Each parking bumper shall be uniformly spaced, accurately aligned, and securely adhered.

E. Exposed surfaces shall be clean and free from chips, cracks, stains, discoloration, and other defects and damage.

END OF SECTION
SECTION 32 17 23
PAVEMENT MARKINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Removal of existing traffic stripes and pavement markers.
B. Removal of existing signs.
C. Cleaning and sweeping of streets before application of traffic stripes and pavement markings.
D. Materials and application for traffic stripes and pavement markings.
E. Materials and application for pavement markers.
F. Traffic control signs and street name signs.
G. Object markers.
H. Survey monuments.

1.02 RELATED SECTIONS

A. Section 32 05 23 – Cement and Concrete for Exterior Improvements

1.03 RELATED DOCUMENTS

A. Caltrans Standard Specifications:
   1. Section 56, Signs.
   2. Section 81, Monuments.
   3. Section 82, Markers and Delineators.
   4. Section 84, Traffic Stripes and Pavement Markings.
   5. Section 85, Pavement Markers.

B. Caltrans Standard Plans:
   7. Plan A73B: Markers.

C. The Manual of Uniform Traffic Control Devices (MUTCD), and the California Supplement to the MUTCD, the editions in effect at time of date on plans.

D. The regulations, standards, and tests of the State of California Department of Transportation Materials and Research Division, edition in effect at time of date on plans.

1.04 QUALITY ASSURANCE

A. Deliver certificates showing conformance with this specification to the Owner with each shipment of materials and equipment to the Project site.

1.05 PROJECT CONDITIONS

A. Do not apply traffic striping or pavement markings to the pavement until after approval to proceed has been given by the Owner.

B. Thoroughly cure new asphalt concrete and portland cement concrete before application of stripes, markings or markers.

PART 2 - PRODUCTS

2.01 THERMOPLASTIC STRIPES AND MARKING

A. Conform thermoplastic striping and marking materials to Section 84-2.02 of Caltrans Standard Specifications, unless noted otherwise herein or on the Plans.

2.02 PAINTED STRIPES AND MARKINGS

A. Conform painted striping and marking materials to Section 84-3.02 of Caltrans Standard Specifications, unless noted otherwise herein or on the Plans.

2.03 PAVEMENT MARKERS

A. Types: Section 85-1.02 of Caltrans Standard Specifications and as indicated.

B. Sampling, Tolerances and Packaging: Section 85-1.03 of Caltrans Standard Specifications.

C. Material


2. Retroreflective: Section 85-1.05 of Caltrans Standard Specifications.

2.04 TRAFFIC CONTROL SIGNS

A. General: Section 56-2 of the Caltrans Standard Specifications.

B. Sign Panels: Conform type (regulatory or warning), size, shape and pattern to the State of California, Department of Transportation, Traffic Manual, edition in effect at the date of the Plans. Sign faces to be of reflectorized porcelain enamel.

C. Posts:

1. Metal: Two (2) inch inside diameter steel pipe. Conform to Section 56-2.02A of Caltrans Standard Specifications, unless otherwise specified.

2. Wood: Conform to Section 56-2.02B.

D. Mounting Hardware: Section 56-2.02D of Caltrans Standard Specifications, unless otherwise specified.
2.05 STREET NAME SIGNS

A. Conform to manufacturer, style, size, and shape shown on the Plans.

B. Posts: Two (2) inch inside diameter steel pipe unless noted otherwise on the Plans. Conform to Section 56-2.02A of Caltrans Standard Specifications.


2.06 REFLECTORIZED OBJECT MARKERS

A. Reflectorized Metal Object Markers: Conform to the applicable requirements of Section 82 of Caltrans Standard Specifications for target plates and reflectors, and Caltrans Standard Plan A73A for type L-1 or L-2 object markers.

B. Posts: Metal posts conforming to the applicable requirements of Section 82-1.02B of Caltrans Standard Specifications and Caltrans Standard Plan A73B.

C. Mounting Hardware: Conform to the applicable requirements of Section 82-1.02G of Caltrans Standard Specifications.

2.07 STREET SURVEY MONUMENTS

A. General: Conform to Section 81-02 of Caltrans Standard Specifications, except that the marker disk will not be furnished. Marker disk shall be 2-inch diameter solid brass with a 2-3/4-inch shaft, “Lietz No. 525” or equal.

1. Portland Cement Concrete: Section 32 05 23 – Cement and Concrete for Exterior Improvements.

PART 3 - EXECUTION

3.01 REMOVAL OF TRAFFIC STRIPES, PAVEMENT MARKINGS AND PAVEMENT MARKERS

A. Where blast cleaning is used for the removal of painted traffic stripes and pavement markings, or for removal of objectionable material, remove the residue, including dust and water, immediately after contact with the surface being treated. Remove by a vacuum attachment operating concurrently with the blast cleaning operation.

B. Where grinding is used for the removal of thermoplastic traffic stripes and pavement markings; remove the residue by means of a vacuum attachment to the grinding machine. Do not allow the residue to flow across or be left on, the pavement.

C. Where markings are to be removed by blast cleaning or by grinding, the removed area shall be approximately rectangular so that no imprint of the removed marking remains on the pavement.

D. Contractor will be responsible for repairing any damage to the pavement during removal of pavement markers. Damage to the pavement, resulting from removal of pavement markers, shall be considered as any depression more than 1/4-inch deep.

3.02 TEMPORARY PAVEMENT MARKERS

A. If permanent pavement markers cannot be installed immediately, and the street or road is to be placed in service, install short term, temporary pavement markers on the new pavement prior to opening the street or road to traffic.

B. Place markers, at a minimum, of 24 feet on centers or as required by the governmental agency having jurisdiction, in the appropriate colors to delineate centerlines and travel lanes on multi-lane roadways.

3.03 THERMOPLASTIC TRAFFIC STRIPES AND PAVEMENT MARKINGS
A. Apply in conformance with the manufacturer's instructions and the applicable requirements of Section 84-2.04 of Caltrans Standard Specifications and Caltrans Standard Plans A20A through A20D, and A24A through A24E.

3.04 PAINTED TRAFFIC STRIPES AND PAVEMENT MARKINGS

A. Apply in conformance with the manufacturer's instructions and the applicable requirements of Section 84-3.03, 3.04 and 3.05 of Caltrans Standard Specifications and Caltrans Standard Plans A20A through A20D, and A24A through A24E.

3.05 PAVEMENT MARKERS

A. Place in conformance with the requirements of Section 85-1.06 of the Caltrans Standard Specifications.

B. Pavement recesses are not required. Markers shall be installed accurately to the line established by the Engineer. No markers shall be installed until the surface has been approved by the Owner.

3.06 TRAFFIC CONTROL SIGNS

A. Install in conformance with Sections 56-2.03 and 2.04 of Caltrans Standard Specifications, Caltrans Standard Plan RS1, the applicable requirements of the State of California Department of Transportation Maintenance Manual and the details shown on the Plans. The horizontal locations shown on Caltrans Standard Plan RS1 shall not be applicable, the horizontal location shall be as shown on the Plans.

B. Portland cement concrete for post foundations shall be of the configuration shown on the Plans.

C. After erection, damage to traffic sign faces shall be touched up or the sign replaced.

3.07 STREET NAME SIGNS

A. Install in accordance with the manufacturer’s instructions and as shown on the Plans.

B. Horizontal location shall be as shown on the Plans.

C. Portland cement concrete for post foundations shall be of the configuration shown on the Plans.

3.08 REFLECTORIZED OBJECT MARKERS

A. Install in conformance with the requirements of Section 82-1.03 of Caltrans Standard Specifications, except that the metal marker posts shall not be driven in place without prior approval of the Owner.

B. Install at locations shown on the Plans.

3.09 STREET SURVEY MONUMENTS

A. General: Conform to Section 81-03 of Caltrans Standard Specifications and Caltrans Standard Plan A74, except that the marker disk will not be furnished. Exact point in marker to be determined by an accurate survey and clearly punched in top of marker together with California Registered Civil Engineer's or California Licensed Land Surveyor's license number.

3.010 PROTECTION

A. Protect the newly installed and traffic stripes and pavement markings from damage until the material has cured.

B. Replace any traffic stripes or pavement markings or markers broken, misaligned or otherwise disturbed prior to opening roadway to traffic.

3.011 RESTORATION OF EXISTING IMPROVEMENTS

A. Existing signs striping or other markings removed or damaged due to the installation of new facilities shall be replaced in kind.
B. Existing landscaping or planting removed, damaged or disturbed due to the installation of traffic control signs or street name signs shall be replaced in kind.

END OF SECTION
PART 1 - GENERAL

1.01 SECTION INCLUDES
   A. Cast-in-place and surface-applied tactile warning surface panels for pedestrian traffic areas.

1.02 RELATED SECTIONS
   A. Section 32 05 23, Concrete for Exterior Improvements

1.03 RELATED DOCUMENTS
   C. ASTM Standards
      1. A 570, Steel, Sheet and Strip, Carbon, Hot-Rolled.
      3. C 501, Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser.
      4. C 1028, Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
   D. AASHTO Standards:
      1. HB-17 single wheel HS20-44 loading “Standard Specifications for Highways and Bridges”.
   E. Federal Standards:
      1. FED-STD-595C – Colors Used in Government Procurement
1.04 SUBMITTALS

A. Follow submittal procedures outlined in Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer’s literature describing products, installation procedures and routine maintenance. Include technical data and tested physical and performance properties. Identify color selection.

C. Samples for Verification Purposes: Submit two (2) tile samples minimum 12”x12” of the kind proposed for use.

D. Shop drawings are required for products specified showing fabrication details, composite structural system, tile surface profile, sound on cane contact amplification feature, plans of tile placement including joints, and material to be used as well as outlining installation materials and procedure.

1.05 QUALITY ASSURANCE

A. Provide Detectable/Tactile Warning Surface Tiles and accessories as produced by a single manufacturer.

B. Installer’s Qualifications: Engage an experienced Installer certified in writing by Detectable/Tactile Warning Surface Tile manufacturer as qualified for installation, who has successfully completed installations similar in material, design, and extent to that indicated for Project.

C. Americans with Disabilities Act (ADA): Provide Detectable/Tactile Warning Surface Tiles which comply with the detectable warnings on walking surfaces section of the Americans with Disabilities Act (Title III Regulations, 28 CFR Part 36 ADA STANDARDS FOR ACCESSIBLE DESIGN, Appendix A, Section 4.29.2 DETECTABLE WARNINGS ON WALKING SURFACES).

D. California Code of Regulations (CCR): Provide only approved DSAAC detectable warning products as provided in the California Code of Regulations (CCR) Title 24, Part 2, Section 205 definition of "Detectable Warning". Section 1117A.4 and 1127B.5 for "Curb Ramps" and Section 1133B.8.5 for "Detectable Warnings at Hazardous Vehicular Areas".

E. Vitrified Polymer Composite (VPC) Detectable/Tactile Warning Surface Tiles shall be an epoxy polymer composition with an ultra violet stabilized coating employing aluminum oxide particles in the truncated domes. The tile shall incorporate an in-line pattern of truncated domes measuring nominal 0.2” height, 0.9” base diameter, and 0.45” top diameter, spaced center-to-center 2.35” to 2.40” as measured side by side and in line. For wheelchair safety the field area shall consist of a non-slip surface with a minimum of 40 - 90° raised points 0.045” high, per square inch; "Armor-Tile" as manufactured by Engineered Plastics Inc., Tel: 800-682-2525, or approved equal.

1. Dimensions: Cast In Place Detectable/Tactile Warning Surface Tiles shall be held within the following dimensions and tolerances:

   a. Length and Width: as needed to install warning surface tiles on each curb ramp detailed on the plans.

   b. Depth:

      i. Cast-in-Place: 1.375” (1-3/8”), (+/-) 5% max.

      ii. Surface-Applied: 0.1875” (3/16”), (+/-) 5% max.

   c. Face Thickness: 0.1875” (1-3/8”), (+/-) 5% max.

   d. Warpage of Edge: 0.5% max.

   e. Embedment Flange Spacing:

      i. Cast-in-Place: Shall be no greater than 3.1”

2. Water Absorption of Tile when tested by ASTM D 570-98 not to exceed 0.05%.
3. Slip Resistance of Tile when tested by ASTM C 1028-96 the combined Wet and Dry Static Co-Efficients of Friction not to be less than 0.80 on top of domes and field area.

4. Compressive Strength of Tile when tested by ASTM D 695-02a not to be less than 28,000 psi.

5. Tensile Strength of Tile when tested by ASTM D 638-03 not to be less than 19,000 psi.

6. Flexural Strength of Tile when tested by ASTM D 790-03 not to be less than 25,000 psi.

7. Chemical Stain Resistance of Tile when tested by ASTM D 543-95 (re approved 2001) to withstand without discoloration or staining - 10% hydrochloric acid, urine, saturated calcium chloride, black stamp pad ink, chewing gum, red aerosol paint, 10% ammonium hydroxide, 1% soap solution, turpentine, Urea 5%, diesel fuel and motor oil.

8. Abrasive Wear of Tile when tested by BYK - Gardner Tester ASTM D 2486-00 with reciprocating linear motion of 37± cycles per minute over a 10" travel. The abrasive medium, a 40 grit Norton Metallite sand paper, to be fixed and leveled to a holder. The combined mass of the sled, weight and wood block is to be 3.2 lb. Average wear depth shall not exceed 0.060 after 1000 abrasion cycles when measured on the top surface of the dome representing the average of three measurement locations per sample.

9. Resistance to Wear of Unglazed Ceramic Tile by Taber Abrasion per ASTM C501-84 (re approved 2002) shall not be less than 500.

10. Fire Resistance of Tile when tested to ASTM E 84-05 flame spread shall be less than 15.

11. Gardner Impact to Geometry "GE" of the standard when tested by ASTM D 5420-04 to have a mean failure energy expressed as a function of specimen thickness of not less than 550 in. lbf/in. A failure is noted when a crack is visible on either surface or when any brittle splitting is observed on the bottom plaque in the specimen.

12. Accelerated Weathering of Tile when tested by ASTM G 155-05a for 3000 hours shall exhibit the following result – ΔE <4.5, as well as no deterioration, fading or chalking of surface of tile color No 33538.

13. Accelerated Aging and Freeze Thaw Test of Tile and Adhesive System when tested to ASTM D 1037-99 shall show no evidence of cracking, delamination, warpage, checking, blistering, color change, loosening of tiles or other detrimental defects.

14. Salt and Spray Performance of Tile when tested to ASTM B 117-03 not to show any deterioration or other defects after 200 hours of exposure.

15. Additional Quality Assurance for Cast-in-Place Tiles:
   a. AASHTO HB-17 single wheel HS20-44 loading “Standard Specifications for Highways and Bridges”. The Cast In Place Tile shall be mounted on a concrete platform with a ½” airspace at the underside of the tile top plate then subjected to the specified maximum load of 10,400 lbs., corresponding to an 8000 lb individual wheel load and a 30% impact factor. The tile shall exhibit no visible damage at the maximum load of 10,400 lbs.
   b. Embedment flange spacing shall be no greater than 3.1” center to center spacing as illustrated on the product Cast In Place drawing.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Detectable/Tactile Warning Surface Tiles shall be suitably packaged or crated to prevent damage in shipment or handling. Finished surfaces shall be protected by sturdy plastic wrappings to protect tile from concrete residue during installation and tile type shall be identified by part number.
B. Detectable/Tactile Warning Surface Tiles shall be delivered to location at building site for storage prior to installation.

1.07 SITE CONDITIONS
A. Environmental Conditions and Protection: Maintain minimum temperature of 40°F in spaces to receive Detectable/Tactile Warning Surface Tiles for at least 24 hours prior to installation, during installation, and for not less than 24 hours after installation.

B. The use of water for work, cleaning or dust control, etc. shall be contained and controlled and shall not be allowed to come into contact with the general public. Provide barricades or screens to protect the general public.

1.08 GUARANTEE
A. Detectable/Tactile Warning Surface Tiles shall be guaranteed in writing for a period of five (5) years from date of final completion. The guarantee includes defective work, breakage, deformation, fading and loosening of tiles.

PART 2 - PRODUCTS
2.01 TACTILE WARNING SURFACE
A. The Vitrified Polymer Composite (VPC) Detectable/Tactile Warning Surface Tile, Armor-Tile manufactured by Engineered Plastics Inc. (800-682-2525), or approved equal.

B. Color: Yellow conforming to Federal Color No. 33538. Color shall be homogeneous throughout the tile.

PART 3 - EXECUTION
3.01 INSTALLATION OF CAST IN PLACE DETECTABLE/TACTILE WARNING SURFACES
A. During Cast In Place Detectable/Tactile Warning Surface Tile installation procedures, ensure adequate safety guidelines are in place and that they are in accordance with the applicable industry and government standards.

B. Prior to placement of the Cast In Place Detectable/Tactile Warning Surface Tile system, review manufacturer and contract drawings with the Contractor prior to the construction and refer any and all discrepancies to the Engineer.

C. The specifications of the structural embedment flange system and related materials shall be in strict accordance with the contract documents and the guidelines set by their respective manufacturers. Not recommended for asphalt applications.

D. The physical characteristics of the concrete shall be consistent with the contract specifications while maintaining a slump range of 4 - 7 to permit solid placement of the Cast In Place Detectable/Tactile Warning Surface Tile system. An overly wet mix will cause the tile to float. Under these conditions, suitable weights such as 2 concrete blocks or sandbags (25 lb) shall be placed on each tile.

E. The concrete pouring and finishing operations require typical mason’s tools, however, a 4’ long level with electronic slope readout, 25 lb. weights, and a large non-marring rubber mallet are specific to the installation of the Cast In Place Detectable/Tactile Warning Surface Tile system. A vibrating mechanism such as that manufactured by Vibco can be employed, if desired. The vibrating unit should be fixed to a soft base such as wood, at least 1 foot square.

F. The factory-installed plastic sheeting must remain in place during the entire installation process to prevent the splashing of concrete onto the finished surface of the tile.

G. When preparing to set the tile, it is important that no concrete be removed in the area to accept the tile. It is imperative that the installation technique eliminates any air voids under the tile. Holes in the tile perimeter allow air to escape during the installation process. Concrete will flow through the large holes in each embedment flange on the underside of the tile. This will lock the tile solidly into the cured concrete.

H. The concrete shall be poured and finished true and smooth to the required dimensions and slope prior to the tile.
placement. Immediately after finishing concrete, the electronic level should be used to check that the required slope is achieved. The tile shall be placed true and square in accordance with the contract drawings. The Cast In Place Detectable/Tactile Warning Surface Tiles shall be tamped (or vibrated) into the fresh concrete to ensure that the field level of the tile is flush to the adjacent concrete surface. The embedment process should not be accomplished by stepping on the tile as this may cause uneven setting which can result in air voids under the tile surface. The tile field level (base of truncated dome) shall be flush to adjacent surfaces to permit proper water drainage and eliminate tripping hazards between adjacent finishes.

I. Immediately after placement, the tile elevation is to be checked to adjacent concrete. The elevation and slope should be set consistent with contract drawings to permit water drainage to curb as the design dictates. Ensure that the field surface of the tile is flush with the surrounding concrete and back of curb so that no ponding is possible on the tile at the back side of curb.

J. While concrete is workable, a 3/8” radius edging tool shall be used to create a finished edge of concrete, then a steel trowel shall be used to finish the concrete around the tile’s perimeter, flush to the field level of the tile.

K. During and after the tile installation and the concrete curing stage, it is imperative that there is no walking, leaning or external forces placed on the tile that may rock the tile causing a void between the underside of tile and concrete.

L. Following tile placement, review installation tolerances to contract drawings and adjust tile before the concrete sets. Two suitable weights of 25 lb each may be required to be placed on each tile as necessary to ensure solid contact of the underside of tile to concrete.

M. Following the concrete curing stage, protective plastic wrap is to be removed from the tile surface by cutting the plastic with a sharp knife, tight to the concrete/tile interface. If concrete bled under the plastic, a soft brass wire brush will clean the residue without damage to the tile surface.

N. If desired, individual tiles can be bolted together using ¼ inch or equivalent hardware. This can help to ensure that adjacent tiles are flush to each other during the installation process. Tape or caulking can be placed on the underside of the bolted butt joint to ensure that concrete does not rise up between the tiles during installation. Any protective plastic wrap which was peeled back to facilitate bolting or cutting, should be replaced and taped to ensure that the tile surface remains free of concrete during the installation process.

O. Tiles can be cut to custom sizes, or to make a radius, using a continuous rim diamond blade in a circular saw or mini-grinder. Use of a straightedge to guide the cut is advisable where appropriate.

P. Any sound-amplifying plates on the underside of the tile, which are dislodged during handling or cutting, should be replaced and secured with construction adhesive. The air gap created between these plates and the bottom of the tile is important in preserving the sound on cane audible properties of the tactile warning surface system as required in various jurisdictions.

3.02 INSTALLATION OF SURFACE APPLIED DETECTABLE/TACTILE WARNING SURFACES

A. During all surface preparation and Surface Applied Detectable/Tactile Warning Surface Tile installation procedures, ensure adequate safety guidelines are in place and that they are in accordance with the applicable industry and government standards.

B. The application of all tiles, adhesives, mechanical fasteners, and caulking shall be in strict accordance with the guidelines set by their respective manufacturers. Not recommended for asphalt applications.

C. Ensure that the surfaces being prepared and fabricated to receive the tiles are constructed correctly and adequately for tile installation.

D. Set the tile true and square to the curb ramp area as detailed in the design drawings, so that its location can be marked on the concrete surface. A thin permanent marker works well. Remove tile when done marking its location.

E. The surface to receive the Surface Applied Detectable/Tactile Warning Surface Tile is to be mechanically cleaned
with a diamond cup grinder or shot blaster to remove any dirt or foreign material. This cleaning and roughening of the concrete surface should include at least 4 inches around the perimeter of the area to receive the tile, and also along the cross pattern established by the corresponding areas on the backside of the tile. Those same areas should then be cleaned with a clean rag soaked in Acetone.

F. Immediately prior to installing the Surface Applied Detectable/Tactile Warning Surface Tile, the concrete surfaces must be inspected to ensure that they are clean, dry, free of voids, curing compounds, projections, loose material, dust, oil, grease, sealers and determined to be structurally sound and cured for a minimum of 30 days.

G. Using Acetone, wipe the backside of the tile around the perimeter and along the internal cross pattern, to remove any dirt or dust particles from the area to receive the adhesive.

H. Apply adhesive, supplied by the tile manufacturer, to the backside of the tile, as recommended by the tile manufacturer.

I. Set the tile true and square to the curb ramp area as detailed in the design drawings.

J. Working from the center of the tile outwards, proceed to drill and install all fasteners in the tile’s molded recesses.

K. Standing with both feet applying pressure around the molded recess provided in the tile, drill a hole true and straight to a depth of 3½” using a 1/4” masonry drill bit. Drill through the tile without hammer option (on the drill) until the tile has been successfully penetrated, then with hammer option (on the drill) to drill into the concrete. Maintaining foot pressure on both sides of the hole while drilling prevents concrete dust from accumulating between the tile and concrete which can affect the tile being installed flush and may compromise installation integrity.

L. Immediately after drilling each hole, before moving on to the next, and while still applying foot pressure, mechanically fasten tiles to the concrete substrate using a leather bound or hard plastic mallet to set the fasteners. Ensure the fastener has been placed to full depth in the dome, straight, and flush to the top of dome. Drive the pin of the fastener with the mallet, taking care to avoid any inadvertent blows to the truncated dome or tile surface.

M. Following the installation of the fasteners, the concrete dust should be vacuumed, brushed or blown away from the tile’s surface and adjacent concrete. Using Acetone on a rag, wipe the concrete around the tile’s perimeter to ensure a clean, dry surface to receive perimeter sealant.

N. The manufacturer-supplied perimeter caulking sealant should be applied following the sealant manufacturer’s recommendations. Tape all perimeter edges of the tile back 1/16” from the tile’s perimeter edge and tape the adjacent concrete back 1/2” from the tile’s perimeter edge to maintain a straight and even caulking line. Apply sealant around tile perimeter using care to work sealant into any void between the tile and concrete interface. Tool the perimeter caulking with a rounded plastic applicator or spatula to create a cove profile between the tile and adjacent concrete. Remove tape immediately after tooling perimeter caulking sealant.

O. Do not allow foot traffic on installed tiles until the perimeter caulking sealant has cured sufficiently to avoid tracking. Curing time is weather dependent (average cure time at 75° F is 30 minutes). Adhesive or caulking on the surface of the tactile warning surface can be removed with Acetone.

P. If installing adjacent tiles, note the orientation of each tile. Careful attention will reveal that one of the long edges of the tile is different than the other in regard to the tiny dotted texture. You may also note a larger perimeter margin before the tiny dotted texture pattern begins. Consistent orientation of each Armor-Tile is required so that the truncated domes on adjacent tiles line up with each other.

Q. To maintain proper spacing between truncated domes on adjacent tiles, the tapered edge should be trimmed off using a continuous rim diamond blade in a circular saw or mini-grinder. The use of a straightedge to guide the cut is required. All cuts should be made prior to installation of the tiles. If installing adjacent tiles, care should be taken to leave a 1/8 inch gap between each tile to allow for expansion and contraction.

R. If tiles are custom cut to size, if pre-molded recesses (to receive fasteners) are removed by the cut, or to maintain a tight installation to the substrate then any truncated dome can be center-drilled with a 1/4 inch masonry drill bit to create a through hole, and the through hole must be countersunk with a suitable carbide countersink bit to receive
mechanical fasteners. Care should be taken to not countersink too widely or deeply. Fasteners should be flush with the top of the truncated dome when countersunk properly.

3.03 CLEANING, PROTECTING, AND MAINTENANCE

A. Protect tiles against damage during construction period to comply with manufacturer’s written instructions.

B. Protect tiles against damage from rolling loads following installation by covering with plywood or hardwood.

C. Clean tactile warning surfaces not more than four days prior to date scheduled for inspection intended to establish date of substantial completion in each area of project. Clean tactile warning surfaces by method specified in the manufacturer’s written instructions.

D. Comply with manufacturer’s written instructions for cleaning and maintaining tile surface.

END OF SECTION
SECTION 32 31 13.73
GATE OPERATORS

PART 1 – GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing the following:
   1. Swinging gate operators.
   2. Sliding gate operators.

B. Related Sections:
   1. Metal fabrications are specified in Section 05 50 00.
   3. Emergency key access systems are specified in Section 10 41 16.
   4. Parking control equipment is specified in Section 11 12 00.
   5. Electrical is specified in Division 26.

1.02 SUBMITTALS

A. General: Comply with Division 01.

B. Product Data: Manufacturer’s printed information and installation instructions including required clearances.

C. Shop Drawings: Include complete details of gate construction including height and dimensions, gate operator, and structural attachment details.

D. Warranty.

1.03 QUALITY ASSURANCE

A. Installer: Company specializing in the installation of gate operators of the type specified, with a minimum of 3-years successful experience.

B. Manufacturer: Company specializing in the manufacture of gate operators of the type specified, with a minimum of 5-years successful experience.

C. Vehicle gate operators shall be manufactured by a single manufacturer as a complete system, including installation accessories, fittings, and fastenings.

D. Comply with NEMA, UL and CSA standards.

1.04 PROTECTION

A. Protect products against damage during transportation.

B. Protect adjacent construction and finishes as required to prevent damage during installation.

1.05 COORDINATION

A. Coordinate installation of vehicle gates and operators to avoid interference with work of other Sections or separate Contracts.
1.06 WARRANTY

A. Warrant gate operators to be free from defects in materials and workmanship for a period of 5-years from date of Substantial Completion. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 – PRODUCTS

2.01 SWINGING GATE OPERATORS

A. Approved Manufacturer: Hy-Security Gate Operator Model HRG 220-A with Smart Touch Controller or approved equal. Swinging gate operators shall be compatible with existing swinging gates.

B. Operation shall be by means of a hydraulic cylinder acting upward in a steel post assembly to cause the post and the gate panel to rotate from zero to 90-degrees without the use of articulating arms, screw drives or mechanical devices. The closing action of the gate panel shall cause the free end of the gate to be mechanically locked in place without the use of externally operated electric or mechanical locks. The opening and closing cycle times will vary depending on gate size and weight, from 14- to 30-seconds. The opening action of the gate panel shall allow the gate to rise approximately 12-inches and clear adjacent curbs or obstructions. The post assembly shall be fully enclosed and not offer any openings for foreign material to enter. Actuator assembly shall be supported on non-lubricated synthetic bearing surfaces. Bearings providing rotation and lift to the actuator assembly shall be permanently lubricated cam followers.

C. Standard mechanical components shall include as a minimum:

1. Indexing arm to allow precise closing adjustment.
2. 2-1/4-inch industrial quality sealed cam followers.
3. Drop bolt-locking device or post-locking device.
4. Power package, including NEMA 3R electric enclosure for electric controls, hydraulic pump and valves.
6. NEMA 4R limit switches to limit travel in each direction.
7. Hydraulic hand pump for emergency operation.
8. 1/4-inch hoses, rated to 2,750 working psi.
9. Hose fittings at valve block and at actuator post assembly shall be quick disconnect type.
10. High performance hydraulic fluid with a viscosity index greater than 375.

D. Minimum standard electrical components: Industrial grade.

1. Pump Motor: 1-hp, 1,725-rpm, 56C, TEFC, continuous duty with a minimum service factor of 1.15. Single or three phase as indicated or as directed by the Architect.
2. All components shall have overload protection.
3. Controls: Smart Touch Controller Board with 256K memory containing:
   a. Inherent entrapment sensor.
   b. Built in “warn before operate” system.
c. Built in timer to close.
d. Liquid crystal display for reporting of functions.
e. 24 programmable output relay options.
f. Anti-tailgate mode.
g. Built-in power surge/lightning strike protection.
h. Menu configuration, event logging and system diagnostics easily accessible with a PC and software.
i. RS232 port for connection to laptop or other computer peripheral and RS485 connection of master/slave systems or network interface.
j. Emergency exit release.

4. Transformer: 75 VA, non-jumpered taps, for all common voltages.
5. Control Unit: 24 VDC.
6. Electrical Sensors: Photo eyes, gate edges or a combination so that the gate is capable of reversing in either direction upon sensing an obstruction. Vehicle detector loops are specified in Section 11 12 00.
7. Provide other features as required to interface with parking control equipment specified in Section 11 12 00.

2.02 SLIDING GATE OPERATOR

A. Approved Manufacturer: Hy-Security Gate Operator Model SlideSmart DC15 or approved equal. Sliding gate operators shall be compatible with existing chain-driven sliding gates.

B. Operation shall be continuous duty, electromechanical, UPS battery backed up chain driven sliding gate operator designed for commercial and industrial cycles. Operator shall start and stop up to a 40-foot gate or maximum gate weight of 1,500 pounds on every cycle. Open/Close speed shall be adjustable 0.75- to 1.25-fps. Adaptive inherent entrapment sensor shall provide optimum gate resistance sensitivity and eliminates false trips. Low flex, zinc-plated chassis provides superior corrosion protection. UPS battery backup uses two 8Ah batteries for up to 4,000-ft. of gate travel after AC power loss.

C. Duty Cycle: Continuous.

D. Horsepower: 1/2 HP.

E. Drive: Electromechanical.

F. Voltage Input: 115V or 208V, 60 Hz.

G. Accessory Power: 24 VAC, 12 VDC and 24 VDC 1A each.


I. User Controls: Smart DC Controller with 70+ configurable settings. 32 character LCD display and 4 tact buttons or a PC using S.T.A.R.T. software.

J. Relays: Two configurable user relays; 30 VDC, 3A solid state and 250 VAC, 10A electromechanical.
K. ETL Listed (UL 325): Usage Class I, II, III, IV.

L. Cycle Tested: 250,000 cycles.

M. Electrical Sensors: Photo eyes, gate edges or a combination so that the gate is capable of reversing in either direction upon sensing an obstruction. Vehicle detector loops are specified in Section 11 12 00.

N. Provide other features as required to interface with parking control equipment specified in Section 11 12 00.

PART 3 – EXECUTION

3.01 INSPECTION

A. Verify that conditions are satisfactory for the installation of gate operators. If unsatisfactory conditions exist, do not commence installation until such conditions have been corrected.

3.02 INSTALLATION

A. Install gate operators according to manufacturer's instructions. Adjust for smooth, trouble-free operation.

B. Advise and consult with the Owner to obtain the Owner's requirements for standard available programmable features or adjustable controls (such as time delays, interlocks, or safety devices), and make necessary adjustments.

C. Instruct Owner's personnel on proper operation and maintenance of gate operators.

3.03 TOUCH-UP

A. Immediately after installation, areas where prime or finish coat has been damaged shall be prepared and touched-up with primer compatible with that applied at the shop.

B. Remove rust before touch-up is applied.

C. Touch-up shall not be obvious.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the Fuel Dispensing System and is defined to include:
   1. Furnishing and installing a complete fuel dispensing system at locations indicated on the drawings.
   2. Interfacing with the other work specified in these Contract Documents.
   3. Acceptance testing.
   4. Training of personnel.
   5. Maintenance of the system during the warranty period.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

A. Sitework: Division 02.
B. Concrete: Division 03.
C. Fluid Dispensing Systems: Division 11
D. Fluid/Fuel Monitoring System: Section 33 05 90.
E. Mechanical: Division 15.
F. Electrical: Division 16.

1.3 REFERENCES

A. Reference Standards:
   1. National Fire Protection Association Standards:
      b. NFPA 70-500 Hazardous (Classified) Locations.
      c. NFPA 496 Standard for Purged and Pressurized Enclosures for Electrical Equipment.
   2. Underwriters’ Laboratories Listings governing fuel system component construction.
   3. Comply with local codes having jurisdiction.
   4. Comply with California Air Resources Board (CARB) requirements.

1.4 SUBMITTALS

A. Product Submission and Shop Drawings: As specified in Division 01.
B. Contractor shall provide an accurate conduit layout and coordination with the Fuel Monitoring System.

1.5 QUALITY ASSURANCE

A. The Contractor’s design and proposed materials shall be at least of the same level of quality as that indicated and specified.

B. The Contractor shall coordinate the work in this section with the proposed work in Division 33 which includes but not limited to submersible fuel pumps, connections for the fuel monitoring system, submersible fuel pump controls, and electrical conduit and wiring including final connections of such to components of all equipment and controls, leak detection system and all other work and material to provide an approved working installation as shown in the Contract Drawings, or required by the Fire Code or as specified.

C. Unless otherwise specified, any materials described, shown, reasonably implied, or obviously a part of the system and necessary to its complete finish and perfect operation shall be furnished and installed, without extra charge. The drawings and specifications are intended to supplement each other, and any item set forth in either shall be recognized as the same as if fully set forth in both.

D. The work required by the Contractor shall meet the criteria set forth in the specifications as well as the code and regulatory requirements of the State, the "NFPA", "U.L." and "I.R.I.".

E. The various component parts shall function together as a workable system, complete with everything necessary for its operation and with all equipment properly adjusted and in working order.

F. The Contractor shall submit the following for review of general conformance with Contract Documents:

1. Complete shop drawings showing connections to the Fuel Dispensing System.

2. Assurances that if substitute equipment is used other than that specified, the specified rate of delivery of each fuel from the fueling nozzles shall be met.

3. Complete shop drawings, catalog cuts, piping diagrams, wiring diagrams, and other information indicating proposed materials, details and layouts. The shop drawings shall indicate all provisions to be made to portions of the building structure to accommodate the work.

4. Name of proposed manufacturers, of all systems components, indicating experience and qualifications.

5. Certification by manufacturers of all system components that the equipment supplied meets or exceeds specification requirements.

6. Maintenance and operation manual(s).

7. The results of all required tests, certified by the manufacturer.

G. Construction Conditions and Coordination

1. Before submitting his bid, the Contractor shall review the Contract Documents and shall thoroughly familiarize himself with the conditions affecting the work. No additional compensation shall be granted on account of extra work made necessary by his failure to investigate such conditions.

2. Prior to initiating work specified in this section, examine all work prepared by others to receive the work of this section and report any defect affecting installation to the Owner’s Representative for correction. Commencement of work shall be construed as complete acceptance of preparatory work by others.
3. Plan installation of new work and connections to existing work to ensure minimum interference with other work of the contract.

4. The work shall be carried out by this Contractor in accordance with actual field requirements and shall not depend on the extent of details shown on plans.

5. The Contractor shall be responsible for verification of critical building dimensions associated with the equipment prior to final fabrication and installation of the equipment.

6. The Contractor shall be responsible for coordinating the fabrication and installation of the equipment with the other work of the Contract and shall be scheduled so that there shall be no delay in the proper installation and completion of any part or part of each respective work task wherein it may be interrelated with that of this Contract so that generally all construction work can proceed in its natural sequence without unnecessary delay.

7. Examine all Contract Drawings relating to this project, and verify all governing conditions at the site and become fully informed as to the extent and character of the work required and its relation to other work in this project. No consideration shall be granted for any alleged misunderstanding of the materials to be furnished for work to be done.

H. Substitutions: To be provided in accordance with requirements listed in Division 01.

1.6 DELIVERY, STORAGE AND HANDLING

A. Store equipment in accordance with manufacturer's recommendations. Protect equipment from dirt and damage. Piping shall be capped on both ends until installation. Store fittings, valves, and other equipment in covered, dry storage until installation.

1.7 WARRANTY

A. Following completion, the Contractor shall provide the Owner with a one (1) year warranty starting at project acceptance, covering all parts, materials, and labor. All warranty work shall be performed by a local manufacturer's representative at the Project Site location, who has capabilities of responding to all problems within 24 hours. Any shipping and delivery costs associated with the warranty of this equipment shall be the responsibility of the Contractor.

PART 2 - PRODUCTS

2.1 RETROFIT UNDERGROUND STORAGE TANK (UST) ACCESSORIES

A. Tank Fuel Level Indicator Leak Monitoring and Alarm System

1. Tank Level: Provide Microprocessor based tank gauging system having a tank transmitter that utilizes a direct lift float which is unaffected by a change in the liquid gravity and comply NFPA 70. Float shall be compatible with the liquid stored in the tank. System shall include NEMA 1 enclosure, remote tank mounted level sensor, digital display in gallons and inches (user selectable), integral intrinsically safe circuits, high and low level warning lights, and temperature compensation. Provide dry contact output signals for remote low and high level alarms. Provide analog 4-20 mA output signals which are linearly scaled to tank level in gallons for connection to the DDC and the remote level indication gauges located at tank. Provide individual level and level alarm output signals for tank to DDC system for remote monitoring and audio/visual alarms at tank. The system shall be suitable for operation on 115 volts, 60 cycles. Provide wiring and raceway for interconnection of all system devices. Must be compatible with Fuel/Fluid monitoring software, Fuel Focus made by Asset Works, a owner’s legacy software system.

2. Known Acceptable Source: Veeder Root Co.
3. Remote level gauge for tank: Remote level gauges shall include a NEMA-4 watertight enclosure with LCD capable of displaying readings up to 20,000, and calibrated for 0 to 20,000 gallons. Gauge shall have operating temperature range of 0 to 120 deg F. Gauges shall operate directly from 4-20 mA outputs from tank monitoring system. Locate gauges where visible to person filling the tank.

4. Provide direct reading level gauge visible from the ground. Readout format is on standard 12-hour clock face. Small hand represents feet, large hand inches. Gauge can be read 20 to 30 feet away to within 1/8 inch. Maximum measurement capability is 12 feet. The gauge can be rotated 360 degrees after mounting.

5. Leak monitoring: Provide a continuous monitoring system for tank and fuel piping. The leak monitor shall be UL listed and FM approved, and shall include NEMA 1 enclosure, LCD display, and intrinsically safe circuits. The LCD display shall indicate which sensor has been activated. The alarm output of the monitor shall send signals to indicate the presence of fuel oil leaks to the DDC. The monitor shall also produce an audible and visual alarm at the leak monitoring panel(s) to alert FAA personnel of leakage. The monitoring system shall be in accordance with NFPA 30 & 30A and NFPA 70. Provide control unit, liquid sensors, sensor cables, sensor cable map, and necessary conduit and wires from the sensors to the central unit. Underground conduits, junction boxes, fittings and couplings shall be watertight to prevent leakage of ground water into conduit. Furnish necessary power supply for control unit. Furnish the following sensors:

   6. Liquid Sensor: Liquid sensor located in the lowest part of tank’s annular space. Sensor shall differentiate sensing of water and fuel, and only alarm upon sensing fuel.

   7. Piping Sensor: Provide leak sensors in the annular space of double wall containment piping in monitoring sumps accessible from ground level for repair/replacement of sensor for fuel supply and fuel vapor recovery piping. Also, leak detectors for fuel tank sumps, fuel dispenser sumps and fuel filter spill containment basin. Sensors shall only detect hydrocarbons.

B. Tank Overfill Alarm: Provide audible and visual tank overfill alarm at each tank. Include alarm silence switch at tank.

C. Quality Assurance

1. Installation shall be in compliance with the latest version of the Petroleum Equipment Institute Publications RP 200, and RP300, NFPA-30, 30A, and all manufacturers’ current installation instructions.

2. Provide listing/approval stamp, label, or other marking on equipment made to specified standards.

3. Only workmen who have a minimum of 2 years’ continuous experience installing this type equipment and who have attended a training seminar put on by the tank manufacturer in the past 2 years shall perform installation of equipment.

4. The contractor shall be International Fire Code Institute certified in the installation of aboveground storage tank equipment.

2.2 LIQUID LEAK DETECTION SYSTEM

A. Provide complete replacement of liquid leak detection systems to monitor for leaks from underground tanks, underground fiberglass piping, manholes, dispenser sumps, and fill sumps. The system shall include one or more liquid leak monitoring panel(s), sensors, system layout map, and auxiliary equipment required to provide continuous leak detection monitoring of the desired area. Upon detection of liquid leak, cable short, cable break, or sensor activation occurrence, the leak
monitoring panel shall record an alarm condition and the location of leak shall be clearly displayed. Leak detection system will meet the underground fuel pipe monitoring requirements of State of California Environmental Protection Agency.

B. Leak detection systems are to be supplied to accommodate a single power feed. As such, leak detection systems should include all necessary panels, interconnecting wire, conduit, and accessories.

C. Design Criteria:

1. Sensing Equipment - The system shall incorporate the following equipment:
   a. Leak monitoring panel.
   b. Sensors.
   c. Jumper cables.
   d. Switch sensors, including float switches, optical sensors, etc.
   e. Sensing Locations - The system shall monitor for leaks and liquids in the following locations: Existing Underground storage tanks (Ruptures to the inner and outer walls as well as product inventory).
   f. Underground piping detection sumps including low points accessible from above ground for repair/replacement of sensors.
   g. Sumps beneath fuel dispensers, diesel fuel filters.
   h. Sumps with piping transitions between aboveground to underground.

2. Liquids Detected - The system shall detect the following liquids:
   a. Hydrocarbon fuels and petroleum liquids.
   b. Aqueous water-based liquids.

3. Sensitivity: Incidental liquid contact of smaller than a 2-inch-diameter puddle shall not be detected. The sensitivity of the system shall be field adjustable.

D. Operation and Maintenance Data:

1. Provide as-installed plan layout, wiring, and point-to-point interconnection diagrams of all circuits, internal and external, for all equipment installed. These schematics shall include the conductor color-coding system. Drawings shall be on AutoCAD.
2. Provide a complete description of the system operation, including operating instructions, and maintenance and repair procedures.
3. Provide a complete system checkout field report with a graphic display map, drawing to scale from as-built drawings for each system installed. The map shall indicate all jumper and sensor routing, switch sensor locations junction boxes, cable connections, equipment, mapping points. The map shall be drawn with AutoCAD and a copy of the electronic file provided to the Owner.
4. Include manufacturer's representative's letter stating that system is operational.

E. Spare Parts:

1. Two keys of each type.
2. One sensor of each type.
3. One float switch of each type.

F. Acceptable Manufacturers:

1. Veeder-Root
G. Training: Upon completion of training, the Owner shall be able to add and delete sensing cable segments, jumper and splice sensing cables, and remap sensing cable lengths without equipment supplier's assistance.

2.3 FUEL DISTRIBUTION PUMPS

A. The contractor will provide the following UL-listed vertical submersible turbine fuel pumps with variable-speed motors as specified on the equipment schedule drawings:

1. Pumps suitable for transferring diesel fuel at a discharge pressure of 70 feet of water and 70 gpm.

2. Pumps suitable for transferring unleaded gasoline at a discharge pressure of 25 feet of water and 30 gpm.

B. The pump vendor will provide all magnetic starters, heaters, connecting wiring, and other necessary equipment for complete pump operation.

C. Pumps shall meet the design criteria stated below

D. Pumps shall comply with CARB and NFPA 30 & 30A requirements for UST tank systems for NFPA defined Class I & II liquids:

1. Contractor is responsible for selection of pumps based on performance requirements specified in this section.

2. Pumps shall be selected such that the rated condition point shall lie at or to the left of the best efficiency point on the pump performance curve but shall not be at a point representing less than 20 percent of rated capacity for the selected impeller size.

3. The motor assembly height shall be field adjustable utilizing a UL listed telescoping shaft and set to a minimum of 6 inches from the bottom of the tank.

4. The entire pumping assembly shall have UL listing and shall meet all requirements of UL Standard UL 79.

5. The piping shall include an approved antisiphon system. Valve(s) shall have integral pressure relief or be provided with an external pressure relief. All piping and valves shall be constructed of stainless steel or have a melting point higher than nodular iron in compliance with NFPA 30 & 30A.

6. Controller for variable-speed pumps will maintain discharge pressure with multiple fuel dispensers operation.

7. Variable-speed pump motors shall have three phase power supply.

8. The pump motor shall have a thermal overcurrent overload protector with automatic reset.

9. The piping shall include a block valves to allow the tank and piping and dispenser to be isolated.

10. Emergency power off-EPO switches will be installed at fuel islands for complete shutdown of fuel distribution system.

E. Acceptable Manufacturer(s):

1. Red Jacket.
F. Pumps shall be provided with one complete set of the following spare parts:

1. Bearings and bearing seals.
2. Packing (when applicable).
4. O-rings.
5. Special tools required for pump maintenance.

G. Pumps with suction and discharge connections greater than or equal to 2.5 inches shall have non-threaded, flanged connections that conform to ANSI standards, with flange face size and type as specified in the attached data sheet(s).

H. Bearing materials shall be recommended and guaranteed by pump manufacturer. Life of anti-friction ball or roller bearings shall be calculated in accordance with ANSI/AFBMA 9, Load Ratings and Fatigue Life for Ball Bearings, or ANSI/AFBMA 11, Load Ratings and Fatigue Life for Roller Bearings, and guaranteed for a minimum life of 30,000 hours at rated conditions.

I. Impellers shall be balanced in accordance with International Organization for Standardization (ISO) G6.3.

J. Pumps shall have spacer-type shaft couplings unless otherwise specified.

K. Pumps shall be provided with the following:

1. Lifting lugs for pumps weighing over 100 pounds.
2. Tapped and plugged suction and discharge pressure gauge connections.

2.4 UNLEADED GASOLINE DISPENSER SYSTEM

A. Acceptable Manufacturers:

1. Products of the following manufacturers are specified herein as the standard of quality for the Unleaded Fuel dispensers. Products equal to listed Manufacturers shall be submitted for approval.

   a. Gasboy International
      Commercial Petroleum Equipment
      1826 West Business Center Drive Orange, CA 92867
      Telephone: (714) 771-7112

B. Construction Features:

1. Single hose dispenser with meter, solenoid, and pulser.
2. Large LCD display, display front and back
3. Fuel supply and vapor recovery piping shall be underground and piped into the base of dispensers through a containment sump.
4. Dispensers shall be compatible with vehicle on-board refueling vapor recovery (ORVR) system for vapor recovery.
5. Power reset - single action resets totalizer and activates each dispenser hose independently.

6. High volume positive displacement meter.

7. Stainless steel panels.

8. Polyurethane paint finish.

9. 10:1 pulsar (120-volt coil) rated for Class I, Division 1 location to interface with fuel management system.

10. 3/4 inch x 12 foot coaxial hose for vapor recovery.

11. Heavy-duty overhead retractor for industrial use to be mounted in dispensers.

12. Shear valves at base for fuel supply and vapor recovery pipes and block valves for isolation of dispenser.

13. Containment sump under base of dispenser.

14. Dual swivels (nozzle and hose)

15. Light unit at dispenser


17. Hose assemblies to be reconnectable breakaway type.

18. Provide a fuel filtering system as part of the dispensing equipment. Manufacturer is to provide information on the filters as part of the shop drawing process.

19. Dispensers shall be supplied with fuel from submerged turbine pump with variable-speed motor at existing fuel tanks. Pump controller will maintain fuel pressure.

C. Capacities and Dimensions:

1. Flow Rate: 10 gpm maximum for vapor recovery, minimum delivery rate to be 8 gpm.

2. Unleaded hose: Vapor recovery coaxial.


D. Dispenser shall include built in filtering system as manufactured by Gasboy International or approved equal with the above minimum requirements.

E. Electrical Requirements: 120VAC-1PH-60HZ

F. Unleaded Vapor Recovery Nozzles:

1. One nozzle per dispenser

2. Full hand insulator
3. Hold-open rack
4. Body: aluminum
5. Swivel: Goodyear maximum coaxial hose swivel
6. Flow regulator
7. Disc: Buna-N
8. Splitter valve
9. Coaxial hose: 1 7/8"
10. Compliance with CARB Phase II vapor recovery.
11. ORVR-compliant nozzle made by Healy, compatible with mini-jet vacuum pump and Healy model 400 ORVR stage 2 vapor recovery system.

G. Unleaded fuel nozzle shall be as manufactured by Franklin Fueling Systems Healy 400 ORVR nozzle.

PART 3 – EXECUTION

3.2 PERFORMANCE

A. Installation Instructions: Install those products per manufacturer’s shop drawings and installation instructions in strict accordance with all City and Fire codes which govern them and also in instructions covered herein under Part 3. Locations indicated on the Drawings.


C. Equipment Start-Up: Perform equipment start-up testing and instruction in accordance with Division 01 and ensure its proper operation prior to acceptance of work by the Owner’s Representative.

3.3 INSTALLATION

A. Coordinate all conduit runs with fuel monitoring system with the installation of the fueling dispensers, and with the submersible fuel pumps, and the submersible pump controls as specified in Division 15 and 16. Coordination procedures shall include but not be limited to installation of all pulse transmitters, fluid solenoid valves, switches, and relays, to assure proper interfacing of equipment.

B. General: Install dispensers and related items in accordance with approved shop drawings, manufacturer’s installation instructions and as indicated on Construction Drawings. Installation shall conform to NFPA 30 & 30A.

C. Start-up by factory technicians to assure correct installation of wiring, pumps, and other devices used within the system. Technician representing manufacturer of equipment item(s) or system(s) being checked out, shall perform the following functions:

1. Perform start-up test in the presence of the Owner’s Representative.

2. Dispensing units shall be tested individually to assure proper function and together, simultaneously, to assure proper delivery rate.

3. Observe all tests as performed, including any required retests.
4. Test all fuel piping in accordance with local fire codes.

5. Train Owner’s personnel in accordance with the provisions of Division 01 in the proper safe operation of the system including:
   a. Proper operation of dispensing system.
   b. Safety precautions with nozzles and breakaway hoses.
   c. Operation and maintenance of pumps, dispensers, and other system appurtenances.
   d. Answering questions that shall give a better understanding of the system.

D. Manufacturer shall provide all required components to meet Class I, Division 1 for all components under the finish floor and Class I, Division 2 for all components within 18 inches above finished floor as required by NFPA and other codes having jurisdiction or as required by local agencies who take precedence over the above mentioned.

3.4 FUEL DISTRIBUTION PUMPS

A. Field Test: Pumps shall be tested after installation to demonstrate their conformance to Specifications. Contractor shall prepare and submit to Owner a test log that records the following:
   1. Capacity, as measured by a calibrated flow meter.
   2. Discharge pressures, as measured by calibrated gauges.
   3. Drive motor voltage and amperage for each phase.

B. Vibration Test: When specified on the pump data sheet, pumps shall be vibration tested after installation. Acceptable peak-to-peak vibration limits are as follows:

<table>
<thead>
<tr>
<th>Speed, S (rpm)</th>
<th>Antifriction Bearing (Measured on Housing)</th>
<th>Sleeve Bearing (Measured on Shaft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero &lt; S &lt; 1,800</td>
<td>3 mils</td>
<td>3.0 mils</td>
</tr>
<tr>
<td>1,800 &lt; S &lt; 3,600</td>
<td>2 mils</td>
<td>2.5 mils</td>
</tr>
</tbody>
</table>

C. Pumps failing to meet the requirements of the Specifications shall be subjected to more accurate tests. If a pump fails a second test, it shall be rejected, replaced, and retested.

3.5 LIQUID LEAK DETECTION SYSTEM

A. Installation: Install system as follows:
   1. Leak monitoring panel(s) shall be mounted and powered prior to installation of the sensing cable(s).
   2. Sensing cable(s) shall be installed after piping and other mechanical work is completed. Take care during installation of sensing cable(s) to avoid contact with potential contaminants, such as puddles or solder flux.
   3. Sensing and jumper cables shall be fastened securely at each point using hold-down clips together with plastic adhesive.
4. System cables shall be labeled at 20-foot increments. Labels shall identify individual sensing cable and record mapping distance. Use TraceTek TT-Tag, or Brady sleeve labels for identifying cables.

3.6 FIELD QUALITY CONTROL

A. Tests: Test components of liquid petroleum dispensing systems for compliance with the specifications. At the sole discretion of the Owner’s Representative, the Contractor may be required to repeat any tests, at no cost to the Owner. Items to be tested, as a minimum, are as follows:

1. Pressure test, in the presence of the Owner’s Representative and Owner’s personnel, supply piping in accordance with the following:
   a. Air pressure at ten psig; or hydrostatic at 25 psig.
   b. Air Test: Introduce compressed air into a suitable opening in system, after closing all other inlets and outlets, until there is a uniform gauge pressure as specified. Maintain pressure without introduction of additional air for 15 minutes and until a soap suds solution test/examination is made to determine each joint and connection leak free.
   c. Hydrostatic: Maintain test pressure, without introduction of additional pressure, until an examination is made to determine each joint and connection leak free, but in no case less than one-half hour actual test time.

2. Each dispenser shall be certified by “California Weights and Measures”.

3. Each dispenser shall operate properly under both automatic and manual operating modes of Fuel Management System.

4. Each nozzle shall shut-off automatically in accordance with tank fill percentage identified in approved manufacturers catalog literature.

5. Dispensed volume of fuel reported by Fuel Monitoring System shall correspond exactly with dispenser register. System shall deliver a minimum of 40 gpm for diesel hoses when all four dispensers are dispensing simultaneously.

6. Coordinate with fuel pumping, piping and management systems specifications to assure proper demand is coordinated.

B. Provide the services of qualified manufacturer’s representatives to perform the following:

1. Inspect testing, prior to substantial completion of the facility, by the Contractor in the presence of the Owner’s Representative, to ensure proper operation of the equipment.

2. Perform all scheduled and unscheduled maintenance during warranty period; provide all labor and materials.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section specifies the Fuel/Fluid Monitoring System and is defined to include, but not necessarily be limited to:

1. Designing, fabricating, furnishing, and installing a complete monitoring system at locations indicated on the Contract Drawings.

2. Interfacing with the other work specified in these Contract Documents.

3. Acceptance testing.

4. Training of Owner personnel.

5. Maintenance of the system during the warranty period.

B. Related Work Specified Elsewhere:

1. Sitework: Division 02.

2. Concrete: Division 03.

3. Fluid Dispensing Systems: Division 11

4. Fuel Dispensing Equipment: Section 33 05 50.

5. Mechanical: Division 23

6. Electrical: Division 26

1.2 DEFINITIONS

A. Basis-of-Design Product Specification: Where a specific manufacturer’s product is named and accompanied by the words “basis of design,” including make or model number or other designation, it is intended to establish required performance of the product. See Section 01600 – Product Requirements for more information.

1.3 QUALITY ASSURANCE

A. Reference Standards:

1. Underwriters' Laboratories Listings governing fuel system component construction and electrical construction.

2. Comply with local codes having jurisdiction as listed in Division 01.

B. The Fuel/Fluid Monitoring System manufacturer shall be:
   992 Sids Rd
   Rockwall, TX 75032
   Telephone: (972) 722-1009
   Fax: (972) 722-1033

2. No alternative manufacturers unless approved by AC Transit District prior to bid.

   C. Substitutions: To be provided in accordance with requirements listed in Division 01. Based on the District’s requirement to be compatible with existing system used, Substitution shall not be granted unless approved by AC Transit during the bidding process. Any substitution during Shop Drawing review shall be rejected.

1.4 SUBMITTALS

   A. The equipment shall be new and furnished with all specified materials and ready for installation when delivered. Used or reconditioned equipment shall not be accepted.

   B. Manufacturer shall be a firm regularly engaged in the design and manufacture of the type of equipment specified herein.

   C. Submit product submission and shop drawings as specified in Division 01.

   D. Submit proposed design for the conduit routing of the specified fluid/fuel monitoring system to the fuel dispensing system and fluid dispensing system as required by shop drawings. Contractor shall coordinate with electrical, civil and equipment drawings in order to incorporate manufacturer’s conduit layout and coordination with disciplines.

   E. Fluid Management System (FMS) supplier shall be required to review and approve fluid impulse meters (pulsars) and solenoids provided by fluid dispensing manufacturer that provide direct connection to the FMS. Manufacturer shall also be required to approve conduit routing submitted by the Contractor.

1.5 JOB CONDITIONS

   A. Work includes design, fabricating, furnishing and installation of a fuel/fluid monitoring system to control the usage of all diesel, and unleaded gasoline dispensing units (specified in section 33 05 50) and fluid monitoring of above ground reels (MO, ATF, EC) in the maintenance building and the Fueling Island service lanes (MO, ATF, EC), and electrical conduit and wiring including final connections of such to components of all equipment and controls, and all other work and material to provide an approved working installation as shown in the Contract Drawings, or as specified.

   B. Unless otherwise specified, any materials described, shown, reasonably implied, or obviously a part of the system and necessary to its complete finish and perfect operation shall be furnished and installed, without extra charge. The drawings and specifications are intended to supplement each other, and any item set forth in either shall be recognized as the same as if fully set forth in both.

   C. The Contractor and the Fluid Management System manufacturer shall be responsible for establishing all conduit sizes and materials, component locations, type and quantities, mounting requirements and hardware, equipment selection and any and all other design parameters necessary to provide a complete operable fuel/fluid monitoring system as described in the specifications and on the Contract Drawings, and coordinate with such components and sizes with approved shop drawings to verify proper installation. Information provided on the contract drawings is minimum requirements to be used as guidelines to assist the Contractor in bidding.

   D. The various component parts shall function together as a workable system completes with everything necessary for its operation and with all equipment properly adjusted and in working order.
E. The Contractor shall submit the following for review of general conformance with Contract Documents:

1. Complete shop drawings, catalog cuts, conduit diagrams, wiring diagrams, and other information indicating proposed materials, details and layouts. The shop drawings shall indicate all provisions to be made to portions of the building structure to accommodate the work.

2. Certification by manufacturers of all system components that the equipment supplied meets or exceeds specification requirements.

3. Sole responsibility for correctness of dimensions, details, quantities, and safety shall remain with the Contractor.

4. Maintenance and operation manuals.

5. The results of all required tests, certified by the manufacturer.

F. Construction Conditions and Coordination

1. Before submitting his bid, the Contractor shall review the Contract Documents and shall thoroughly familiarize himself with the conditions affecting the work. No additional compensation shall be granted on account of extra work made necessary by his failure to investigate such conditions.

2. Prior to initiating work specified in this Section examine all work prepared by others to receive the work of this Section and report any defect affecting installation to the District Representative for correction. Commencement of work shall be construed as complete acceptance of preparatory work by others.

3. Plan installation of new to insure minimum interference with other Work of the Contract.

4. The Work shall be carried out by this Contractor in accordance with actual field requirements and shall not depend on the extent of details shown on plans.

5. The Contractor shall be responsible for verification of critical building dimensions associated with the equipment prior to final fabrication and installation of the equipment.

6. The Contractor shall be responsible for: Coordinating the fabrication and installation of the equipment with the other Work of the Contract and shall be scheduled so that there shall be no delay in the proper installation and completion of any part or part of each respective work task wherein it may be interrelated with that of this Contract so that generally all construction work can proceed in its natural sequence without unnecessary delay.

7. Examine all Contract Drawings relating to this Project, and verify all governing conditions at the site and become fully informed as to the extent and character of the work required and its relation to other work in this Project. No consideration shall be granted for any alleged misunderstanding of the materials to be furnished for work to be done.

1.6 WARRANTY

A. Following completion, the Contractor shall provide the Owner with a one (1) year warranty starting at project acceptance, covering all parts, materials, and labor. All warranty work shall be performed by a local manufacturer's representative, at the Project Site location, who has capabilities of responding to all problems within 24 hours. Any shipping and delivery costs associated with the warranty of this equipment shall be the responsibility of the Contractor.
2.1 FLUID MANAGEMENT SYSTEM

A. Comprising Equipment Item No.: F-9, and RR-27, as well as interface to existing client network for the system and controlling software.

2.2 DESCRIPTION

A. System Parameters: Installation shall provide electronic recording of vehicle number, mileage, and amounts of diesel fuel, unleaded fuel, engine oils, engine coolant, and automatic transmission fluid dispensed to buses and gasoline dispensed to support vehicles at service lanes. Data collection will take place via the Fluid Control Terminal (FCT). System shall provide a fully functional interface to a tank monitoring controller for monitoring of fluids stored in remote tanks, and fluid deliveries. System shall provide software for fluid use and inventory reports. System shall permit add-on expansion of additional liquid products or reels, if desired by District at a future date. System shall automatically collect, record, transmit, compile and print data as specified herein. The system shall be designed to meet the following objectives:

1. Improve fuel inventory management by integrating one or more tank level monitoring systems into the fuel system.
2. Provide the appropriate reports to the using agencies
3. Capture vehicle mileage at time of servicing and fueling.
4. Be accessible to end users via the District network utilizing the existing client/server user interface.
5. Meet all NFPA, State, and Fire regulatory requirements for safe operation in the conjunction with all fuels and petroleum products.
6. Fluid Control Terminals at shall have a Class I Division 2 electrical classification per the National Electrical Code.

B. System/Components. Provide items and components to perform the above functions. Equipment shall include but not limited to the following:

1. Fluid Control Terminals (FCT)
2. Integration to Fluid monitoring system client computer and custom District client server interface
3. Coordinate the installation and wiring of control solenoid valves, pulsars, meters or meter modification kits provided by the fluid dispensing manufacturers. Locate as required per each service position.
4. Software and programs as necessary for functioning of FCT and FCT Controller Units. Software shall verify accurate data transmission using reasonableness checks, parity checks, and other checks required to ensure accurate data transmission. Software and programs shall be configured to match the existing District facilities for consistency and ease of use.
5. All necessary conduit, junction boxes, and pull wire for the proper installation and operation of the system will be the responsibility of the Contractor. Pulsars are to be provided by the lubrication system manufacturer, but approved by the fluid management system manufacturer prior to acceptance.

C. System Operation

1. FMS shall provide mileage, diesel fuel, gasoline, engine oil, ATF, engine coolant, record management by automatically recording, storing, compiling, and printing formatted transaction data continuously on a 24-hour per day basis.
2. FMS shall be automatic except for operator functions specified herein. System shall operate unattended except for normal service operator inputs, operator file updates periodic status monitoring, and printer paper and ribbon replacement. Operator transactions and printer messages shall be in conversational language and shall include at a minimum, the existing error messages used at other DISTRICT facilities. Input and output codes shall not be used, unless format and storage capacities absolutely dictate their use. All operator transactions and printer messages shall be defined in plain language and be bound in a system manual.

3. FMS shall verify all bus or vehicle identification inputs against bus and vehicle authorization file maintained on the existing DISTRICT server.

4. FMS shall verify all employee identification inputs against employee authorization file maintained on the existing DISTRICT server.

5. FMS shall provide System Controller Unit operator with ability to maintain the following from the existing DISTRICT server:
   a. Set current date and time.
   b. Delete vehicle authorization from file.
   c. Enter vehicle authorization in file.
   d. Enter employee in file.
   e. Delete employee from file.
   f. Place FCT units off and on line.
   g. Set fluid quantity limits for exception reports.
   h. Set engine oil type by vehicle for selective oil control.
   i. Set request and schedule print option for each report.
   j. Enter special message of up to 16 characters including blanks (such as PARK IN ROW B) and list of bus numbers for which this message shall apply. This message shall then be displayed on the FCT unit when one of the buses is serviced.
   k. Request status of fuel storage tanks.
   l. Request record of fuel receipts.
   m. Request tank alarm history.
   n. Define storage tank parameters.
   o. Produce all reports defined in the System Reporting Requirements section of these specifications and integrated data with existing District facilities.
   p. FMS shall provide the capability for all the above data to be downloaded from a host CPU to the Central Control Server on demand from the host CPU.
   q. Create other software users.
   r. Define software application permissions for each user.
   s. Manage in and out of service buses. Provide the user interface and reporting needed to take buses in or out of service for maintenance.
   t. Provide complex bus inspection management. Keep track of all inspection history, provide at least 10 inspection events for each classification of vehicle and project the need for future inspections based on date range, fuel, oil or coolant consumed.

D. Sequence of Operations

1. Normal Mode of Operation: Vehicle Information
   a. Vehicle Transmitter (VIT) shall prompt initiation of fueling sequence and activate appropriate fuel hose location and petroleum product fluid reels.
      FCT shall prompt operator for:
      ENTER ID
      RE-ENTER ID (if invalid)
   b. During the time that the fueling operator is entering his employee ID and his ID number is being verified by the Controller through the existing data validity checks on the DISTRICT fueling system server, the FCT unit shall cause the VIT unit transmit the total miles traveled (life-to-date miles) for the vehicle.
c. If the FCT Controller contains a special message (such as PARK IN ROW B, PM A SCHEDULED, etc.), this message shall be flashed on the display of the FCT unit.

d. At this point solenoid valves in the diesel, engine oil, coolant, ATF lines, and air to consumable suction pumps shall be energized and opened by the FCT unit. Only the engine oil specified for the fueling vehicle should be energized.

e. As fuel, engine oil, ATF, or coolant are dispensed into bus or vehicle, quantities of products dispensed shall be sensed and recorded initially by FCT. Electronic pulsar/transducers shall sense fuel in tenths of gallon, and other liquids in tenths of a quart.

f. Diesel fuel dispensed shall be displayed on FCT display as follows:
FUEL D<XXX>YYYYY
where XXX is the calculated expected fuel required quantity, if available, and *** if not available. YYYYY is the actual quantity in tenths of fuel dispensed.

g. Products and quantities of each dispensed item shall be transmitted by the FCT unit to the existing DISTRICT fueling system server and stored in the existing DISTRICT fuel system database.

h. Upon completion of servicing and exit from the service lane, the VIT-sensing ground loop shall sense departure of bus or vehicle and cause FCT to terminate transaction and record final quantity information.

i. Transaction shall be automatically terminated at end of any 5-minute interval following cessation of fueling operation. The time-out should be configurable per FCT to allow for longer or shorter inter-pulse timeouts as required.

2. Back-up Mode of Operation: The sequence of operations for servicing vehicles which are not equipped with a VIT or for which there is a malfunction in the VIT, shall be as follows:

a. The sequence shall begin as described above with the entry of the employee ID.

b. After a short time-out period, during which a vehicle number and mileage are not received by the receiver unit, the FCT unit shall automatically proceed with a prompt ENTER VEH NUMBER and require entry through the keypad of a valid vehicle number for the vehicle to be serviced.

c. For the next step the system shall provide the user the capability to ENTER MILEAGE or the system shall automatically calculate mileage based upon fuel dispensed to the vehicle if a mileage is not entered.

d. At this point solenoid valves in the diesel, engine oils, coolant, and ATF lines shall be energized and opened by the FCT unit and succeeding steps would be identical to those described in the preceding paragraph.

3. Sequence of Operations-Non-Revenue Position: The sequence of operations for the non-revenue dispenser positions shall be the same as the back-up mode of operation for the diesel position with the exception that transaction termination shall be by time out or pushing CANCEL button only.

E. Features and Construction

1. Fluid Control Terminals

a. General: FCT shall:
   (1) Be located at service position in the fuel islands as noted per plans. Typical of 4 locations.
   (2) Be located in Safety Inspection bay reel set in the Maintenance Building as shown on the drawings. Typical of 3 locations.
   (3) Be the interface between fueling operator, dispenser, traffic sensors, and FMS.
   (4) Be weatherproof, vandal resistant, and tamper proof.
   (5) Be plug-in, remove and replace, maintainable.
   (6) Consist of push-button console with display, mounted on upright stand.
   (7) Operate in temperature range from 0 degrees F to 120 degrees F, and relative humidity range of 5 to 95 per cent, non-condensing.
F. Software Systems

1. Network Communications: The system shall include communication technology that interconnects the various FCT's with the existing central control server and network. The communication technology shall integrate the hardware into a complete fleet fluid management system.

2. Communication Procedure

   a. Communication between the central control server and the FCT's shall be by networked connection. Communication routines shall be capable of operating over the DISTRICT network.

   b. The FCT's shall connect to the server by networked connection. Once the communication channel is established, the FCT's shall transmit each of its stored transactions. The server shall accept the transaction and allow the next transaction to be sent. When the FCT's indicates that there is no more data to send, the server shall update the FCT's with any new vehicle information and/or time and date.

   c. The FCT's shall be able to accept downloaded time for call parameters that shall allow the user to configure each individual site based on its activity level. For example, a very high use site might be configured to poll in hourly or after 100 transactions. A low usage or long distance site might be configured to call only once or twice per day or upon reaching 500 transactions. The call in parameters shall be easy to configure in the system and shall be accessed through the standard graphical user interface. The FCT's shall initiate communication based on number of transactions and/or lapsed time. In addition, the remote fuel island terminal shall automatically establish communication with the server in the event of power failure, intrusion or other defined occurrences (i.e. fire, fuel leak etc.)

   d. The system server shall also have the capability to automatically poll the FCT's. The software system shall provide the user with a menu driven polling routine. A menu providing the capability to poll ICTs or one remote fuel island terminal on demand shall also be provided.

3. Communication

   a. The central control server shall maintain communication security between the network and FCT's. The FCT's shall not transmit data unless the central control server specifically requests the information in the correct sequence.

   b. When the FCT has completed the transmission of data to the central control server, the server shall transmit control information back to the terminal. The control information shall contain the number of minutes before the next polling sequence, the maximum number of transactions to collect before calling, and the maximum number of transactions to collect before refusing to accept any more transactions.

G. Utilities: 120V-1PH-60Hz Service at island controller, and at Safety/Inspection Bay controller.

H. Fluid Management System shall be manufactured by S&A Systems, Inc of Redwall, Texas.

PART 3 - EXECUTION

3.1 PERFORMANCE
A. Installation Instructions: Install those Products, as specified previously under PART 2 and not specifically covered for installation herein under PART 3, in strict accordance with manufacturer's installation instructions and at locations indicated on the Drawings.


C. Equipment Start-Up: Perform equipment start-up testing and instruction in accordance with Division 01 and insure its proper operation prior to acceptance of work by the District Representative.

3.2 INSTALLATION

A. Coordination procedures shall include but not be limited to installation of all pulse transmitters, fluid solenoid valves, switches and relays, to assure proper interfacing of equipment.

B. Start-up by factory technicians to assure correct installation of wiring, pumps, and other devices used within the system. Technician representing manufacturer of equipment item(s) or system(s) being checked out, shall perform the following functions:

1. Assure correct installation and wiring of the card reader, terminal/printer microprocessor, pumps, stands, and other devices used with the system. Contractor to utilize manufacturer shop drawing schematics as the final conduit routing for the management system.

2. Input all necessary information into Fuel/Fluid Monitoring System microprocessor for proper initial operation of system, including all required information regarding all vehicles assigned to the Owner.

3. Observe all tests as performed, including any required re-tests.

4. Train Owner personnel in accordance with the provisions of Division 01 in the proper safe operation of the system including:
   a. Card reader operation by the user.
   b. Microprocessor operation and purpose of override switches.
   c. Transaction Log communication interface operation.
   d. Answering questions that shall give a better understanding of the system.

3.3 FIELD QUALITY CONTROL

A. Tests: Test components of the Fuel/Fluid Monitoring System for compliance with the specifications. At the sole discretion of the DISTRICT Representative, the Contractor may be required to repeat any tests, at no cost to the Owner. Items to be tested, as a minimum, are as follows:

1. Fuel/Fluid Monitoring System shall be tested for compliance with all requirements of Article 2.02.

2. Dispensed volume of diesel fuel, gasoline, motor oil, coolant and ATF reported by Fuel/Fluid Monitoring System shall correspond exactly with volumes actually dispensed into measured containers from each monitored control handle.

3. Transaction log communication interface shall properly transfer a sample log from the microprocessor memory to the Owner’s host computer in a format compatible with Owner’s software.

B. Provide the services of qualified manufacturer’s representatives to perform the following:
1. Observe testing, prior to substantial completion of the facility, by the Contractor in the presence of the DISTRICT Representative, to ensure proper operation of the equipment.

2. Perform all scheduled and unscheduled maintenance during warranty period; provide all labor and materials.

C. Once installed, proper operation of the system shall be demonstrated as follows:

1. Automatic transfer of correct vehicle number and mileage from the VIT units.

2. Automatic transfer of correct vehicle number and mileage from the mileage collection unit to the hand-held portable reader.

3. Transfer of stored vehicle number and mileage data from the hand-held portable reader to a PC.

4. Programming (and re-programming) of the mileage collection unit with vehicle number, current life-to-date miles, and tire factor (revolutions per mile).

5. Fluid dispensing accuracy, as compared to the metered dispensing guns and a calibrated container.

6. System reports on usage and vehicle information.

7. Projected inspection reports

END OF SECTION
PART 1 - GENERAL

1.01 SECTION INCLUDES
A. Manhole structures for gravity storm drain and sanitary sewer utilities.

1.02 RELATED SECTIONS
A. Section 31 23 33 – Trenching and Backfilling.
B. Section 33 30 00 – Sanitary Sewerage Utilities.
C. Section 33 40 00 – Storm Drainage Utilities.
D. Section 32 05 23 – Cement and Concrete for Exterior Improvements.

1.03 RELATED DOCUMENTS
A. AASHTO:
   1. M 199: Precast Reinforced Concrete Manhole Sections.
B. ASTM:
   1. A 615/A615M: Deformed and Billet-Steel Bars for Concrete Reinforcement.
   2. C 478: Precast Reinforced Concrete Manhole Sections.
   3. C 1244: Test Method for Concrete Sewer Manholes by Negative Air Pressure (Vacuum) Test.
C. Caltrans Standard Specifications.
   1. Section 51, Concrete Structures.
   2. Section 75, Miscellaneous Metal.

1.04 DEFINITIONS
A. AASHTO: American Association of State Highway and Transportation Officials.

1.05 SUBMITTALS
A. Follow submittal procedures outlined in Section 01 33 00 – Submittal Procedures.
B. Product data for the following:
   1. Cleanout plugs or caps.
C. Shop drawings: Include plans, elevations, details and attachments for the following:
   1. Precast concrete manholes, frames and covers.
   2. Precast concrete clean out boxes and box covers.
D. Design Mix Reports and Calculations: For each class of cast-in-place concrete.
E. Field Test Reports: Indicate and interpret test results for compliance with performance.

1.06 DELIVERY, STORAGE AND HANDLING

A. Handle precast concrete manholes according to manufacturer’s written instructions.

B. Protect imported bedding and backfill material from contamination by other materials.

PART 2 - PRODUCTS

2.01 CLEANOUTS

A. Piping: Same as sanitary sewer line if possible.

B. Top Cap: Threaded and of same material as piping if possible.

C. Box Size: As required to provide access and allow easy removal and reinstallation of cap.

D. Box Types:
   2. Traffic Areas: Portland cement concrete box and box cover or steel or cast iron cover, heavy duty, both box and cover to be rated for AASHTO H20 loading.

E. Box Cover Markings: “S.D.” for storm drain cleanouts, “S.S.” for sanitary sewer cleanouts, unless otherwise specified.

F. Available Manufacturers: Subject to compliance with requirements, box manufacturers offering products that may be incorporated into the Project include, but are not limited to the following:
   1. Associated Concrete Products, Inc. (Santa Ana, California) (Tel. 714-557-7470).
   2. Brooks Products Inc. (El Monte, California) (Tel. 818-443-3017).
   3. Christy Concrete Products, Inc. (Fremont, California) (Tel. 800-486 7070).

2.02 MANHOLES

A. General: Size, shape, configuration, depth, etc. of manhole and frame and cover shall be as indicated.

B. Portland Cement Concrete and Reinforcing:
   1. Cast-In-Place Portion: Use Class A Concrete per Caltrans Standard Specification Section 90, and ASTM A615 Grade 60 reinforcing steel bars.
   2. Precast Portion: ASTM C 478. Rate for AASHTO H20 loading in traffic areas.

C. Frames and Covers: As indicated and in accordance with Caltrans Standard Specification Section 75-1.02.

D. Steps: ASTM C 478 or AASHTO M 199. Manufacture from deformed, ½-inch steel reinforcement rod complying with ASTM A 615 and encased in polypropylene complying with ASTM D4101. Include pattern designed to prevent lateral slippage off step. Acceptable manufacturer is Hanson Concrete Products, (Milpitas, CA) (Tel 408-262-1091) or equal.

2.03 JOINT SEALANT FOR STRUCTURES AND MANHOLES

1. Use to seal around pipes at connections to structures and manholes. Also use to seal joints between precast sections of structures and manholes.

B. Gaskets: Preformed flexible rubber or plastic gasket.
   2. Plastic Gaskets: Federal Specification SS-S-00210 (GSA-FSS), Type I, Rope Form; or alternate standard which may exist. Acceptable material is “Ram-Nek,” as manufactured by the K. T. Snyder Company (Houston TX), or equal.

PART 3 - EXECUTION

3.01 CLEANOUT INSTALLATION
   A. General: Install as indicated.

3.02 MANHOLE INSTALLATION
   A. General: Install as indicated.

3.03 TESTING OF MANHOLES ON GRAVITY LINES
   A. At the option of the Contractor, either the following hydrostatic or vacuum test shall be performed.
   B. Hydrostatic Test:
      1. Insert inflatable plugs in all sewer inlets and outlets.
      2. Fill the manhole with water to a point six inches below the base of the manhole frame.
      3. Maintain the water at this point for one hour to allow time for absorption.
      4. Begin one-hour test period. Measure the amount of water added in one-hour period to maintain the water level at six inches below the base of the manhole frame. Do not allow water level to drop more than 25% of the manhole depth.
      5. Determine the allowable leakage by the following formula.
      6. \[ L = 0.0002 \times D \times H^{1/2} \]
      7. \( L = \) Allowable leakage, gallons per minute.
      8. \( D = \) Depth of manhole from top to bottom, feet.
      9. \( H = \) Head of water in feet as measured from the surface of the water in the manhole to the sewer line invert or to the prevailing ground water surface outside the manhole. The lesser height governs.
      10. If the leakage exceeds the allowable, determine the cause, take remedial action and re-test the manhole. If the leakage is less than the allowable and leaks are observed, repair the leaks.
   C. Vacuum Test:
      1. General: Test in accordance with ASTM C 1244.
      2. Test prior to backfilling around the manhole.
      3. Test Preparation: Plug all lift holes and pipes entering or exiting the manhole.
      4. Place test head inside the top section of the manhole’s cone section and inflate in accordance with the manufacturers instructions.
5. Draw a vacuum of 10-inches of mercury and shut the pump off.

6. With the valve closed, the time for the vacuum to drop 9-inches shall be measured.

7. The manhole shall pass the test if the time is greater than 60 seconds for a 48-inch diameter manhole, 75 seconds for a 60-inch diameter manhole and 90 seconds for a 72-inch diameter manhole.

8. If the manhole fails the initial test, make necessary repairs with a non-shrink grout while the vacuum is still being drawn. Retest until a satisfactory test is obtained.

END OF SECTION
SECTION 330554
FUEL DISPENSING EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the Fuel Dispensing System and is defined to include:

1. Furnishing and installing a complete fuel dispensing system at locations indicated on the drawings.
2. Interfacing with the other work specified in these Contract Documents.
3. Acceptance testing.
4. Training of personnel.
5. Maintenance of the system during the warranty period.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

A. Sitework: Division 02.
B. Concrete: Division 03.
C. Fluid Dispensing Systems: Division 11
D. Fluid/Fuel Monitoring System: Section 33 05 90.
E. Mechanical: Division 15.
F. Electrical: Division 16.

1.3 REFERENCES

A. Reference Standards:

1. National Fire Protection Association Standards:
   b. NFPA 70-500 Hazardous (Classified) Locations.
   c. NFPA 496 Standard for Purged and Pressurized Enclosures for Electrical Equipment.
2. Underwriters' Laboratories Listings governing fuel system component construction.
3. Comply with local codes having jurisdiction.
4. Comply with California Air Resources Board (CARB) requirements.

1.4 SUBMITTALS

A. Product Submission and Shop Drawings: As specified in Division 01.
B. Contractor shall provide an accurate conduit layout and coordination with the Fuel Monitoring System.

1.5 QUALITY ASSURANCE

A. The Contractor's design and proposed materials shall be at least of the same level of quality as that indicated and specified.

B. The Contractor shall coordinate the work in this section with the proposed work in Division 33 which includes but not limited to submersible fuel pumps, connections for the fuel monitoring system, submersible fuel pump controls, and electrical conduit and wiring including final connections of such components of all equipment and controls, leak detection system and all other work and material to provide an approved working installation as shown in the Contract Drawings, or required by the Fire Code or as specified.

C. Unless otherwise specified, any materials described, shown, reasonably implied, or obviously a part of the system and necessary to its complete finish and perfect operation shall be furnished and installed, without extra charge. The drawings and specifications are intended to supplement each other, and any item set forth in either shall be recognized as the same as if fully set forth in both.

D. The work required by the Contractor shall meet the criteria set forth in the specifications as well as the code and regulatory requirements of the State, the "NFPA", "U.L." and "I.R.I.".

E. The various component parts shall function together as a workable system, complete with everything necessary for its operation and with all equipment properly adjusted and in working order.

F. The Contractor shall submit the following for review of general conformance with Contract Documents:

1. Complete shop drawings showing connections to the Fuel Dispensing System.

2. Assurances that if substitute equipment is used other than that specified, the specified rate of delivery of each fuel from the fueling nozzles shall be met.

3. Complete shop drawings, catalog cuts, piping diagrams, wiring diagrams, and other information indicating proposed materials, details and layouts. The shop drawings shall indicate all provisions to be made to portions of the building structure to accommodate the work.

4. Name of proposed manufacturers, of all systems components, indicating experience and qualifications.

5. Certification by manufacturers of all system components that the equipment supplied meets or exceeds specification requirements.

6. Maintenance and operation manual(s).

7. The results of all required tests, certified by the manufacturer.

G. Construction Conditions and Coordination

1. Before submitting his bid, the Contractor shall review the Contract Documents and shall thoroughly familiarize himself with the conditions affecting the work. No additional compensation shall be granted on account of extra work made necessary by his failure to investigate such conditions.

2. Prior to initiating work specified in this section, examine all work prepared by others to receive the work of this section and report any defect affecting installation to the Owner's Representative for correction. Commencement of work shall be construed as complete acceptance of preparatory work by others.
3. Plan installation of new work and connections to existing work to ensure minimum interference with other work of the contract.

4. The work shall be carried out by this Contractor in accordance with actual field requirements and shall not depend on the extent of details shown on plans.

5. The Contractor shall be responsible for verification of critical building dimensions associated with the equipment prior to final fabrication and installation of the equipment.

6. The Contractor shall be responsible for coordinating the fabrication and installation of the equipment with the other work of the Contract and shall be scheduled so that there shall be no delay in the proper installation and completion of any part or part of each respective work task wherein it may be interrelated with that of this Contract so that generally all construction work can proceed in its natural sequence without unnecessary delay.

7. Examine all Contract Drawings relating to this project, and verify all governing conditions at the site and become fully informed as to the extent and character of the work required and its relation to other work in this project. No consideration shall be granted for any alleged misunderstanding of the materials to be furnished for work to be done.

H. Substitutions: To be provided in accordance with requirements listed in Division 01.

1.6 DELIVERY, STORAGE AND HANDLING

A. Store equipment in accordance with manufacturer’s recommendations. Protect equipment from dirt and damage. Piping shall be capped on both ends until installation. Store fittings, valves, and other equipment in covered, dry storage until installation.

1.7 WARRANTY

A. Following completion, the Contractor shall provide the Owner with a one (1) year warranty starting at project acceptance, covering all parts, materials, and labor. All warranty work shall be performed by a local manufacturer's representative at the Project Site location, who has capabilities of responding to all problems within 24 hours. Any shipping and delivery costs associated with the warranty of this equipment shall be the responsibility of the Contractor.

PART 2 - PRODUCTS

2.1 RETROFIT UNDERGROUND STORAGE TANK (UST) ACCESSORIES

A. Tank Fuel Level Indicator Leak Monitoring and Alarm System

1. Tank Level: Provide Microprocessor based tank gauging system having a tank transmitter that utilizes a direct lift float which is unaffected by a change in the liquid gravity and comply NFPA 70. Float shall be compatible with the liquid stored in the tank. System shall include NEMA 1 enclosure, remote tank mounted level sensor, digital display in gallons and inches (user selectable), integral intrinsically safe circuits, high and low level warning lights, and temperature compensation. Provide dry contact output signals for remote low and high level alarms. Provide analog 4-20 mA output signals which are linearly scaled to tank level in gallons for connection to the DDC and the remote level indication gauges located at tank. Provide individual level and level alarm output signals for tank to DDC system for remote monitoring and audio/visual alarms at tank. The system shall be suitable for operation on 115 volts, 60 cycles. Provide wiring and raceway for interconnection of all system devices. Must be compatible with Fuel/Fluid monitoring software, Fuel Focus made by Asset Works, a owner's legacy software system.

2. Known Acceptable Source: Veeder Root Co.
3. Remote level gauge for tank: Remote level gauges shall include a NEMA-4 watertight enclosure with LCD capable of displaying readings up to 20,000, and calibrated for 0 to 20,000 gallons. Gauge shall have operating temperature range of 0 to 120 deg F. Gauges shall operate directly from 4-20 mA outputs from tank monitoring system. Locate gauges where visible to person filling the tank.

4. Provide direct reading level gauge visible from the ground. Readout format is on standard 12-hour clock face. Small hand represents feet, large hand inches. Gauge can be read 20 to 30 feet away to within 1/8 inch. Maximum measurement capability is 12 feet. The gauge can be rotated 360 degrees after mounting.

5. Leak monitoring: Provide a continuous monitoring system for tank and fuel piping. The leak monitor shall be UL listed and FM approved, and shall include NEMA 1 enclosure, LCD display, and intrinsically safe circuits. The LCD display shall indicate which sensor has been activated. The alarm output of the monitor shall send signals to indicate the presence of fuel oil leaks to the DDC. The monitor shall also produce an audible and visual alarm at the leak monitoring panel(s) to alert FAA personnel of leakage. The monitoring system shall be in accordance with NFPA 30 & 30A and NFPA 70. Provide control unit, liquid sensors, sensor cables, sensor cable map, and necessary conduit and wires from the sensors to the central unit. Underground conduits, junction boxes, fittings and couplings shall be watertight to prevent leakage of ground water into conduit. Furnish necessary power supply for control unit. Furnish the following sensors:

6. Liquid Sensor: Liquid sensor located in the lowest part of tank's annular space. Sensor shall differentiate sensing of water and fuel, and only alarm upon sensing fuel.

7. Piping Sensor: Provide leak sensors in the annular space of double wall containment piping in monitoring sumps accessible from ground level for repair/replacement of sensor for fuel supply and fuel vapor recovery piping. Also, leak detectors for fuel tank sumps, fuel dispenser sumps and fuel filter spill containment basin. Sensors shall only detect hydrocarbons.

B. Tank Overfill Alarm: Provide audible and visual tank overfill alarm at each tank. Include alarm silence switch at tank.

C. Quality Assurance

1. Installation shall be in compliance with the latest version of the Petroleum Equipment Institute Publications RP 200, and RP300, NFPA-30, 30A, and all manufacturers' current installation instructions.

2. Provide listing/approval stamp, label, or other marking on equipment made to specified standards.

3. Only workmen who have a minimum of 2 years’ continuous experience installing this type equipment and who have attended a training seminar put on by the tank manufacturer in the past 2 years shall perform installation of equipment.

4. The contractor shall be International Fire Code Institute certified in the installation of aboveground storage tank equipment.

2.2 LIQUID LEAK DETECTION SYSTEM

A. Provide complete replacement of liquid leak detection systems to monitor for leaks from underground tanks, underground fiberglass piping, manholes, dispenser sumps, and fill sumps. The system shall include one or more liquid leak monitoring panel(s), sensors, system layout map, and auxiliary equipment required to provide continuous leak detection monitoring of the desired area. Upon detection of liquid leak, cable short, cable break, or sensor activation occurrence, the leak
monitoring panel shall record an alarm condition and the location of leak shall be clearly displayed. Leak detection system will meet the underground fuel pipe monitoring requirements of State of California Environmental Protection Agency.

B. Leak detection systems are to be supplied to accommodate a single power feed. As such, leak detection systems should include all necessary panels, interconnecting wire, conduit, and accessories.

C. Design Criteria:

1. Sensing Equipment - The system shall incorporate the following equipment:
   a. Leak monitoring panel.
   b. Sensors.
   c. Jumper cables.
   d. Switch sensors, including float switches, optical sensors, etc.
   e. Sensing Locations - The system shall monitor for leaks and liquids in the following locations: Existing Underground storage tanks (Ruptures to the inner and outer walls as well as product inventory).
   f. Underground piping detection sumps including low points accessible from above ground for repair/ replacement of sensors.
   g. Sumps beneath fuel dispensers, diesel fuel filters.
   h. Sumps with piping transitions between aboveground to underground.

2. Liquids Detected - The system shall detect the following liquids:
   a. Hydrocarbon fuels and petroleum liquids.
   b. Aqueous water-based liquids.

3. Sensitivity: Incidental liquid contact of smaller than a 2-inch-diameter puddle shall not be detected. The sensitivity of the system shall be field adjustable.

D. Operation and Maintenance Data:

1. Provide as-installed plan layout, wiring, and point-to-point interconnection diagrams of all circuits, internal and external, for all equipment installed. These schematics shall include the conductor color-coding system. Drawings shall be on AutoCAD.
2. Provide a complete description of the system operation, including operating instructions, and maintenance and repair procedures.
3. Provide a complete system checkout field report with a graphic display map, drawing to scale from as-built drawings for each system installed. The map shall indicate all jumper and sensor routing, switch sensor locations junction boxes, cable connections, equipment, mapping points. The map shall be drawn with AutoCAD and a copy of the electronic file provided to the Owner.
4. Include manufacturer's representative's letter stating that system is operational.

E. Spare Parts:

1. Two keys of each type.
2. One sensor of each type.
3. One float switch of each type.

F. Acceptable Manufacturers:

1. Veeder-Root
Training: Upon completion of training, the Owner shall be able to add and delete sensing cable segments, jumper and splice sensing cables, and remap sensing cable lengths without equipment supplier's assistance.

2.3 FUEL DISTRIBUTION PUMPS

A. The contractor will provide the following UL-listed vertical submersible turbine fuel pumps with variable-speed motors as specified on the equipment schedule drawings:

1. Pumps suitable for transferring diesel fuel at a discharge pressure of 70 feet of water and 70 gpm.
2. Pumps suitable for transferring unleaded gasoline at a discharge pressure of 25 feet of water and 30 gpm.

B. The pump vendor will provide all magnetic starters, heaters, connecting wiring, and other necessary equipment for complete pump operation.

C. Pumps shall meet the design criteria stated below

D. Pumps shall comply with CARB and NFPA 30 & 30A requirements for UST tank systems for NFPA defined Class I & II liquids:

1. Contractor is responsible for selection of pumps based on performance requirements specified in this section.
2. Pumps shall be selected such that the rated condition point shall lie at or to the left of the best efficiency point on the pump performance curve but shall not be at a point representing less than 20 percent of rated capacity for the selected impeller size.
3. The motor assembly height shall be field adjustable utilizing a UL listed telescoping shaft and set to a minimum of 6 inches from the bottom of the tank.
4. The entire pumping assembly shall have UL listing and shall meet all requirements of UL Standard UL 79.
5. The piping shall include an approved antisiphon system. Valve(s) shall have integral pressure relief or be provided with an external pressure relief. All piping and valves shall be constructed of stainless steel or have a melting point higher than nodular iron in compliance with NFPA 30 & 30A.
6. Controller for variable-speed pumps will maintain discharge pressure with multiple fuel dispensers operation.
7. Variable-speed pump motors shall have three phase power supply.
8. The pump motor shall have a thermal overcurrent overload protector with automatic reset.
9. The piping shall include a block valves to allow the tank and piping and dispenser to be isolated.
10. Emergency power off-EPO switches will be installed at fuel islands for complete shutdown of fuel distribution system.

E. Acceptable Manufacturer(s):

1. Red Jacket.
F. Pumps shall be provided with one complete set of the following spare parts:

1. Bearings and bearing seals.
2. Packing (when applicable).
4. O-rings.
5. Special tools required for pump maintenance.

G. Pumps with suction and discharge connections greater than or equal to 2.5 inches shall have non-threaded, flanged connections that conform to ANSI standards, with flange face size and type as specified in the attached data sheet(s).

H. Bearing materials shall be recommended and guaranteed by pump manufacturer. Life of anti-friction ball or roller bearings shall be calculated in accordance with ANSI/AFBMA 9, Load Ratings and Fatigue Life for Ball Bearings, or ANSI/AFBMA 11, Load Ratings and Fatigue Life for Roller Bearings, and guaranteed for a minimum life of 30,000 hours at rated conditions.

I. Impellers shall be balanced in accordance with International Organization for Standardization (ISO) G6.3.

J. Pumps shall have spacer-type shaft couplings unless otherwise specified.

K. Pumps shall be provided with the following:

1. Lifting lugs for pumps weighing over 100 pounds.
2. Tapped and plugged suction and discharge pressure gauge connections.

2.4 UNLEADED GASOLINE DISPENSER SYSTEM

A. Acceptable Manufacturers:

1. Products of the following manufacturers are specified herein as the standard of quality for the Unleaded Fuel dispensers. Products equal to listed Manufacturers shall be submitted for approval.

   a. Gasboy International
      Commercial Petroleum Equipment
      1826 West Business Center Drive Orange, CA 92867
      Telephone: (714) 771-7112

B. Construction Features:

1. Single hose dispenser with meter, solenoid, and pulser.
2. Large LCD display, display front and back
3. Fuel supply and vapor recovery piping shall be underground and piped into the base of dispensers through a containment sump.
4. Dispensers shall be compatible with vehicle on-board refueling vapor recovery (ORVR) system for vapor recovery.
5. Power reset - single action resets totalizer and activates each dispenser hose independently.

6. High volume positive displacement meter.

7. Stainless steel panels.

8. Polyurethane paint finish.

9. 10:1 pulsar (120-volt coil) rated for Class I, Division 1 location to interface with fuel management system.

10. 3/4 inch x 12 foot coaxial hose for vapor recovery.

11. Heavy-duty overhead retractor for industrial use to be mounted in dispensers.

12. Shear valves at base for fuel supply and vapor recovery pipes and block valves for isolation of dispenser.

13. Containment sump under base of dispenser.

14. Dual swivels (nozzle and hose)

15. Light unit at dispenser


17. Hose assemblies to be reconnectable breakaway type.

18. Provide a fuel filtering system as part of the dispensing equipment. Manufacturer is to provide information on the filters as part of the shop drawing process.

19. Dispensers shall be supplied with fuel from submerged turbine pump with variable-speed motor at existing fuel tanks. Pump controller will maintain fuel pressure.

C. Capacities and Dimensions:

1. Flow Rate: 10 gpm maximum for vapor recovery, minimum delivery rate to be 8 gpm.

2. Unleaded hose: Vapor recovery coaxial.


D. Dispenser shall include built in filtering system as manufactured by Gasboy International or approved equal with the above minimum requirements.

E. Electrical Requirements: 120VAC-1PH-60HZ

F. Unleaded Vapor Recovery Nozzles:

1. One nozzle per dispenser

2. Full hand insulator
3. Hold-open rack
4. Body: aluminum
5. Swivel: Goodyear maximum coaxial hose swivel
6. Flow regulator
7. Disc: Buna-N
8. Splitter valve
9. Coaxial hose: 1 7/8"
10. Compliance with CARB Phase II vapor recovery.
11. ORVR-compliant nozzle made by Healy, compatible with mini-jet vacuum pump and Healy model 400 ORVR stage 2 vapor recovery system.

G. Unleaded fuel nozzle shall be as manufactured by Franklin Fueling Systems Healy 400 ORVR nozzle.

PART 3 – EXECUTION

3.2 PERFORMANCE

A. Installation Instructions: Install those products per manufacturer’s shop drawings and installation instructions in strict accordance with all City and Fire codes which govern them and also in instructions covered herein under Part 3. Locations indicated on the Drawings.


C. Equipment Start-Up: Perform equipment start-up testing and instruction in accordance with Division 01 and ensure its proper operation prior to acceptance of work by the Owner’s Representative.

3.3 INSTALLATION

A. Coordinate all conduit runs with fuel monitoring system with the installation of the fueling dispensers, and with the submersible fuel pumps, and the submersible pump controls as specified in Division 15 and 16. Coordination procedures shall include but not be limited to installation of all pulse transmitters, fluid solenoid valves, switches, and relays, to assure proper interfacing of equipment.

B. General: Install dispensers and related items in accordance with approved shop drawings, manufacturer's installation instructions and as indicated on Construction Drawings. Installation shall conform to NFPA 30 & 30A.

C. Start-up by factory technicians to assure correct installation of wiring, pumps, and other devices used within the system. Technician representing manufacturer of equipment item(s) or system(s) being checked out, shall perform the following functions:

1. Perform start-up test in the presence of the Owner’s Representative.
2. Dispensing units shall be tested individually to assure proper function and together, simultaneously, to assure proper delivery rate.
3. Observe all tests as performed, including any required retests.
4. Test all fuel piping in accordance with local fire codes.

5. Train Owner’s personnel in accordance with the provisions of Division 01 in the proper safe operation of the system including:
   a. Proper operation of dispensing system.
   b. Safety precautions with nozzles and breakaway hoses.
   c. Operation and maintenance of pumps, dispensers, and other system appurtenances.
   d. Answering questions that shall give a better understanding of the system.

D. Manufacturer shall provide all required components to meet Class I, Division 1 for all components under the finish floor and Class I, Division 2 for all components within 18 inches above finished floor as required by NFPA and other codes having jurisdiction or as required by local agencies who take precedence over the above mentioned.

3.4 FUEL DISTRIBUTION PUMPS

A. Field Test: Pumps shall be tested after installation to demonstrate their conformance to Specifications. Contractor shall prepare and submit to Owner a test log that records the following:
   1. Capacity, as measured by a calibrated flow meter.
   2. Discharge pressures, as measured by calibrated gauges.
   3. Drive motor voltage and amperage for each phase.

B. Vibration Test: When specified on the pump data sheet, pumps shall be vibration tested after installation. Acceptable peak-to-peak vibration limits are as follows:

<table>
<thead>
<tr>
<th>Speed, S (rpm)</th>
<th>Antifriction Bearing (Measured on Bearing Housing)</th>
<th>Sleeve Bearing (Measured on Shaft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero &lt;S &lt;1,800</td>
<td>3 mils</td>
<td>3.0 mils</td>
</tr>
<tr>
<td>1,800 &lt;S &lt;3,600</td>
<td>2 mils</td>
<td>2.5 mils</td>
</tr>
</tbody>
</table>

C. Pumps failing to meet the requirements of the Specifications shall be subjected to more accurate tests. If a pump fails a second test, it shall be rejected, replaced, and retested.

3.5 LIQUID LEAK DETECTION SYSTEM

A. Installation: Install system as follows:
   1. Leak monitoring panel(s) shall be mounted and powered prior to installation of the sensing cable(s).
   2. Sensing cable(s) shall be installed after piping and other mechanical work is completed. Take care during installation of sensing cable(s) to avoid contact with potential contaminants, such as puddles or solder flux.
   3. Sensing and jumper cables shall be fastened securely at each point using hold-down clips together with plastic adhesive.
4. System cables shall be labeled at 20-foot increments. Labels shall identify individual sensing cable and record mapping distance. Use TraceTek TT-Tag, or Brady sleeve labels for identifying cables.

3.6 FIELD QUALITY CONTROL

A. Tests: Test components of liquid petroleum dispensing systems for compliance with the specifications. At the sole discretion of the Owner’s Representative, the Contractor may be required to repeat any tests, at no cost to the Owner. Items to be tested, as a minimum, are as follows:

1. Pressure test, in the presence of the Owner’s Representative and Owner’s personnel, supply piping in accordance with the following:
   a. Air pressure at ten psig; or hydrostatic at 25 psig.
   b. Air Test: Introduce compressed air into a suitable opening in system, after closing all other inlets and outlets, until there is a uniform gauge pressure as specified. Maintain pressure without introduction of additional air for 15 minutes and until a soap suds solution test/examination is made to determine each joint and connection leak free.
   c. Hydrostatic: Maintain test pressure, without introduction of additional pressure, until an examination is made to determine each joint and connection leak free, but in no case less than one-half hour actual test time.

2. Each dispenser shall be certified by “California Weights and Measures”.

3. Each dispenser shall operate properly under both automatic and manual operating mode of Fuel Management System.

4. Each nozzle shall shut-off automatically in accordance with tank fill percentage identified in approved manufacturers catalog literature.

5. Dispensed volume of fuel reported by Fuel Monitoring System shall correspond exactly with dispenser register. System shall deliver a minimum of 40 gpm for diesel hoses when all four dispensers are dispensing simultaneously.

6. Coordinate with fuel pumping, piping and management systems specifications to assure proper demand is coordinated.

B. Provide the services of qualified manufacturer's representatives to perform the following:

1. Inspect testing, prior to substantial completion of the facility, by the Contractor in the presence of the Owner’s Representative, to ensure proper operation of the equipment.

2. Perform all scheduled and unscheduled maintenance during warranty period; provide all labor and materials.

END OF SECTION
SECTION 33 05 90
FUEL/FLUID MONITORING SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section specifies the Fuel/Fluid Monitoring System and is defined to include, but not necessarily be limited to:

1. Designing, fabricating, furnishing, and installing a complete monitoring system at locations indicated on the Contract Drawings.

2. Interfacing with the other work specified in these Contract Documents.

3. Acceptance testing.

4. Training of Owner personnel.

5. Maintenance of the system during the warranty period.

B. Related Work Specified Elsewhere:

1. Sitework: Division 02.

2. Concrete: Division 03.


4. Fuel Dispensing Equipment: Section 33 05 50.

5. Mechanical: Division 23.

6. Electrical: Division 26

1.2 DEFINITIONS

A. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, it is intended to establish required performance of the product. See Section 01600 – Product Requirements for more information.

1.3 QUALITY ASSURANCE

A. Reference Standards:

1. Underwriters' Laboratories Listings governing fuel system component construction and electrical construction.

2. Comply with local codes having jurisdiction as listed in Division 01.

B. The Fuel/Fluid Monitoring System manufacturer shall be:
992 Sids Rd
Rockwall, TX 75032
Telephone:  (972) 722-1009
Fax:  (972) 722-1033

2. No alternative manufacturers unless approved by AC Transit District prior to bid.

C. Substitutions: To be provided in accordance with requirements listed in Division 01. Based on the District’s requirement to be compatible with existing system used, Substitution shall not be granted unless approved by AC Transit during the bidding process. Any substitution during Shop Drawing review shall be rejected.

1.4 SUBMITTALS

A. The equipment shall be new and furnished with all specified materials and ready for installation when delivered. Used or reconditioned equipment shall not be accepted.

B. Manufacturer shall be a firm regularly engaged in the design and manufacture of the type of equipment specified herein.

C. Submit product submission and shop drawings as specified in Division 01.

D. Submit proposed design for the conduit routing of the specified fluid/fuel monitoring system to the fuel dispensing system and fluid dispensing system as required by shop drawings. Contractor shall coordinate with electrical, civil and equipment drawings in order to incorporate manufacturer’s conduit layout and coordination with disciplines.

E. Fluid Management System (FMS) supplier shall be required to review and approve fluid impulse meters (pulsars) and solenoids provided by fluid dispensing manufacturer that provide direct connection to the FMS. Manufacturer shall also be required to approve conduit routing submitted by the Contractor.

1.5 JOB CONDITIONS

A. Work includes design, fabricating, furnishing and installation of a fuel/fluid monitoring system to control the usage of all diesel, and unleaded gasoline dispensing units (specified in section 33 05 50) and fluid monitoring of above ground reels (MO, ATF, EC) in the maintenance building and the Fueling Island service lanes (MO, ATF, EC), and electrical conduit and wiring including final connections of such to components of all equipment and controls, and all other work and material to provide an approved working installation as shown in the Contract Drawings, or as specified.

B. Unless otherwise specified, any materials described, shown, reasonably implied, or obviously a part of the system and necessary to its complete finish and perfect operation shall be furnished and installed, without extra charge. The drawings and specifications are intended to supplement each other, and any item set forth in either shall be recognized as the same as if fully set forth in both.

C. The Contractor and the Fluid Management System manufacturer shall be responsible for establishing all conduit sizes and materials, component locations, type and quantities, mounting requirements and hardware, equipment selection and any and all other design parameters necessary to provide a complete operable fuel/fluid monitoring system as described in the specifications and on the Contract Drawings, and coordinate with such components and sizes with approved shop drawings to verify proper installation. Information provided on the contract drawings is minimum requirements to be used as guidelines to assist the Contractor in bidding.

D. The various component parts shall function together as a workable system completes with everything necessary for its operation and with all equipment properly adjusted and in working order.
E. The Contractor shall submit the following for review of general conformance with Contract Documents:

1. Complete shop drawings, catalog cuts, conduit diagrams, wiring diagrams, and other information indicating proposed materials, details and layouts. The shop drawings shall indicate all provisions to be made to portions of the building structure to accommodate the work.

2. Certification by manufacturers of all system components that the equipment supplied meets or exceeds specification requirements.

3. Sole responsibility for correctness of dimensions, details, quantities, and safety shall remain with the Contractor.

4. Maintenance and operation manuals.

5. The results of all required tests, certified by the manufacturer.

F. Construction Conditions and Coordination

1. Before submitting his bid, the Contractor shall review the Contract Documents and shall thoroughly familiarize himself with the conditions affecting the work. No additional compensation shall be granted on account of extra work made necessary by his failure to investigate such conditions.

2. Prior to initiating work specified in this Section examine all work prepared by others to receive the work of this Section and report any defect affecting installation to the District Representative for correction. Commencement of work shall be construed as complete acceptance of preparatory work by others.

3. Plan installation of new to insure minimum interference with other Work of the Contract.

4. The Work shall be carried out by this Contractor in accordance with actual field requirements and shall not depend on the extent of details shown on plans.

5. The Contractor shall be responsible for verification of critical building dimensions associated with the equipment prior to final fabrication and installation of the equipment.

6. The Contractor shall be responsible for: Coordinating the fabrication and installation of the equipment with the other Work of the Contract and shall be scheduled so that there shall be no delay in the proper installation and completion of any part or part of each respective work task wherein it may be interrelated with that of this Contract so that generally all construction work can proceed in its natural sequence without unnecessary delay.

7. Examine all Contract Drawings relating to this Project, and verify all governing conditions at the site and become fully informed as to the extent and character of the work required and its relation to other work in this Project. No consideration shall be granted for any alleged misunderstanding of the materials to be furnished for work to be done.

1.6 WARRANTY

A. Following completion, the Contractor shall provide the Owner with a one (1) year warranty starting at project acceptance, covering all parts, materials, and labor. All warranty work shall be performed by a local manufacturer’s representative, at the Project Site location, who has capabilities of responding to all problems within 24 hours. Any shipping and delivery costs associated with the warranty of this equipment shall be the responsibility of the Contractor.
2.1 FLUID MANAGEMENT SYSTEM

A. Comprising Equipment Item No.: F-9, and RR-27, as well as interface to existing client network for the system and controlling software.

2.2 DESCRIPTION

A. System Parameters: Installation shall provide electronic recording of vehicle number, mileage, and amounts of diesel fuel, unleaded fuel, engine oils, engine coolant, and automatic transmission fluid dispensed to buses and gasoline dispensed to support vehicles at service lanes. Data collection will take place via the Fluid Control Terminal (FCT). System shall provide a fully functional interface to a tank monitoring controller for monitoring of fluids stored in remote tanks, and fluid deliveries. System shall provide software for fluid use and inventory reports. System shall permit add-on expansion of additional liquid products or reels, if desired by District at a future date. System shall automatically collect, record, transmit, compile and print data as specified herein. The system shall be designed to meet the following objectives:

1. Improve fuel inventory management by integrating one or more tank level monitoring systems into the fuel system.
2. Provide the appropriate reports to the using agencies.
3. Capture vehicle mileage at time of servicing and fueling.
4. Be accessible to end users via the District network utilizing the existing client/server user interface.
5. Meet all NFPA, State, and Fire regulatory requirements for safe operation in the conjunction with all fuels and petroleum products.
6. Fluid Control Terminals at shall have a Class I Division 2 electrical classification per the National Electrical Code.

B. System/Components. Provide items and components to perform the above functions. Equipment shall include but not limited to the following:

1. Fluid Control Terminals (FCT)
2. Integration to Fluid monitoring system client computer and custom District client server interface
3. Coordinate the installation and wiring of control solenoid valves, pulsars, meters or meter modification kits provided by the fluid dispensing manufacturers. Locate as required per each service position.
4. Software and programs as necessary for functioning of FCT and FCT Controller Units. Software shall verify accurate data transmission using reasonableness checks, parity checks, and other checks required to ensure accurate data transmission. Software and programs shall be configured to match the existing District facilities for consistency and ease of use.
5. All necessary conduit, junction boxes, and pull wire for the proper installation and operation of the system will be the responsibility of the Contractor. Pulsars are to be provided by the lubrication system manufacturer, but approved by the fluid management system manufacturer prior to acceptance.

C. System Operation

1. FMS shall provide mileage, diesel fuel, gasoline, engine oil, ATF, and engine coolant, record management by automatically recording, storing, compiling, and printing formatted transaction data continuously on a 24-hour per day basis.
2. FMS shall be automatic except for operator functions specified herein. System shall operate unattended except for normal service operator inputs, operator file updates periodic status monitoring, and printer paper and ribbon replacement. Operator transactions and printer messages shall be in conversational language and shall include at a minimum, the existing error messages used at other DISTRICT facilities. Input and output codes shall not be used, unless format and storage capacities absolutely dictate their use. All operator transactions and printer messages shall be defined in plain language and be bound in a system manual.

3. FMS shall verify all bus or vehicle identification inputs against bus and vehicle authorization file maintained on the existing DISTRICT server.

4. FMS shall verify all employee identification inputs against employee authorization file maintained on the existing DISTRICT server.

5. FMS shall provide System Controller Unit operator with ability to maintain the following from the existing DISTRICT server:
   a. Set current date and time.
   b. Delete vehicle authorization from file.
   c. Enter vehicle authorization in file.
   d. Enter employee in file.
   e. Delete employee from file.
   f. Place FCT units off and on line.
   g. Set fluid quantity limits for exception reports.
   h. Set engine oil type by vehicle for selective oil control.
   i. Set request and schedule print option for each report.
   j. Enter special message of up to 16 characters including blanks (such as PARK IN ROW B) and list of bus numbers for which this message shall apply. This message shall then be displayed on the FCT unit when one of the buses is serviced.
   k. Request status of fuel storage tanks.
   l. Request record of fuel receipts.
   m. Request tank alarm history.
   n. Define storage tank parameters.
   o. Produce all reports defined in the System Reporting Requirements section of these specifications and integrated data with existing District facilities.
   p. FMS shall provide the capability for all the above data to be downloaded from a host CPU to the Central Control Server on demand from the host CPU.
   q. Create other software users.
   r. Define software application permissions for each user.
   s. Manage in and out of service buses. Provide the user interface and reporting needed to take buses in or out of service for maintenance.
   t. Provide complex bus inspection management. Keep track of all inspection history, provide at least 10 inspection events for each classification of vehicle and project the need for future inspections based on date range, fuel, oil or coolant consumed.

D. Sequence of Operations

1. Normal Mode of Operation: Vehicle Information
   a. Vehicle Transmitter (VIT) shall prompt initiation of fueling sequence and activate appropriate fuel hose location and petroleum product fluid reels. FCT shall prompt operator for:
      ENTER ID
      RE-ENTER ID (if invalid)
   b. During the time that the fueling operator is entering his employee ID and his ID number is being verified by the Controller through the existing data validity checks on the DISTRICT fueling system server, the FCT unit shall cause the VIT unit transmit the total miles traveled (life-to-date miles) for the vehicle.
c. If the FCT Controller contains a special message (such as PARK IN ROW B, PM A SCHEDULED, etc.), this message shall be flashed on the display of the FCT unit.

d. At this point solenoid valves in the diesel, engine oil, coolant, ATF lines, and air to consumable suction pumps shall be energized and opened by the FCT unit. Only the engine oil specified for the fueling vehicle should be energized.

e. As fuel, engine oil, ATF, or coolant are dispensed into bus or vehicle, quantities of products dispensed shall be sensed and recorded initially by FCT. Electronic pulser/transducers shall sense fuel in tenths of gallon, and other liquids in tenths of a quart.

f. Diesel fuel dispensed shall be displayed on FCT display as follows:
FUEL D<XXX>YYYYY
where XXX is the calculated expected fuel required quantity, if available, and *** if not available. YYYYY is the actual quantity in tenths of fuel dispensed.

g. Products and quantities of each dispensed item shall be transmitted by the FCT unit to the existing DISTRICT fueling system server and stored in the existing DISTRICT fuel system database.

h. Upon completion of servicing and exit from the service lane, the VIT-sensing ground loop shall sense departure of bus or vehicle and cause FCT to terminate transaction and record final quantity information.

i. Transaction shall be automatically terminated at end of any 5-minute interval following cessation of fueling operation. The time-out should be configurable per FCT to allow for longer or shorter inter-pulse timeouts as required.

2. Back-up Mode of Operation: The sequence of operations for servicing vehicles which are not equipped with a VIT or for which there is a malfunction in the VIT, shall be as follows:

a. The sequence shall begin as described above with the entry of the employee ID.

b. After a short time-out period, during which a vehicle number and mileage are not received by the receiver unit, the FCT unit shall automatically proceed with a prompt ENTER VEH NUMBER and require entry through the keypad of a valid vehicle number for the vehicle to be serviced.

b. For the next step the system shall provide the user the capability to ENTER MILEAGE or the system shall automatically calculate mileage based upon fuel dispensed to the vehicle if a mileage is not entered.

c. At this point solenoid valves in the diesel, engine oils, coolant, and ATF lines shall be energized and opened by the FCT unit and succeeding steps would be identical to those described in the preceding paragraph.

3. Sequence of Operations-Non-Revenue Position: The sequence of operations for the non-revenue dispenser positions shall be the same as the back-up mode of operation for the diesel position with the exception that transaction termination shall be by time out or pushing CANCEL button only.

E. Features and Construction

1. Fluid Control Terminals

a. General: FCT shall:
(1) Be located at service position in the fuel islands as noted per plans. Typical of 4 locations.
(2) Be located in Safety Inspection bay reel set in the Maintenance Building as shown on the drawings. Typical of 3 locations.
(3) Be the interface between fueling operator, dispenser, traffic sensors, and FMS.
(4) Be weatherproof, vandal resistant, and tamper proof.
(5) Be plug-in, remove and replace, maintainable.
(6) Consist of push-button console with display, mounted on upright stand.
(7) Operate in temperature range from 0 degrees F to 120 degrees F, and relative humidity range of 5 to 95 per cent, non-condensing.
F. Software Systems

1. Network Communications: The system shall include communication technology that interconnects the various FCT’s with the existing central control server and network. The communication technology shall integrate the hardware into a complete fleet fluid management system.

2. Communication Procedure

   a. Communication between the central control server and the FCT’s shall be by networked connection. Communication routines shall be capable of operating over the DISTRICT network.

   b. The FCT’s shall connect to the server by networked connection. Once the communication channel is established, the FCT’s shall transmit each of its stored transactions. The server shall accept the transaction and allow the next transaction to be sent. When the FCT’s indicates that there is no more data to send, the server shall update the FCT’s with any new vehicle information and/or time and date.

   c. The FCT’s shall be able to accept downloaded time for call parameters that shall allow the user to configure each individual site based on its activity level. For example, a very high use site might be configured to poll in hourly or after 100 transactions. A low usage or long distance site might be configured to call only once or twice per day or upon reaching 500 transactions. The call in parameters shall be easy to configure in the system and shall be accessed through the standard graphical user interface. The FCT’s shall initiate communication based on number of transactions and/or lapsed time. In addition, the remote fuel island terminal shall automatically establish communication with the server in the event of power failure, intrusion or other defined occurrences (i.e. fire, fuel leak etc.)

   d. The system server shall also have the capability to automatically poll the FCT’s. The software system shall provide the user with a menu driven polling routine. A menu providing the capability to poll ICTs or one remote fuel island terminal on demand shall also be provided.

3. Communication

   a. The central control server shall maintain communication security between the network and FCT’s. The FCT’s shall not transmit data unless the central control server specifically requests the information in the correct sequence.

   b. When the FCT has completed the transmission of data to the central control server, the server shall transmit control information back to the terminal. The control information shall contain the number of minutes before the next polling sequence, the maximum number of transactions to collect before calling, and the maximum number of transactions to collect before refusing to accept any more transactions.

G. Utilities: 120V-1PH-60Hz Service at island controller, and at Safety/Inspection Bay controller.

H. Fluid Management System shall be manufactured by S&A Systems, Inc of Redwall, Texas.

PART 3 - EXECUTION

3.1 PERFORMANCE
A. Installation Instructions: Install those Products, as specified previously under PART 2 and not specifically covered for installation herein under PART 3, in strict accordance with manufacturer's installation instructions and at locations indicated on the Drawings.


C. Equipment Start-Up: Perform equipment start-up testing and instruction in accordance with Division 01 and insure its proper operation prior to acceptance of work by the District Representative.

3.2 INSTALLATION

A. Coordination procedures shall include but not be limited to installation of all pulse transmitters, fluid solenoid valves, switches and relays, to assure proper interfacing of equipment.

B. Start-up by factory technicians to assure correct installation of wiring, pumps, and other devices used within the system. Technician representing manufacturer of equipment item(s) or system(s) being checked out, shall perform the following functions:

1. Assure correct installation and wiring of the card reader, terminal/printer microprocessor, pumps, stands, and other devices used with the system. Contractor to utilize manufacturer shop drawing schematics as the final conduit routing for the management system.

2. Input all necessary information into Fuel/Fluid Monitoring System microprocessor for proper initial operation of system, including all required information regarding all vehicles assigned to the Owner.

3. Observe all tests as performed, including any required re-tests.

4. Train Owner personnel in accordance with the provisions of Division 01 in the proper safe operation of the system including:
   a. Card reader operation by the user.
   b. Microprocessor operation and purpose of override switches.
   c. Transaction Log communication interface operation.
   d. Answering questions that shall give a better understanding of the system.

3.3 FIELD QUALITY CONTROL

A. Tests: Test components of the Fuel/Fluid Monitoring System for compliance with the specifications. At the sole discretion of the DISTRICT Representative, the Contractor may be required to repeat any tests, at no cost to the Owner. Items to be tested, as a minimum, are as follows:

1. Fuel/Fluid Monitoring System shall be tested for compliance with all requirements of Article 2.02.

2. Dispensed volume of diesel fuel, gasoline, motor oil, coolant and ATF reported by Fuel/Fluid Monitoring System shall correspond exactly with volumes actually dispensed into measured containers from each monitored control handle.

3. Transaction log communication interface shall properly transfer a sample log from the microprocessor memory to the Owner’s host computer in a format compatible with Owner’s software.

B. Provide the services of qualified manufacturer’s representatives to perform the following:
1. Observe testing, prior to substantial completion of the facility, by the Contractor in the presence of the DISTRICT Representative, to ensure proper operation of the equipment.

2. Perform all scheduled and unscheduled maintenance during warranty period; provide all labor and materials.

C. Once installed, proper operation of the system shall be demonstrated as follows:

1. Automatic transfer of correct vehicle number and mileage from the VIT units.

2. Automatic transfer of correct vehicle number and mileage from the mileage collection unit to the hand-held portable reader.

3. Transfer of stored vehicle number and mileage data from the hand-held portable reader to a PC.

4. Programming (and re-programming) of the mileage collection unit with vehicle number, current life-to-date miles, and tire factor (revolutions per mile).

5. Fluid dispensing accuracy, as compared to the metered dispensing guns and a calibrated container.

6. System reports on usage and vehicle information.

7. Projected inspection reports

END OF SECTION
SECTION 33 30 00
SANITARY SEWERAGE UTILITIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Roadway and/or site sanitary gravity sewers and force mains up to 5 feet of any on-site building.

1.02 RELATED SECTIONS

A. Section 31 23 33 – Trenching and Backfilling.
B. Section 32 05 23 – Cement and Concrete for Exterior Improvements.
C. Section 33 05 16 – Utility Structures.

1.03 RELATED DOCUMENTS

A. AASHTO:
   1. M 252: Corrugated Polyethylene Drainage Tubing.
   2. M 294: Corrugated Polyethylene Pipe, 12 to 24-inch Diameter.

B. ASTM:
   1. A 615/A615M: Deformed and Billet-Steel Bars for Concrete Reinforcement.
   2. A 674 Practice for Polyethylene Encasement for Ductile Iron Pipe for Water and Other Liquids.
   5. D 1785: Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
   10. D 3034: Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
15. F-1336: Poly(Vinyl Chloride) (PVC) Gasket Sewer Fittings.

C. AWWA:
3. C110: Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm Through 1,219 mm) for Water.

D. Caltrans Standard Specifications.
1. Section 65, Reinforced Concrete Pipe

1.04 DEFINITIONS
A. AASHTO: American Association of State Highway and Transportation Officials.
E. HDPE: High-density polyethylene.
F. PE: Polyethylene.
G. DIP: Ductile iron pipe.
H. PVC: Polyvinyl Chloride.
I. RCP: Reinforced concrete pipe.
J. NPS: Nominal pipe size.

1.05 SUBMITTALS
A. Follow submittal procedures outlined in Section 01 33 00 – Submittal Procedures.
B. Product data for the following:

1. Piping materials and fittings.
2. Special pipe couplings.
C. Design Mix Reports and Calculations: For each class of cast-in-place concrete.

D. Field Test Reports: Indicate and interpret test results for compliance with performance.

1.06 DELIVERY, STORAGE AND HANDLING

A. Do not store plastic pipe and fittings in direct sunlight.

B. Protect pipe, fittings, and seals from dirt and damage.

C. Handle precast concrete pipe and other precast structures according to manufacturer’s written instructions.

D. Protect imported bedding and backfill material from contamination by other materials.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS FOR GRAVITY FLOW

A. PE Pipe and Fittings (HDPE): 4-inch through 10-inch, AASHTO M252 Type S, smooth interior and corrugated exterior. Bell and spigot joints.


   2. Couplings: AASHTO M 252, corrugated band type, engage a minimum of 4 corrugations, 2 on each side of pipe joint.


   2. Couplings: AASHTO M 252, corrugated band type, engage a minimum of 4 corrugations, 2 on each side of pipe joint.

C. PVC Pipe:

   1. Pipe:

      a. 4-inch through 15-inch: ASTM D 3034, SDR 35. Bell and spigot joints.

      b. 18 inch through 36-inch: ASTM F 679, T-1 wall. Bell and spigot joints.

   2. Fittings:

      a. 4-inch through 27-inch: ASTM F 1336.

      b. 30-inch through 36-inch: ASTM D 3034, SDR 35


2.02 SPECIAL PIPE COUPLINGS

A. Gravity Piping: ASTM C 1173. Rubber or elastomeric sleeve and band assembly fabricated to match outside diameters of pipes to be joined.

2.03 MANHOLES AND CLEANOUTS

A. See Section 33 05 16 – Utility Structures.
3.01 GRAVITY PIPE INSTALLATION

A. General: Install pipe, fittings, and appurtenances utilizing best practices, manufacturer’s instructions, and in accordance with Section 6 and 7 of ASTM D 2321 for plastic pipe, Caltrans Standard Specification Section 65-1.07 for reinforced concrete pipe and chapter 11.3.3 of AWWA M41 for ductile iron pipe.

B. Pipe Depth and Trench Configuration: Conform to typical trench section(s) indicated.

C. Excavation, Bedding, Backfill, and Compaction: Section 31 23 33 – Trenching and Backfilling.

D. Handling: Carefully handle during loading, hauling, unloading and placing operations to avoid breakage or damage. Use strap type slings for lifting and placing; no chains or hooks will be permitted. Comply with the manufacturer’s recommendations.

E. Laying: Before lowering pipe into the trench, remove all stakes, debris, loose rock and other hard materials from the bottom of the trench. Lay accurately in conformance with lines and grades indicated. Start laying the pipeline at the low end and proceed upstream. Lay bell and spigot pipe with the bell end facing upstream. Lay pipe on a bed prepared by handwork, dug true to grade. Furnish firm bearing for pipe throughout it’s entire length with bell holes provided at the ends of each pipe length of sufficient size to permit making up the particular type of joint being used. Adjust pipe to line and grade by scraping away or filling and tamping material under the body of the pipe for the entire pipe length and not by blocking or wedging. After final positioning, hold pipe in place in trench with backfill material placed equally on both sides of the pipe at as many locations as required to hold the pipe section in place.

F. Curved Alignment: When necessary to conform to the alignment specifically indicated, lay pipe on a curved alignment by means of asymmetrical closure of joints or bending of the pipe barrel. Use shorter lengths of pipe than the standard length if necessary to achieve curvature specified. Do not exceed the recommendations of the pipe manufacture for deflections at the joints or pipe bending.

G. Closure: Close open ends of pipes and appurtenance at the end of each days work or when work is not in progress.

3.02 SPECIAL PIPE COUPLINGS

A. General: Use where required to join piping and no other appropriate method is specified. Do not use instead of specified joining methods.

B. Installation: Per manufacturer’s instructions.

3.03 TESTING OF GRAVITY PIPING MAINS

A. Obstructions: After backfilling and compacting, but before paving or other surface improvements, test sewer for obstructions either by rodding or by the sewer ball method. Provide for intercepting all grit, rocks and other flushed debris to keep debris from entering the existing system.

B. At the option of the Contractor, either the following hydrostatic or air test shall be performed.

C. Hydrostatic Test:

1. Test after backfilling to finish grade or pavement structural section subgrade in paved areas.

2. Test sewer mains between successive manholes by closing the lower end of the sewer main to be tested and the inlet sewer main of the upper manhole with stoppers.
3. Fill pipe and manholes with water to a point four feet below the ground surface of the upper manhole, but in no case less than four feet above the pipe invert. If ground water is present, the water surface at the upper manhole shall be at least four feet above the level of the ground water.

4. Fill piping at least one hour prior to testing.

5. Test piping at least two hours by maintaining the head specified above with measured additions of water. The sum of these additions of water, in the two-hour test period, shall be the leakage amount.

6. The maximum allowable head of water above any portion of sewer being tested shall be 15-feet. Where the difference in elevation between successive manholes exceeds 15-feet, a test tee shall be installed between manholes, and the testing shall be carried on between the tee and the manhole.

7. The allowable leakage shall not exceed 0.1-gallons per minute per inch diameter, per 1000-feet of sewer main being tested.

8. If the leakage exceeds the above amount, determine the cause and remedy it prior to retesting.

9. If the leakage is less than the allowable, but leaks are observed, repair the observed leaks.

D. Air Test:

1. Test after backfilling to finish grade or pavement structural section subgrade in paved areas.

2. Apply to each length between adjacent manholes.

3. Supply pressure gauge with minimum divisions of 0.10-psi and with an accuracy of +/- 0.04-psi. When requested by the Owner, provide certification that the gauge has been tested for accuracy within the last six months by a reliable testing firm.

4. Pressurize the test section to 3.5-psi, and then hold the pressure above 3.0-psi during a saturation period of at least 5 minutes. At the end of the saturation period, note the pressure, which must be a minimum of 3.0-psi, and begin the timed period. If the pressure drops 0.5-psi in less than the time given in the following table the section of pipe has not passed the test.

5. | Pipe Size | Minimum Time Allowed for Pressure to Drop 0.5-PSI |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4&quot;</td>
<td>125 seconds</td>
</tr>
<tr>
<td>6&quot;</td>
<td>185 seconds</td>
</tr>
<tr>
<td>8&quot;</td>
<td>245 seconds</td>
</tr>
<tr>
<td>10&quot;</td>
<td>310 seconds</td>
</tr>
<tr>
<td>12&quot;</td>
<td>370 seconds</td>
</tr>
<tr>
<td>15&quot;</td>
<td>460 seconds</td>
</tr>
<tr>
<td>18&quot;</td>
<td>555 seconds</td>
</tr>
<tr>
<td>21&quot;</td>
<td>10 minutes</td>
</tr>
<tr>
<td>24&quot;</td>
<td>12 minutes</td>
</tr>
<tr>
<td>27&quot;</td>
<td>14 minutes</td>
</tr>
<tr>
<td>30&quot;</td>
<td>16 minutes</td>
</tr>
<tr>
<td>36&quot;</td>
<td>18 minutes</td>
</tr>
<tr>
<td>42&quot;</td>
<td>20 minutes</td>
</tr>
<tr>
<td>48&quot;</td>
<td>23 minutes</td>
</tr>
<tr>
<td>54&quot;</td>
<td>26 minutes</td>
</tr>
</tbody>
</table>
6. If the time for the pressure to drop 0.5 psi is 125% or less of the time indicated, the line shall immediately be re-pressurized to 3.0 psi and the test repeated. If, during the 5-minute saturation period, the pressure drops less than 0.5 psi after the initial pressurization and air is not added, the section undergoing the test shall have passed.

7. If the test did not pass, find and repair the leak to the satisfaction of the Owner.

8. When the prevailing ground water is above the line being tested the air pressure shall be increased 0.43 psi for each foot the water table is above the invert of the pipe at the highest manhole.

3.04 TESTING OF LATERALS

A. At the option of the Contractor, either the following hydrostatic or air test shall be performed.

B. Hydrostatic Test:
   1. Test laterals before backfilling.
   2. Plug lateral at its ends and fill with water through the cleanouts.
   3. Maintain the water level in the cleanouts as high as possible throughout the test period.
   4. One hour after filling with water, examine the lateral for leakage.
   5. Repair all leaks to the satisfaction of the Owner.
   6. Do not backfill the trench until testing and repairs of the lateral are complete, and approved by the Owner.
   7. Following approval of the Owner, remove all plugs, dispose of the water and complete the connection to the main.

C. Air Test
   1. Test after backfilling to finish grade or pavement structural section subgrade in paved areas.
   2. Test in accordance with subsection above titled “Testing of Gravity Piping Mains,” paragraph titled “Air Test.”

END OF SECTION
SECTION 33 40 00
STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.01 SECTION INCLUDES
A. Roadway and/or site storm drainage up to 5-feet of any on-site building.

1.02 RELATED SECTIONS
A. Section 31 23 33 – Trenching and Backfilling
B. Section 32 05 23 – Cement and Concrete for Exterior Improvements

1.03 RELATED DOCUMENTS
A. AASHTO:
   1. M 252: Corrugated Polyethylene Drainage Tubing.
   2. M 294: Corrugated Polyethylene Pipe, 12 to 24-inch Diameter.

B. ASTM:
   2. A 615/A615M: Deformed and Billet-Steel Bars for Concrete Reinforcement.
   6. D 1785: Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
   11. D 3034: Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

C. AWWA:
3. C110: Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm Through 1,219 mm) for Water.

D. Caltrans Standard Specifications:
1. Section 65, Reinforced Concrete Pipe.
2. Section 66, Corrugated Metal Pipe.
3. Section 70. Miscellaneous Facilities.
4. Section 72, Slope Protection.

E. Caltrans Standard Plans:
1. Plan D94A: Metal and Plastic Flared End Sections.
2. Plan D94B: Concrete Flared End Sections.
3. Plan D97A: Corrugated Metal Pipe Coupling Details No.1, Annular Coupling Band Bar and Strap and Angle Connection.
4. Plan D97B: Corrugated Metal Pipe Coupling Details No. 2, Hat Band Coupler and Flange Details.
5. Plan D97C: Corrugated Metal Pipe Coupling Details No. 3, Helical and Universal Couplers.
6. Plan D97D: Corrugated Metal Pipe Coupling Details No. 4, Hugger Coupling Bands.
7. Plan D97E: Corrugated Metal Pipe Coupling Details No. 5, Standard Joint.
8. Plan D97F: Corrugated Metal Pipe Coupling Details No. 6, Positive Joint.
11. Plan D98B: Slotted Corrugated Steel Pipe Drain Details.

1.04 DEFINITIONS

A. AASHTO: American Association of State Highway and Transportation Officials.
E. CMP: Corrugated metal pipe.
F. DIP: Ductile iron pipe.

G. HDPE: High-density polyethylene.

H. NPS: Nominal pipe size.

I. PE: Polyethylene.

J. PVC: Polyvinyl chloride.

K. RCP: Reinforced concrete pipe.

1.05 SUBMITTALS

A. Follow submittal procedures outlined in Section 01 33 00 – Submittal Procedures.

B. Product Data Shop Drawings, Etc.: For the following:
   1. Piping materials and fittings.
   2. Special pipe couplings.
   3. Polymer-concrete, channel drainage systems (trench drains).
   4. Joint sealants.
   5. Plastic area drains.
   6. Precast concrete catch basins, inlets, curb inlets, and area drains, including frames and grates.
   7. Concrete, metal and plastic flared end sections.

C. Design Mix Reports and Calculations: For each class of cast in place concrete.

D. Field Test Reports: Indicate and interpret test results for compliance with performance.

1.06 DELIVERY, STORAGE AND HANDLING

A. Do not store plastic structures, pipe and fittings in direct sunlight.

B. Protect pipe, fittings, and seals from dirt and damage.

C. Handle precast concrete pipe and other precast structures according to manufacturer’s written instructions.

D. Protect imported bedding and backfill material from contamination by other materials.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

A. Reinforced Concrete Pipe: Designated by Class, rubber gasketed joints.
   2. Oval shaped (Elliptical) Reinforced Concrete Pipe: Caltrans Standard Specification Section 65-1.02B. Class HE-III and VE-III.
   3. Reinforced Concrete Pipe Arch: Caltrans Standard Specification Section 65-1.02C.
B. PE Pipe and Fittings: 4-inch through 10-inch, AASHTO M 252 Type S, smooth interior and corrugated exterior. Bell and spigot joints.
   2. Couplings: AASHTO M 252, corrugated band type. Engage a minimum of 4 corrugations, 2 on each side of pipe joint.

   2. Couplings: AASHTO M 252, corrugated band type. Engage a minimum of 4 corrugations, 2 on each side of pipe joint.

2.02 PIPE ANCHORS
   A. Section 32 05 23 – Cement and Concrete for Exterior Improvements

2.03 SPECIAL PIPE COUPLINGS
   A. Plastic, Cast Iron and Ductile Iron Pipe: ASTM C 1173, rubber or elastomeric sleeve and band assembly fabricated to match outside diameters of pipes to be joined.
   B. Reinforced Concrete Pipe: Portland cement concrete collar as indicated.
   C. Section 32 05 23 – Cement and Concrete for Exterior Improvements

2.04 CURB INLETS, CATCH BASINS, DROP INLETS, AREA DRAINS, ETC.
   A. General: Size, shape, configuration, depth, etc. of structure and frame, grate, or cover shall be as indicated.
   B. Section 32 05 23 – Cement and Concrete for Exterior Improvements
   C. Precast Structure: Rate for AASHTO H20 loading in traffic areas.
   D. Steps: ASTM C 478 or AASHTO M 199. Manufacture from deformed, ½-inch steel reinforcement rod complying with ASTM A 615 and encased in polypropylene complying with ASTM D4101. Include pattern designed to prevent lateral slippage off step. Acceptable manufacturer is Hanson Concrete Products, (Milpitas, CA) (Tel 408-262-1091).
   E. Frames, Grates and Covers: Caltrans Standard Specification Section 75-1.02, 75-1.03 and 75-1.05.
      1. Galvanize steel frames, grates and covers.
      2. Grates and covers shall be non-rocking.
      3. Rate for AASHTO H20 loading in traffic areas.

2.05 MANHOLES AND CLEANOUTS
   A. See Section 33 05 16 – Utility Structures.

PART 3 - EXECUTION

3.01 PIPE INSTALLATION
   A. General: Install pipe, fittings, and appurtenances utilizing best practices, manufacturer’s instructions, and in accordance with Section 6 and 7 of ASTM D 2321 for plastic pipe, Caltrans Standard Specification Section 65-
1.07 for reinforced concrete pipe, Caltrans Standard Specification Sections 66-1.045 and 66-105 for corrugated metal pipe and chapter 11.3.3 of AWWA M41 for cast iron and ductile iron pipe.

B. Pipe Depth and Trench Configuration: Conform to typical trench section(s) indicated.

C. Excavation, Bedding, Backfill, and Compaction: Section 31 23 33 – Trenching and Backfilling.

D. Handling: Carefully handle during loading, hauling, unloading and placing operations to avoid breakage or damage. Use strap type slings for lifting and placing; no chains or hooks will be permitted. Comply with manufacturer’s recommendations.

E. Laying: Before lowering pipe into the trench, remove all stakes, debris, loose rock and other hard materials from the bottom of the trench. Lay accurately in conformance with lines and grades indicated. Start laying the pipeline at the low end and proceed upstream. Lay bell and spigot pipe with the bell end facing upstream. Lay pipe on a bed prepared by handwork, dug true to grade. Furnish firm bearing for pipe throughout its entire length with bell holes provided at the ends of each pipe length of sufficient size to permit making up the particular type of joint being used. Adjust pipe to line and grade by scraping away or filling and tamping material under the body of the pipe for the entire pipe length and not by blocking or wedging. After final positioning, hold pipe in place in trench with backfill material placed equally on both sides of the pipe at as many locations as required to hold the pipe section in place.

F. Curved Alignment: When necessary to conform to the alignment specifically indicated, lay pipe on a curved alignment by means of asymmetrical closure of joints or bending of the pipe barrel. Use shorter lengths of pipe than the standard length if necessary to achieve curvature specified. Do not exceed the recommendations of the pipe manufacture for deflections at the joints or pipe bending.

G. Closure: Close open ends of pipes and appurtenance openings at the end of each days work or when work is not in progress.

3.02 INSTALLATION OF PIPE ANCHORS

A. Install at location, configuration and details shown on the Plans.

3.03 SPECIAL PIPE COUPLINGS

A. General: Use where required to join piping and no other appropriate method is specified. Do not use instead of specified joining methods.

B. Installation: Per manufacturer's instructions.

3.04 INSTALLATION OF CURB INLETS, CATCH BASINS, DROP INLETs, AREA DRAINS, ETC.

A. Excavation, Bedding, Backfill, and Compaction: Section 31 23 33 – Trenching and Backfilling.

B. Poured in Place Structures: Install as indicated and Caltrans Standard Specification Section 51.
   1. Shape bottoms to convey flows as indicated.

C. Precast Structures: Install as indicated.
   1. Seal all joints and pipe entrances and exits.
   2. Place concrete in bottom and shape to convey flows as indicated.

3.05 TESTING

A. General: Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
   1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to authorities having jurisdiction.

3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours advance notice.

4. Submit separate reports for each test.

5. Where authorities having jurisdiction do not have published procedures, perform tests in accordance with latest edition of the Uniform Plumbing Code (UPC) Section 1109.0, Testing.

6. Leaks and loss in test pressure constitute defects that must be repaired.

7. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION
   A. Proprietary storm water treatment devices, including the following:
      1. Underground oil-sediment separator with duplex pumps.
      2. At-grade storm water filtration system.
   B. Related Sections:
      3. Storm Drainage Utilities in Section 33 40 00.
      4. Base Courses in Section 32 11 00.

1.03 SUBMITTALS
   A. General: Comply with Division 01 Submittal Procedures.
   B. Product Data: Provide shop drawings for oil-sediment separator and storm water filtration system.

PART 2 - PRODUCTS

2.01 UNDERGROUND OIL-SEDIMENT SEPARATOR
   A. Precast concrete structure for gravity separation of sediment and free floating oils. Separation system shall have the following design elements to assure adequate removal of sediments, oil, and grease:
      1. Internal high flow bypass: Shall divert storms in excess of the water quality storm around treatment chambers without the use of a separate bypass structure.
      5. Offline separation chamber: The primary separation chambers shall be located offline to prevent washout of settled pollutants.
      3. Plug flow conduits: The transfer of flow from the primary separation chamber to the secondary chamber shall be through submerged plug flow conduits installed in a serpentine flow path to optimize the plug flow regime, extend the flow path, and provide a quiescent separation chamber.
      6. Hydraulic residence time: The separator shall have a minimum hydraulic residence time of 4 minutes in the separation treatment chambers.
      7. Hydraulic loading rate: The separator shall have a maximum hydraulic loading rate of 13 gpm/sf in the separation treatment chambers.
      8. Capacities: The separator shall have a treatment flow capacity of 540 gpm, a sediment storage capacity of 3 cubic yards, and an oil/floatable storage capacity of 310 gallons.
      9. Acceptable manufacturers: Clara 40CP, by StormwateRx, or approved equal.
   B. Materials:
      1. Internal Components:
         a. Plug Flow Conduits shall be constructed of PVC or ABS.
b. Outlet Orifice shall be constructed of PVC or ABS.

c. Duplex pump system shall include 2 HP (460V/3PH/5A), 297 GPM pumps capable of overcoming at least 22 feet of total dynamic head, with a single float switch (qty 3) and 4 inch check valves. A control panel is required for the pump system. Double piggyback float switch, check valves, and flow control valves are also required.

2. Precast Concrete Components:

a. Precast Concrete: Shall be provided according to ASTM C478.

b. Joint Sealant: Consoen CS-101 or approved equal.

3. Casting components:

a. All metal used for ductile iron castings shall conform to ASTM A-536-84, Grade 80-55-06.

b. All castings at a minimum shall be heavy duty rated for HS20-44 load rating, which supports 32,000 pounds per axle or 16,000 pounds per set of dual wheels.

C. Contractor Supplied Components:

1. Sub-base: Six inches minimum of ¾-inch minus rock, 95% compaction. Compact sub-grade materials to 95% of maximum density at +/–2% of optimum moisture. Unsuitable native material below sub-grade shall be replace to suit geotechnical engineer’s approval.

2. Cast-in-Place Concrete: Shall be 3,000 psi, 28-day strength, ¾-inch round rock, 4-inch slump maximum, placed within 90 minutes of initial mixing.

3. Grout: Shall be non-shrink grout meeting the requirements of Corps of Engineers CRD-C588. Specimens molded, cured, and tested in accordance with ASTM C-109 shall have a minimum compressive strength of 6,200 psi. Grout shall not exhibit visible bleeding.

4. Backfill: Shall be ¾ inch minus rock (95% compaction), or as otherwise specified in section 31 23 33, Trenching and Backfilling.

2.02 STORM WATER FILTRATION SYSTEM

A. At-grade enhanced media filtration system for industrial storm water applications. The filtration system shall include the following design features:

1. Inlet inline flow meter to monitor the influent flow rate and cumulative volume of the filtration system.

2. Inlet flow control valve to meter the flow rate through the system.

3. Pretreatment chamber with buffering media in an up-flow configuration to enhance the precipitation of metals.

4. Linear inlet distributor to direct flow over the length of the filtration chamber.

5. Layered inert and sorptive filtration media, minimum 21 inch depth.

6. Underdrain piping and gravel for conveyance.

7. Adjustable head control outlet.

8. Emergency overflow in filtration chamber with a passive overflow level indicator.

9. Inlet and outlet sample ports.

10. Acceptable manufacturers: Aquip 300S, by StormwateRx, or approved equal.

B. Materials:
1. Internal Components:
   a. All internal plumbing shall be constructed of PVC or HDPE.
   b. Filtration media shall be a combination of inert and sorptive media.

2. Steel Components:
   a. Container shall be constructed of 12 gage steel, sandblasted and painted per manufacturer's specifications.

C. Contractor Supplied Components:
   1. Level Concrete Pad: See structural drawings and specifications.
   2. Forklift and Operator: Forklift with 60 inch spacing on center required for placement of equipment.
   3. PVC Plumbing: All connections to Aquip inlet and outlet shall be PVC (or equal).

PART 3 - EXECUTION

3.01 UNDERGROUND OIL-SEDIMENT SEPARATOR

A. Precast concrete:
   1. Contractor to make all pipe connections. Grout all inlet and outlet pipes flush with interior wall. Contractor to grout interior walls.
   2. Sanded PVC fittings shall be used on all PVC inlet and outlet pipes.

B. PVC Piping: Shall be joined in accordance with ASTM D2564.

B. Treated outlet orifice: Shall be installed in cast-in-PVC sleeve after baffle wall installation using PVC pipe glue.

D. Plug flow conduits: Shall be installed in cast-in-PVC sleeves after baffle wall installation using PVC pipe glue.

3.02 STORM WATER FILTRATION SYSTEM

A. Contractor shall receive, unload, and store the equipment until installation. The equipment shall be kept clean of trash and debris until installation.

B. Contractor shall place filtration system structure on level pad and provide forklift and operator for installation of filtration media. Vertical equipment clearance of 14 feet or greater above surface is required for installation and maintenance.

C. Contractor shall provide labor for installation of the filtration media.

D. Manufacturer shall install internal piping components of filtration system.

E. Contractor to make inlet and outlet pipe connections to the filtration system.

F. PVC piping shall be joined in accordance with ASTM D2564.

3.03 PUMP STARTUP AND TESTING

A. Pump installation to comply with ANSI/HI 1.4 for sump pumps.

B. Leak test: Charge piping system and test for leaks. Test until there are no leaks. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each items is an integral part.
C. The tests shall include system capacity and all control and alarm functions.

D. When any defects are detected, correct defects and repeat test.

E. The commissioning agent will observe startup and contractor testing of the stormwater treatment system and pumps. Coordinate the startup and contractor testing schedules with the commissioning agent.

3.04 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of Section 01 91 13, GENERAL COMMISSIONING REQUIREMENTS.

3.05 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative to instruct AC Transit personnel in operation and maintenance of the stormwater treatment system.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Extent of Breathable Air Systems Work is indicated on drawings and schedules, and by requirements of this section.

1.02 QUALITY ASSURANCE

A. Codes and Standards:

1. NFPA Compliance: Install and test breathable air systems in accordance with NFPA 99.

2. ASME Compliance: Fabricate and install breathable air systems in accordance with ASME B31.9 "Building Service Piping".

3. UL Compliance: Provide electrical components which are UL-listed and have UL label affixed.

4. Breathable Air Systems shall be oil free air complying, as a minimum, with Grade D in Compressed Gas Association, Inc., Pamphlet G-7.1, Commodity Specification for Air, and having a maximum dew point of -20 degree F (-28.9 degree C).

5. American Society of Sanitary Engineers (ASSE) 6010 Professional Qualification Standards for Medical Gas System Installers.

6. American Society of Sanitary Engineers (ASSE) 6030 Professional Qualification Standards for Medical Gas System Verifiers.

1.03 SUBMITTALS

A. Submit in accordance with Division 1.

B. Shop Drawings: Submit scaled layout drawings of breathable air systems pipe and fittings including, but not necessarily limited to, pipe and tube sizes, locations, elevations and slopes of horizontal runs, wall and floor penetrations, equipment connections, and gas outlets. Indicate interface and spatial relationship between piping and proximate equipment.

C. The Contractor shall furnish documentation attesting that all installed piping materials were purchased cleaned and complied with the requirements of NFPA 99.

D. The Contractor shall furnish copies of ASSE 6010 qualifications for all workers installing breathable air piping.

E. Furnish product data for all piping, fittings, valves, brazing materials, and air compressors and associated equipment, alarm panels, and breathable air outlets.

1.04 COORDINATION

A. Breathable Air Contractor shall supply and install the master alarm system, including the signal wiring. The Electrical Contractor shall provide power wiring to each alarm panel. Medical Gas Contractor is responsible for proper termination, testing and marking of alarm panels. Termination shall be done by or under supervision of manufacturer of alarm panels.

B. Coordinate with Breathable Air Verifier to deliver a complete, tested medical gas installation ready for Owner's use.
1.05 CLOSEOUT SUBMITTALS

A. Submit in accordance with Division 1.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

A. All Pressurized Seamless Breathable Tube (Piping):

1. Seamless ASTM B-819, Type L hard drawn seamless medical gas copper tubing, identified by the markings “BA” in Blue (Type L).

2. Fittings shall be wrought copper compliant with ANSI B16.22 or brazed fittings complying with ASME B16.50.

3. Brazing alloy shall comply with ANSI/AWS A5.8, BcuP Series with at least 1000 degree F melting point.

B. Isolation of copper tubing from dissimilar metal shall be accomplished either through use of copper or copper plated hangers or hangers with plastic isolators.

2.02 IN-LINE SHUTOFF VALVES

A. Shutoff Valves:

1. Valves shall be ball-type, with Teflon seats and adjustable stem packing gland with Teflon stem seal. Valves shall be rated at a minimum 400 psig, and for 30-inches Hg vacuum. Valves operate from full ON to full OFF by turning the vinyl-gripped valve handle 90 degrees. Factory installed copper tubing shall be extended sufficiently to help prevent valve seat damage during brazing. Provide color-code gas service identification on each valve in compliance with NFPA 99 labeling requirements.

2. All main line, riser, service and future valves as indicated on the drawings shall include plugged 1/8-inch NPTF ports on the inlet and outlet.

3. All valves shall have locking capabilities.

2.03 EQUIPMENT AND ACCESSORIES

A. Station Outlets:

1. Wall Outlet Stations: Modular, Quick-Connect Type.

a. Cover plate assembly contains quick-connect latch release mechanism, indexing pins for safety keying the gas-specific cover plate to the appropriate rough-in box, and color-coded gas service identification. The safety-keying index pins permanently captured between the cover plate and latch assembly. Designs with index pins molded in plastic will not be acceptable.

b. Attach cover plate to the primary valve assembly. Primary valve threaded into the rough-in box separately from the cover plate to facilitate leak-testing around the valve. Designs which prevent this test will not be acceptable. Brass primary valve body shall be adjustable to compensate for variation in plaster thickness. Provide an O-ring within the valve to seal mating adaptor plugs. Future replacement of this O-ring shall not require disassembly of the cover plate. Self-sealing primary valve poppet shall require no dust cap or cover.

c. Rough-In Box: Constructed of corrosion resistant, zinc plated, sheet steel with provisions for field-ganging. Provide two (2) factory-started, slotted, hex-head screws and fasteners
with each rough-in box. Installer may gang rough-in boxes using holes provided for 1/8-inch diameter pop rivets.

d. Each rough-in box shall contain a base and tube assembly consisting of a 1/2-inch O.D. Type K copper connection, brass block and base housing, a secondary check valve per NFPA 99 (not required in vacuum), primary valve, O-ring seal, check valve, deflator spring (except vacuum), pressure testing cap plug, and plaster shield. The copper inlet tube shall be capable of rotating 360 degrees to adjust for field piping conditions.

e. Secondary Check Valve: Fully automatic and self-sealing upon removal of the primary valve. Field replaceable primary valve seal without shutting off gas supply to the outlet station

f. Wall Outlet Stations shall be Chemetron 500 Models, 64-01-500 Series, or equivalent.

2.04  ALARM SYSTEMS

A. Alarm Panels:

1. All Breathable Air Alarm Panels shall be designed to meet the requirements of NFPA and shall be U.L. Listed as an assembly. Alarms shall include all necessary displays, factory wiring, transformers, and circuitry requiring only 115 or 230-volt primary power. Internal voltage shall be stepped down for control circuit power as required by manufacturer of panel.

2. Alarm Panels shall be modular in design.

3. The alarm shall store the last four (4) alarm conditions in memory at the alarm panel and these conditions can be indicated by using the buttons on the alarm panel control module.

4. Each panel shall include a Power On indicator and Test Function for testing all modules electrically.

5. Low voltage shielded wiring between remote located transducer and control panel shall be sized as required by panel manufacturer. Low voltage shielded wiring shall be provided and installed by the contractor.

6. Furnish and install the alarm. Coordinate the power wiring with Division 26.

7. Termination of alarm wiring to be done by or under supervision of manufacturer of alarm.

8. The panel shall be equipped with contacts for connection to the PC-based alarm monitoring software.

9. Alarms shall be tested, labeled and fully operational for Owner.

PART 3 - EXECUTION

3.01 INSTALLATION OF BASIC IDENTIFICATION

A. Install breathable air piping signs on piping in accordance with NFPA 99 requirements.

B. Label piping with name of gas service, identification color and direction of flow. Where non-standard pressures are piped, label for pressure. Labels shall be placed at least once every 20-feet of linear run or once in each story (whichever is more frequent). A label shall additionally be placed immediately on each side of each wall or floor penetration. Pipe labels shall be self-adhesive vinyl or other water resistant material with permanent adhesive colored in accordance with NFPA 99 and shall be visible on all sides of the pipe.
C. Alarms and valves shall be labeled for gas service and areas monitored or controlled. Coordinate with Owner for final room or area designations. Label valves with name and identification color of the gas and direction of flow.

3.02 INSTALLATION OF BREATHABLE AIR PIPING

A. All installation shall be performed in strict accordance with NFPA 99 standards. Brazing procedures shall be as detailed in NFPA 99. Brazing shall be performed only by brazers qualified under NFPA 99.

B. Copper tubing, fittings and valves shall be pre-cleaned and prepared for oxygen service by the manufacturer and received sealed on the job. Certificates of origin and of proper preparation shall be maintained on the job site attesting the above.

C. The interior surfaces of tube ends, fittings and other components that were cleaned for oxygen service by the manufacturer, but became contaminated prior to being installed, shall be permitted to be recleaned on-site by the installer by thoroughly scrubbing the interior surfaces with a clean, hot water-alkaline solution, such as sodium carbonate or trisodium phosphate 450 g to 11 L (1 lb to 3 gal) of potable water and thoroughly rinsing them with clean, hot, potable water.

D. Scrubbing shall be employed where necessary to ensure complete cleaning. After washing, the material shall be rinsed thoroughly in clean hot water. After cleaning, particular care shall be exercised in the storage and handling of all pipe and fittings. Pipe and fittings shall be temporarily capped or plugged to prevent recontamination before final assembly. Tools used in cutting or reaming shall be kept free from oil and grease. Where such contamination has occurred, the items affected shall be re-washed and rinsed. During brazing of medical gas systems, the piping shall be continuously purged with dry nitrogen to avoid oxidation of the inside of the tubing.

E. Braze piping joints and connections unless otherwise indicated.

F. The use of flux is prohibited when making of joints between copper-to-copper pipes and fittings.

G. During any brazing operation, the interior of the pipe shall be purged continuously with oil-free, dry nitrogen NF, following the procedure in NFPA 99. At the completion of any section, all open pipe ends shall be capped using an external cap.

H. Protect buried gas piping against freezing and corrosion with underground piping insulation and corrosion-protective coating.

I. After installation of piping, but prior to installation of outlet valves, blow lines clear with oil-free dry nitrogen NF.

J. Threaded joints in piping systems shall be avoided whenever possible. Where unavoidable, make up the male threads with polytetrafluoroethylene (such as Teflon) tape. Do not use liquid sealants.

K. All joints in the piping, except those at valves or equipment requiring screw connections, shall be made with Handy & Harman Si-fos or equal, using Handy Flush technique and joint preparation as outlined by Handy & Harman. Male screw joints used in shutoff valves shall be tinned with a soft solder.

L. Protect oxygen pipelines installed in combustible partitions against physical damage by installation within pipe or conduit. Openings for pipelines installed in concealed spaces shall be fire-stopped with construction having a fire resistance equal to or greater than the original construction.

M. Oxygen supply line may be run in chases with other service piping, but locate the oxygen lines to avoid contact with steam or hot water lines.

N. Do not use medical gas piping systems as a grounding electrode.

O. Piping penetrating an electromagnetic shield shall have an isolation device on each side of shield.

3.03 INSTALLATION OF SUPPORTS AND ANCHORS
A. Install supports and anchors, in accordance with Division 22, "Hangers and Supports for Plumbing Piping and Equipment", and as defined in NFPA 99, Table 5.1.10.4.5.

3.04 INSTALLATION OF VALVES

A. Inline Shutoff Valves: Locate valves in a secure area and lock open and label in accordance with NFPA 99 as follows:

B. Caution - (Name of Gas) Valve

C. Do Not Close Except in Emergency

D. This Valve Controls Supply to (Area served)

E. Main Shutoff Valves: Where indicated, provide shutoff valve on each main supply line, locate to be accessible in emergency (not requiring step ladder or removal of ceiling tile).

3.05 INSTALLATION OF EQUIPMENT AND ACCESSORIES

A. Install medical gas equipment and accessories where indicated, in accordance with applicable NFPA Standards, with equipment manufacturer's written instructions, and with recognized industry practices, to ensure that breathable air equipment and accessories comply with requirements and serve intended purposes.

B. Wall Outlet Stations: Field assemble modular outlet stations with sequences and services indicated on the plans. Centerline spacing of multiple outlets shall be 5-inches minimum.

1. Locate outlets 60-inches from finished floor unless otherwise indicated on the architectural drawings.

3.06 ALARM SYSTEMS

A. The Mechanical Contractor shall make all necessary inter-piping connections between alarm panels and laterals or mains in which pressure is to be sensed.

B. The Division 26 Contractor shall provide necessary 115V, 24V, AC wiring for the operation of "Operating" and "Emergency" alarms.

3.07 FIELD QUALITY CONTROL

A. Test breathable piping, including pressure, cross connection, and final testing in accordance with NFPA 99. Indicate in writing to Owner that required tests have been successfully conducted and permanent records of tests maintained.

B. Test breathable alarms for proper operation at high pressure, low pressure, and gas supply status.

3.08 INSTALLER TESTING

A. Prior to declaring the lines ready for final verification, the installing contractor shall follow strictly the procedures for verification as described in NFPA 99 and attest in writing over the notarized signature of an officer of the installing company the following:

1. That all brazing was conducted by brazers qualified to ASSE 6010 and holding current medical gas endorsements.

2. That all brazing was conducted with nitrogen purging.

3. That all lines have been blown clear of any construction debris using oil free dry nitrogen are clean and ready for use.
4. That the assembled piping, prior to the installation of any devices, maintained a test pressure 1-1/2 times the standard pressures listed in NFPA 99 Table 5.1.11, but in no case less than 150 psig.

5. That after installation of all devices, the pipeline was proven leak free for 24 hours at a pressure 20 percent above the standard pressures listed in NFPA 99 Table 5.1.11.

6. That after completion of the final Standing Pressure Test, the system was thoroughly flushed with the gas to be used in the system to assure the removal of all nitrogen.

B. Provide four (4) originals of the affidavit, distributed; One to the Engineer, one to the Owner's Representative, one to the General Contractor, and one to the Verifier.

3.09 BREATHABLE AIR SYSTEMS CERTIFICATION

A. General: Evaluate and certify breathable air systems, including source equipment, valving, alarms, and station outlets, for mechanical and therapeutic function.

1. Provide certification by Agency independent of facility, System Installer, Contractor, and Suppliers.

   a. In addition to the system(s) verification, written report and certificate bearing the notarized signature of an officer of the verification company, a current copy of liability insurance shall be provided indicating coverage in the minimum amount of $1 million per occurrence and general aggregate liability in the minimum amount of $1 million valid and in force when the project is verified.

2. Mechanical and Therapeutic Function: As defined in NFPA 99 and CGA P2.1.

B. Provide full documentation of the following:

1. That Breathable Air System follows guidelines of NFPA 99, regarding placement and applicability of valves, alarms, and source equipment.

2. That no cross connections exist in pipeline.

3. Include in documentation, examination of outflow of each station outlet, following mechanical cross connection procedure as specified by NFPA 99. Additionally, examine each system outflow with appropriate analyzer and document concentrations. Include Medical Gas in mechanical examination.

4. Where Laboratory Systems are treated as separate systems, perform cross connection tests to document their separation from medical systems as required by NFPA 99.

5. That station outlets are delivering gas at pressure and flow consistent with needs indicated, but in no case to be below CGA or NFPA guidelines.

6. That pipeline is free of debris, including liquid.

7. That station outlets are functional.

8. That delivered gas is as pure as required by applicable CGA specifications for breathing gas. Take samples from such station outlets as agreed by facility and agency. In no case shall number of samplings be fewer than two; one from source, and one from such station outlets as will determine that gas has traversed the greatest length of pipeline. Evaluate samples against CGA requirements for human use and compare to one another.

9. That reserve source equipment and its control equipment is in place and is operational.

10. That valves are functional. Document control zones without regard to plans. Compare this documentation to As-Built Plans, and report discrepancies between actual installation and plans to facility.
11. That alarms are functioning and are set in accordance with NFPA 99. Document and compare surveillance areas of each to Record Drawings, and report discrepancies between actual installation and drawings to Architect/Engineer.

12. That breathable air is dry. Examination shall consist of dewpoint taken at source and most distant station outlet of each lateral branch. Document temperatures and pressures affecting dryness.

13. Provide four originals of this affidavit, and report, distributed: One to the Engineer, one to the Owner's Representative, one to the General Contractor, and one to the Installing Contractor.

END OF SECTION
PAR 1 - GENERAL

The General Provisions of the Contract, including General and Special Conditions and the requirements of Division 1, apply to the Work in this Section.

1.01 WORK INCLUDED

A. Equipment items as listed below by Equipment Identifier:

1. 6120 Booth, paint, side, downdraft with heated air makeup (Ref. Part 2..01)

B. Modifications to utilities, ducting, roof penetrations, roughing-in, installation of equipment, and final connection of utilities, with labor services, and incidentals necessary for complete and operational equipment installation as a result of expansion/relocation of booth.

1.02 QUALITY ASSURANCE

A. Experience: Equipment shall be produced by a manufacturer of established reputation with a minimum of five years experience supplying specified equipment.

B. Manufacturer’s Representative:

1. Installation: Provide a qualified manufacturer’s representative at site to supervise work related to equipment installation, check out, and start up.

2. Training: Provide technical representative to provide training to Owner’s maintenance personnel in operation and maintenance of specified equipment.

1.03 BUY AMERICA COMPLIANCE

A. The Contractor shall comply with the applicable Buy America requirements set forth in 49 U.S.C. 5323(j) and the applicable regulations in 49 C.F.R. Part 661, as amended. If the Contractor procures any capital items with Federal funds, it is the Contractor’s responsibility to obtain the Buy America certification required under such regulations.

B. Reference Division 1 for Buy America compliance.

1.04 SUBMITTALS

A. Product Data: Submit Product Data in accordance with Section 01300 of these specifications

B. Operations and Maintenance Manual:

1. Submit Operations and Maintenance Manuals in accordance with Division 1- General Requirements of these specifications.

2. Provide complete parts, operating, and maintenance manual covering equipment at time of installation.

3. Description of system and components.

4. Schematic diagrams of electrical, plumbing, and compressed air system.

5. Manufacturer’s printed operating instructions.
6. Printed listing of periodic preventive maintenance items and recommended frequency to validate warranties. Failure to provide maintenance information will indicate that preventive maintenance is not a condition for validation of warranties.

C. Shop Drawings: Submit Shop Drawings in accordance with Section 01300.

1.05 PRODUCT SUBSTITUTIONS

A. Follow requirements specified in Division 1 – General Requirements.

B. Additional costs resulting from substitution of products other than those specified, by model number, including drawing changes and construction, will be at the expense of the Contractor.

C. Substitution Approval: Prior to delivery or installation, submittals for each equipment item by Equipment Identifier shall be provided in accordance with Division 1 - General Requirements. Acceptance will be based on the technical requirements herein as determined by Owner and Architect.

1.06 WARRANTY

A. Warrant work specified herein for one year from substantial completion against defects in materials, functions, and workmanship specified herein.

B. Warranty shall include materials and labor necessary to correct defects.

C. Submit warranties in accordance with Division 1 - General Requirements of these specifications.

D. All parts shall be readily available locally in the United States.

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in manufacturer’s containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid and/or dusty conditions.

B. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Equipment Identifier of this specification.

1.08 LABELING

A. Manufacturer shall securely attach in a prominent location, on each major item of equipment, a non-corrosive nameplate showing manufacturer’s name, address, model number, serial number, and pertinent utility or operating data.

B. All electrical equipment and materials shall be new and shall be listed by Underwriter’s Laboratories, Inc. (UL) in categories for which standards have been set by that agency and labeled as such in the manufacturer’s plant.

PART 2 - PRODUCTS

2.01 BOOTH, PAINT, SIDE, DOWNDRAFT, WITH HEATED AIR MAKEUP

Equipment Identifier: 6120

A. Manufacturer’s Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer’s name and model to establish minimal acceptable standards of quality, features, performance, and construction.
AFC Finishing Solutions
b. Osseo WI (800) 331-7744
c. Model No.: DTSDD6036

2. Alternate manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers may be considered as equal.

a. Global Finishing Solutions, Osseo, WI (800) 848-8738
b. Spray Systems, Pamona, CA (909) 623-6944

B. Capacities/Dimensions:

1. Overall paint booth dimensions:

<table>
<thead>
<tr>
<th>Dimensions (inches)</th>
<th>Length</th>
<th>Width</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment</td>
<td>252</td>
<td>724</td>
<td>264</td>
</tr>
</tbody>
</table>

2. Working Dimensions: 16 feet wide by 19 feet high by 60 feet deep

C. Features/Performance/Construction:

1. Paint booth shall be of side downdraft design to create a conventional vertical and horizontal flow of air to effectively remove particulate matter from the spraying area.

2. Paint booth shall include four each 34 inches heavy duty exhaust units (12,000 CFM at 1/2 inch s.p.), 48,000 CFM total with four each manometers (draft gauge).

3. Paint booth shall include a NEMA/12 pre-wired control panel with main breaker disconnect, magnetic motor starter, motor fuse protection, lighting contactor, lighting fuse protection, terminal strips for field welding, system operating lights, air make-up temp select, and UL industrial listing.

4. Paint booth shall be designed and provided in accordance with all local codes, OSHA, and NFPA regulations.

5. Structure: Paint booth shall be constructed of a minimum 18 gauge galvanized sheet metal panels. Panels shall be pre-punched, companion flanged for easy assembly.

6. Paint booth shall include one each ceiling type intake plenum chamber and four each exhaust fans to exhaust chamber adapters.

7. Paint booth shall include two access doors, 3 feet by 7 feet high with a 14 by 18 inch observation window, and one set of solid, product entry doors, 11 feet wide by 14 feet high.

8. Lighting: Shall be supplemented with 36 each, interior access, open type, 48 inches, 4-tube fluorescent light fixtures. Fixtures to be vapor proof.

9. Paint booth shall include three-axis pneumatic personnel lift and necessary booth support for personnel lift.
10. Paint booth shall include a RAM 30 Direct Fired Heater air make-up unit with the following:
   a. 100 percent replacement air
   b. 2,000,000 BTU/up to 80 degrees F temperature rise
   c. Digital temperature controls and modulating gas valve
   d. Honeywell flame safe guard control
   e. UV scanner
   f. Electric spark igniter
   g. Ignition transformer
   h. Pilot and main gas valves
   i. Pilot and main gas regulators
   j. Leak test valve
   k. Combustion blower with automatic inlet louvers
   l. On/Off switch
   m. Indicator lights
   n. Lockout alarm bell
   o. Control cabinet with terminal strip for easy servicing
   p. Intake fan
   q. Intake duct

D. Utility Requirements:

<table>
<thead>
<tr>
<th>1. Electrical:</th>
<th>Exaust</th>
<th>Heated</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Connection Requirements</td>
<td>system</td>
<td>Airmakeup</td>
<td></td>
</tr>
<tr>
<td>Voltage</td>
<td>460</td>
<td>460</td>
<td>120</td>
</tr>
<tr>
<td>Phase</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>HP</td>
<td>---</td>
<td>15</td>
<td>---</td>
</tr>
<tr>
<td>Amps</td>
<td>60</td>
<td>25</td>
<td>60</td>
</tr>
</tbody>
</table>

| a. Connection Requirements          | Lighting |
| Voltage                             | 277      |
| Phase                              | 3        |
| Amps                               | 36       |
PART 3 - EXECUTION

3.01 INSPECTION

A. Coordinate location of rough-in work and utility stub-outs to assure match with the equipment being installed.

B. Inspect delivered equipment for damage from shipping and exposure to weather. Compare delivered equipment with packing lists and specifications to assure receipt of all equipment items and specified accessories.

C. Report in writing to the Architect any damaged, missing or incomplete scheduled equipment and improper rough-in work or utility stub-outs.

3.02 INSTALLATION

A. Manufacturer shall be responsible for complete operational equipment installation.

B. Perform work under direct supervision of Foreman of Construction Superintendent with authority to coordinate installation of scheduled equipment with Architect or designated representative.

C. Install equipment in accordance with plans, shop drawings, and manufacturer’s instructions.

1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level (or slight slope as required by instructions), plumb and at right angles to adjacent work.

2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.

3. Anchorage: Attach equipment as directed by Architect or designated representative. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.

D. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.

3.03 TESTING

A. After final connections are made and prior to authorizing payment, specified equipment shall be tested for compliance with specification in the presence of the Architect or designated representative using acceptance procedures provided by the manufacturer. Testing report shall be submitted to the Architect or designated representative.

3.04 CLEANUP

A. Touch-up damage to painted finishes.

B. Wipe and clean equipment of any oil, grease and solvents, and make ready for use.

C. Clean area around equipment installation and remove packing or installation debris from job site.

D. Notify Architect or designated representative for acceptance observation.

3.05 TRAINING

A. Direct the technical representative to provide specified hours of training to designated Owner’s maintenance personnel in operation and maintenance of the following equipment. Coordinate, with Owner, training schedule and list of personnel to be trained.

1. 6120 Booth, paint, side, downdraft with heated air makeup; 8 hours (minimum)
B. Obtain, from technical representative, a list of Owner’s personnel trained in equipment operations and maintenance.

END OF SECTION
PART 1 - GENERAL

The General Provisions of the Contract, including General and Special Conditions and the requirements of Division 1, apply to the Work in this Section.

1.01 WORK INCLUDED

A. Equipment items as listed below by Equipment Identifier:
   1. 2030 Bench, battery (Ref. Part 2.01)
   2. 3470 Tank, mop, with wringer (Ref. Part 2.02)

B. Installation of equipment with labor, services, and incidentals necessary for complete and operational equipment installation.

1.02 QUALITY ASSURANCE

A. Equipment shall be manufactured by a manufacturer of established reputation with a minimum of five years experience performing similar fabrication techniques.

1.03 BUY AMERICA COMPLIANCE

A. The Contractor shall comply with the applicable Buy America requirements set forth in 49 U.S.C. 5323(j) and the applicable regulations in 49 C.F.R. Part 661, as amended. If the Contractor procures any capital items with Federal funds, it is the Contractor’s responsibility to obtain the Buy America certification required under such regulations.

B. Reference Division 1 for Buy America compliance.

1.04 SUBMITTALS

A. Shop Drawings shall be submitted in accordance with Division 1 - General Requirements of these specifications.

1.05 PRODUCT SUBSTITUTIONS

A. Follow requirements specified in Division 1 - General Requirements.

B. Additional costs resulting from substitution of products other than those specified, by model number, including drawing changes and construction, will be at the expense of the Contractor.

C. Substitution Approval: Prior to delivery or installation, submittals for each equipment item by Equipment Identifier shall be provided in accordance with Division 1 - General Requirements. Acceptance will be based on the technical requirements herein as determined by Owner and Architect.

1.06 WARRANTY

A. Warrant work specified herein for one year from substantial completion against defects in materials, functions, and workmanship.

B. Warranty shall include materials and labor necessary to correct defects.

C. Defects shall include, but not be limited to noisy, rough or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish. Defects shall not include damage due to neglect, misuse, or situations resulting from non-performance of a manufacturer’s recommended preventive maintenance schedule.
D. Submit warranties in accordance with Division 1 - General Requirements of these specifications.

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in manufacturer’s containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid and/or dusty conditions.

B. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Equipment Identifier of this specification.

C. Provide equipment and material specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

PART 2 - PRODUCTS

2.01 BENCH, BATTERY

Equipment Identifier: 2030

A. Manufacturer’s Reference: Custom fabricated item, reference Equipment Drawings.

B. Capacities/Dimensions:

1. Overall dimensions, nominal:

<table>
<thead>
<tr>
<th>Dimensions (inches)</th>
<th>Length</th>
<th>Width</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment</td>
<td>144</td>
<td>24</td>
<td>20</td>
</tr>
</tbody>
</table>

2. Capacity: 200 pounds per linear foot of bench

3. Dry paint thickness, minimum: 6 mils.

C. Features/Performance/Construction:

1. Construction: Bench shall be fabricated per specification and as shown.

2. Materials: Unit materials shall be 2 by 4 inch Grade 1 or better hardwood (preferably smooth, straight, kiln dried oak), marine grade wood glue, and zinc plated, No. 12 by 2-3/4 inch flat head wood screws.

3. Assembly: All joints shall be glued and fastened with countersunk wood screws.

D. Finish: All exposed wood surfaces shall be sealed and finished with one to one mix of International Paint Integard-740 epoxy paint product number and curing agent number 4346-B applied per manufacturer’s recommendations in Owner’s choice of color.

2.02 TANK, MOP, WITH WRINGER

Equipment Mark Number: 3470

A. Manufacturer’s Reference:

1. Fabricated item as shown on Equipment Layout Drawings

B. General Description:

1. This item provides a means for rinsing, wringing, and storing mops used in the daily cleaning of bus floors. The unit consists of a two compartment tank; one compartment equipped with a mop holding rack to keep mop
handles upright, hereafter referred to as Compartment One, and one compartment equipped with a mop squeezer/wringer hereafter referred to as Compartment Two. Compartment One is filled with fresh, clean, running water from faucet for rinsing and storing mops. The water overflows into Compartment Two, which is used for dirty rinsing and wringing mops. The overflow from Compartment Two is plumbed to drain. Each compartment is to be fitted with fixtures as described in this specification and as shown.

C. Capacities and Dimensions:

1. Dimensions: Reference detail on Equipment Layout Plans:

2. Tank compartments, nominal:
   a. Quantity: Two each per tank unit
   b. Capacity: 30 gallons per compartment.
   c. Length: 25 inches
   d. Width: 21 inches
   e. Overall tank depth: 18-1/2 inches
   f. Depth to overflow: 14 inches

D. Features/Performance/Construction:

1. Tank:
   a. Material: Tank shall be fabricated of minimum 16-gauge stainless sheet steel or other approved non-corrosive material with two individual compartments. The tank shall be reinforced as necessary to provide a rigid structure.
   b. Construction: Tank shall be constructed with double walled coved corner construction. The inner wall shall be integrally welded to the outer wall and 3/4-inch radius coved interior corners. All welded joints are to be polished to a number 3 finish.
   c. Mounting: A reinforcing bottom frame shall be provided for the tank. It shall have provisions for permanently anchoring the tank assembly to a concrete housekeeping pad using concrete anchors and bolts.
   d. Cleanouts: Each compartment shall have self-cleaning, solid bronze or brass drain valves to completely drain compartments for cleaning. Drain valves shall be configured with 2 inch male threaded nipples (both ends) and a 2 inch gate valve. Gate valve shall have a 2 inch female threaded connection at outlet side for connection as directed by Owner.
   e. Compartment overflow: The divider between compartments shall be fitted with a 2 inch diameter bronze or brass overflow collar placed such that bottom of opening for overflow is 14 inches above bottom of compartments as shown.
   f. Tank overflow: Compartment Two shall be fitted with a 2 inch diameter bronze or brass overflow pipe to connect to waste drain such that bottom of opening for overflow is 12 inches above bottom of compartment as shown.

2. Mop holding rack:
   a. Description: A rack to hold mops in upright position shall be mounted around Compartment One. It shall have three sides, be flange mounted, and bolted to floor as shown on drawings or mounted directly on tank framing.
b. Construction: Rack shall be fabricated of 1 inch diameter, minimum, stainless steel tubing with stainless steel fittings.

3. Mop squeezer/wringer: Provide a stainless steel, commercially available tank edge mounted wringer, Royce Rolls Ringer (800) 253-9633, No. 3b or approved equal.

4. Water tap fixture: A standard hot and cold mixing discharge outlet, threaded to accommodate connection of standard water hose shall be provided by the Plumbing contractor.

E. Utilities Requirements:

<table>
<thead>
<tr>
<th>1. Plumbing:</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Domestic Water:</td>
</tr>
<tr>
<td>Connection (inches)</td>
</tr>
<tr>
<td>Flow Rate (GPM)</td>
</tr>
</tbody>
</table>

F. Finish: All components to be stainless steel or have other non-corrosive finish.

PART 3 - EXECUTION

3.01 INSPECTION

A. Coordinate location of rough-in work and utility stub-outs to assure match with equipment to be installed.

B. Inspect delivered equipment for damage from shipping and exposure to weather. Compare delivered equipment with packing lists and specifications to assure receipt of all equipment items and specified accessories.

3.02 INSTALLATION

A. Perform work under direct supervision of Foreman of Construction Superintendent with authority to coordinate installation of scheduled equipment with Architect.

B. Install equipment in accordance with plans, shop drawings, and manufacturer’s instructions:

1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level (or slight slope as required by instructions), plumb, and at right angles to adjacent work.

2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.

3. Anchorage: Attach equipment as directed by Architect or designated representative. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.

C. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.

3.03 TESTING

A. After final connections are made and prior to authorizing payment, specified equipment shall be tested for compliance with specifications in the presence of the Architect or designated representative using acceptance procedures provided by the manufacturer. Testing report shall be submitted to the Architect or designated representative.

3.04 CLEANUP

A. Touch-up damage to painted finishes.
B. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.

C. Clean area around equipment installation and remove packing and installation debris from job site.

D. Notify Architect or designated representative for acceptance observation.

END OF SECTION