TECHNICAL SPECIFICATIONS

“L” TOWER BUILDING
SEISMIC AND CODE UPGRADES

AT

RIO HONDO COLLEGE
3600 Workman Mill Road
Whittier, CA 90601

RIO HONDO COMMUNITY COLLEGE DISTRICT
3600 Workman Mill Road
Whittier, CA 90601
Tel. (562) 908-3441

W+W Project No. 15003.00
December 22, 2015

NOT FOR CONSTRUCTION
DSA APPROVAL IS PENDING

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### TABLE OF CONTENTS

#### DIVISION 01 – GENERAL REQUIREMENTS

- **01 1100** Summary of Work
- **01 2610** Construction Document Modification Procedures
- **01 2976** Progress Payment Procedures
- **01 3113** Project Coordination
- **01 3119** Project Meetings
- **01 3300** Submittal Procedures
- **01 4100** Regulatory Requirements
- **01 4200** References
- **01 4500** Quality Control
  - *DSA Form 103 – Statement of Structural Tests and Special Inspections*
- **01 5000** Temporary Facilities and Controls
- **01 5713** Temporary Erosion and Sedimentation Controls
- **01 6000** Product Requirements
- **01 7123** Field Engineering
- **01 7329** Cutting and Patching
- **01 7419** Construction Waste Management and Disposal
- **01 7423** Cleaning
- **01 7700** Closeout Procedures
- **01 7839** Project Record Documents

#### DIVISION 02 – EXISTING CONDITIONS

- **02 4119** Selective Demolition

#### DIVISION 03 – CONCRETE

- **03 3000** Cast-in-Place Concrete
- **03 3930** Epoxy-Injected Crack Repair
- **03 4913** Glass Fiber Reinforced Concrete Panels
- **03 9300** Fiber Reinforced Polymer Strengthening System

#### DIVISION 05 – METALS

- **05 0513** Shop-Applied Coatings for Metal
- **05 1200** Structural Steel Framing
- **05 1250** Buckling Restrained Bracing
- **05 3000** Metal Decking
- **05 5000** Metal Fabrications

#### DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES

- **06 1013** Miscellaneous Carpentry
- **06 4000** Architectural Woodwork

#### DIVISION 07 – THERMAL AND MOISTURE PROTECTION

- **07 0150** Roof Repairs
- **07 1400** Cold Fluid-Applied Waterproofing
- **07 1616** Crystalline Waterproofing
- **07 2100** Building Insulation
- **07 4213** Aluminum Plate Panel System
- **07 4243** Aluminum Composite Panel System
DIVISION 07 – THERMAL AND MOISTURE PROTECTION  (Continued)
07 6200  Sheet Metal Flashing and Trim
07 8116  Cementitious Fireproofing
07 8400  Firestopping
07 9200  Joint Sealants
07 9513  Expansion Joint Cover Assemblies

DIVISION 08 – OPENINGS
08 1113  Hollow Metal Doors and Frames
08 1400  Wood Doors
08 3100  Access Doors and Panels
08 3484  Smoke Containment System
08 4413  Aluminum Curtain Wall
08 7100  Door Hardware
08 7113  Automatic Door Operators
08 8000  Glazing
08 9000  Louvers

DIVISION 09 – FINISHES
09 2216  Non-Structural Metal Framing
09 2400  Portland Cement Plaster
09 2900  Gypsum Board
09 3000  Tile
09 5100  Acoustical Ceilings
09 6500  Resilient Flooring
09 6800  Carpet
09 9100  Painting
09 9600  High Performance Coatings

DIVISION 10 – SPECIALTIES
10 1400  Signage
10 2113  Toilet Compartments
10 2813  Toilet Accessories
10 4400  Fire Protection Specialties

DIVISION 12 – FURNISHINGS
12 2413  Roller Shades

DIVISION 14 – CONVEYING SYSTEMS
14 2123  Electric Traction Elevators

DIVISION 21 – FIRE SUPPRESSION
21 1300  Automatic Fire Sprinklers

DIVISION 22 – PLUMBING
22 0510  Basic Plumbing Requirements
22 0511  Supplementary Plumbing Requirements
22 0512  Plumbing Product Substitution
22 0513  Electrical Requirements for Plumbing Equipment
DIVISION 22 – PLUMBING (Continued)
22 0514 Selective Demolition
22 0515 Access Doors and Panels
22 0519 Meters and Gages
22 0523 Valves
22 0529 Supports and Anchors
22 0548 Vibration Control
22 0553 Plumbing Identification
22 0700 Plumbing Insulation
22 1100 Basic Plumbing Piping Materials
22 1116 Water Distribution Piping (Inside Buildings)
22 1119 Escutcheons, Dielectric Fittings, Unions and Strainers
22 1316 Drainage and Vent Systems
22 3436 Water Heaters
22 4000 Plumbing Fixtures

DIVISION 23 – HEATING, VENTILATING AND AIR-CONDITIONING (HVAC)
23 0510 Basic HVAC Requirements
23 0511 Supplementary HVAC Requirements
23 0512 HVAC Product Substitution
23 0513 Electrical Requirements for HVAC Equipment
23 0514 Selective HVAC Demolition
23 0515 Access Doors and Panels
23 0519 Meters and Gages
23 0520 Variable Frequency Drives and Motors
23 0523 Valves
23 0529 Supports and Anchors
23 0548 Vibration Control
23 0553 HVAC Identification
23 0593 Testing, Adjusting, and Balancing
23 0700 HVAC Insulation
23 1116 Escutcheons, Dielectric Fittings, Unions and Strainers
23 2100 Basic HVAC Piping Materials
23 2113 Hydronic Piping
23 3113 Metal Ductwork
23 3300 Ductwork Accessories
23 3423 Power and Gravity Ventilators
23 7513 Air Handling Units
23 3713 Air Outlets and Inlets
23 8126 Split Air Conditioning System

DIVISION 26 – ELECTRICAL
26 0500 Common Work Results for Electrical
26 0505 Basic Electrical Materials and Methods
26 0530 Conduit and Wire
26 0533 Manholes and Pullboxes
26 0543 Underground Ducts and Raceways For Electrical Systems
26 0548 Sound Control
26 0910 Supplemental Metering and Sub-Metering
26 0923 Occupancy Motion Sensors
26 0943 Lighting Control System
DIVISION 26 – ELECTRICAL (Continued)
26 1000 Power Distribution (Over 600 Volts)
26 1100 Substation
26 1800 Interrupter and Sectionalizing Switches
26 2416 Branch Circuit Panelboards and Terminal Cabinets
26 2419 Motor Control Equipment
26 3210 Automatic Transfer Switch
26 3215 Standby Power
26 5000 Lighting Fixtures
26 5200 Emergency Lighting Central Battery

DIVISION 27 – COMMUNICATIONS
27 0536 Cable Tray for Communication Systems
27 2000 Electronic Network Systems Infrastructure
27 4100 Audio/Video Communications
27 5126 Assistive Listening System
27 5313 Clock System

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY
28 1600 Intrusion Detection System
28 3100 Digital Addressable Fire Alarm and Voice Evacuation System

DIVISION 31 – EARTHWORK
31 0000 Earthwork
31 1000 Site Clearing
31 2200 Grading
31 2316 Excavation
31 2323 Fill
31 6329 Drilled Concrete Piers and Shafts

DIVISION 32 – EXTERIOR IMPROVEMENTS
32 0126 Pavement Repair
32 1216 Asphalt Paving
32 1236 Seal for Bituminous Surfacing
32 1313 Concrete Paving
32 1723 Pavement Markings
32 1726 Tactile Warning Surfacing

DIVISION 33 – UTILITIES
33 0513 Manholes and Structures
33 1116 Site Water Utility Distribution Piping

END OF TABLE OF CONTENTS
PART 1 – GENERAL

1.01 PROJECT DESCRIPTION

A. Project consists of selective demolition and new construction work to seismically retrofit existing 57,800 gross square foot, five story concrete structure, with basement; Former Library (L Tower) Building at Rio Hondo, Whittier, California, as shown on Contract Documents prepared by Westberg + White, Inc., Architects.
1. Project also consists of upgrades as necessary to bring building into compliance with current Title 24/CBC requirements.

B. Work includes:
1. Installation of new structural steel lateral bracing system.
2. Replacement of existing mechanical systems.
3. New electric traction elevators.
4. New restrooms
5. New fire sprinkler system
6. Upgrades to building electrical and fire alarm systems.

C. Work also includes:
1. Selective site demolition.
2. New construction consisting of paving removal and replacement, including pavement marking.
3. New concrete retaining wall.
4. Alterations of landscape planting and irrigation system to facilitate and meet current accessibility and fire life/safety code requirements

1.02 RELATED DOCUMENTS

A. Refer to District’s Division 00 Documents, including General Conditions, and other Division 01 Sections, for additional requirements.

1.03 CONTRACTS

A. Construct Work under single fixed-price contract.

1.04 WORK UNDER SEPARATE CONTRACTS

A. Hazardous material abatement by others, prior to start of Work under this Contract:
1. Removal of existing floor tile.
2. Refer to "Hazardous Materials" Article.

1.05 WORK SEQUENCE

A. General: Conform to construction schedule as specified.
1. Construction time shall start as of date specified in initial "Notice to Proceed" from Architect to Contractor and end with date of acceptance of Work by Owner.
B. Construction Schedule: Work will be conducted in single phase and provide least possible interference to activities of Owner's personnel and to permit orderly transfer of personnel and equipment to new facilities.

C. Liquidated Damages: Liquidated damages will be assessed under conditions provided in Agreement.

1.06 CONTRACTOR'S USE OF PREMISES

A. General: During construction period, Contractor shall limit his use of premises to immediate area required for construction operations.
   1. Contractor's use of premises is also limited by Owner's right to perform construction operations with its own forces or to employ separate contractors on portions of Project.

B. Contractor shall limit his use of premises for Work and for storage as directed, to allow for:
   1. Work by other Contractors.
   2. Owner occupancy.
   3. Use by Public.

C. Coordinate use of premises under direction of Architect and Owner.

D. Assume full responsibility for protection and safekeeping of products under this contract, stored on Project Site.

E. Move stored products under Contractor's control, which interfere with operations of Owner or separate contractor.

F. Obtain and pay for use of additional storage or work areas needed for operations.

1.07 WORK DURING COLLEGE SESSIONS

A. Work under this contract will be executed in part during regular sessions of College.
   1. Contractor shall cooperate with College authorities in every way to minimize disturbance.

B. In entrance and exit of workers, and in bringing in, storing, and removal of equipment, Contractor shall cooperate with those in authority and prevent interference with functioning of College.
   1. Observe rules and regulations in force and avoid unnecessary dust, mud or accumulated debris, or undue interference with convenience, sanitation or routine of departmental activities.

C. In connecting new utilities to existing, and similar operations, Contractor shall time and coordinate such operations so that there will be no interference with College activities.

1.08 HAZARDOUS MATERIALS

A. Asbestos or Hazardous Waste: It is understood and agreed that this contract does not contemplate handling of asbestos or other hazardous waste material.
1. Should asbestos or other hazardous waste material be encountered, notify Owner immediately.
2. Do not disturb, handle, or attempt to remove.

PART 2 – PRODUCTS  (Not Applicable)

PART 3 – EXECUTION  (Not Applicable)

END OF SECTION 01 1100
SECTION 01 2610

CONSTRUCTION DOCUMENT MODIFICATION PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

A. Section specifies administrative and procedural requirements for handling and processing Construction Document Modifications to Contract.

1.02 MINOR CHANGES IN WORK

A. Supplemental instructions authorizing minor changes in Work, not involving adjustment to Contract Sum or Contract Time, will be issued by Architect on AIA form G710 - Architect's Supplemental Instructions.

1.03 CONSTRUCTION CHANGE DOCUMENT APPROVAL REQUESTS

A. Construction Change Documents will not be allowed without Division of the State Architect (DSA) approval.

B. Owner-Initiated Change Requests: Proposed changes in Work that will require adjustment to Contract Sum or Contract Time will be issued by Architect, with detailed description of proposed change and supplemental or revised Drawings and Specifications, when necessary.
   1. Change requests issued by Architect are for information only.
      a. Do not consider them an instruction either to stop Work in progress, or to execute proposed change.
   2. Unless otherwise indicated in change request, within ten days of receipt of change request, submit to Architect for Owner's review, estimate of cost necessary to execute proposed change.
      a. When no estimate of cost is submitted within 10 days it will be assumed to be "no cost change".
      b. Include list of quantities of products to be purchased and unit costs, along with total amount of purchases to be made.
      c. Provide breakdown of labor cost involved with the proposed change.
         1) Where requested, furnish survey data to substantiate quantities.
      d. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
      e. Include statement indicating effect proposed change in Work will have on Contract Time.

C. Contractor-Initiated Change Requests:
   1. When latent or other unforeseen conditions require modifications to Contract, Contractor may propose changes by submitting request for change to Architect.
      a. Contractor shall notify Owner within ten days of occurrence leading to such request or request will be denied and Contractor will not be entitled to additional compensation.
   2. Include statement outlining reasons for change and effect of change on Work.
      a. Provide complete description of proposed change.
b. Indicate effect of the proposed change on Contract Sum and Contract Time.

3. Include list of quantities of products to be purchased and unit costs along with total amount of purchases to be made.
   a. Provide breakdown of labor cost involved with proposed change.
   b. Where requested, furnish survey data to substantiate quantities.

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

5. Comply with requirements in Section 01 6000, when proposed change in Work requires substitution of one product or system for product or system specified.

D. Construction Change Document: *DSA Form 140 – Application for Approval of Construction Change Document – CCD Category A.*

   1. Form will be prepared by Architect for approval by DSA.

### 1.04 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive:

1. When Owner and Contractor are not in total agreement on terms of Change Order Proposal Request, Architect may issue Construction Change Directive on *AIA Form G714*, instructing Contractor to proceed with change in Work, for subsequent inclusion in Contract.

2. Construction Change Directive will contain complete Construction Change Document and designate method to be followed to determine change in Contract Sum or Contract Time.

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

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

### 1.05 CONTRACT CHANGE ORDER PROCEDURES

A. Upon DSA approval of Construction Change Document DSA Form 140, Architect will issue Construction Change Documents for signatures of Owner and Contractor on proper approved form, as provided in General Conditions of the Contract.

**PART 2 – PRODUCTS** *(Not Applicable)*

**PART 3 – EXECUTION** *(Not Applicable)*

**END OF SECTION 01 2610**
SECTION 01 2976

PROGRESS PAYMENT PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Administrative and procedural requirements governing Contractor's applications for payment.

B. Related Sections:
   1. Section 01 2610: Construction Document Modification Procedures
   2. Section 01 7700: Closeout Procedures
   3. Section 01 7839: Project Record Documents

C. Related Requirements:
   1. Refer to District's Division 00 Documents, including General Conditions, for requirements related to Contractor's Construction Schedule, Submittal Schedule, and Progress Payments Procedures.

1.02 SCHEDULE OF VALUES

A. Coordinate preparation of Schedule of Values with preparation of Contractor's construction schedule.
   1. Correlate line items in Schedule of Values with other required administrative schedules and forms, including:
      a. Contractor's Construction Schedule.
      b. Application for Payment form.
      c. List of Subcontractors.
      d. Schedule of Alternates.
      e. List of products.
      f. List of principal suppliers and fabricators.
      g. Schedule of Submittals.
   2. Submit Schedule of Values to Architect at earliest feasible date, but in no case later than fourteen days before date scheduled for submittal of initial application for payment.
   3. Sub-Schedules: Where Work is separated into phases that require separately phased payments, provide sub-schedules showing values correlated with each phase of payment.

B. Format and Content:
   1. Include following project identification on Schedule of Values:
      a. Project name and location.
      b. Name of Architect.
      c. Project number.
      d. Contractor's name and address.
      e. Date of submittal.
   2. Arrange Schedule of Values in tabular form with separate columns to indicate following for each item listed:
      a. Generic name.
      b. Related specification section.
c. Name of subcontractor.
d. Name of manufacturer or fabricator.
e. Name of supplier.
f. Change Orders (numbers) that have affected value.
g. Dollar value.
h. Percentage of Contract sum to nearest one-hundredth percent, adjusted to total 100 percent.

3. Provide breakdown of Contract Sum in sufficient detail to facilitate continued evaluation of applications for payment and progress reports.
   a. Break principal subcontract amounts down into several line items.

4. Round amounts off to nearest whole dollar; total shall equal Contract Sum.

5. For each part of Work where application for payment may include materials or equipment, purchased or fabricated and stored, but not yet installed, provide separate line items on Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of Work.

6. Margins of Cost: Show line items for indirect costs, and margins on actual costs, only to extent that such items will be listed individually in applications for payment.
   a. Each item in Schedule of Values and applications for payment shall be complete including its total cost and proportionate share of general overhead and profit margin.
   b. At Contractor's option, temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown as separate line items in Schedule of Values or distributed as general overhead expense.

7. Schedule Updating: Update and resubmit Schedule of Values when Change Orders or Construction Change Directives result in change in Contract Sum.
   a. Submit along with updated construction schedule prior to monthly progress payment submittal

1.03 APPLICATIONS FOR PAYMENT

A. Each application for payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
   1. Initial application for payment, application for payment at time of Substantial Completion, and final application for payment involve additional requirements.

B. Payment Application Times: Date for each progress payment is 5th day of each month.
   1. Period of construction Work covered by each application for payment is period ending fifteen days prior to date for each progress payment and starting day following end of preceding period.

C. Payment Application Forms: Use AIA Document G702 –Application and Certification For Payment as form for application for payment or approved equal.

D. Application Preparation: Complete every entry on form, including notarization and execution by person authorized to sign legal documents on behalf of Owner.
   1. Incomplete applications will be returned without action.
   2. Entries shall match data on Schedule of Values and Contractor's construction schedule.
      a. Use updated schedules if revisions have been made.
   3. Include amounts of approved Change Orders issued prior to last day of
construction period covered by application.

E. Transmittal: Submit five executed copies of each application for payment to Architect by means ensuring receipt within twenty-four hours.
   1. One copy shall be complete, including waivers of lien and similar attachments, when required.
   2. Transmit each copy with transmittal form listing attachments, and recording appropriate information related to application in manner acceptable to Architect.

F. Waivers of Mechanics Lien: When requested by Architect or Owner, with each application for payment, submit waivers of mechanics lien from every entity who may lawfully be entitled to file mechanics lien arising out of the Contract, and related to Work covered by payment.

G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first application for payment include following:
   1. List of subcontractors.
   2. List of principal suppliers and fabricators.
   3. Schedule of Values.
   4. Contractor's Construction Schedule (preliminary if not final).
   5. Submittal Schedule (preliminary if not final).
   6. Certificates of insurance and insurance policies.
   7. Performance and Payment Bonds

H. Application for Payment at Substantial Completion: Following issuance of Certificate of Substantial Completion, submit application for payment.
   1. Application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of Work.

I. Administrative actions and submittals that shall proceed or coincide with application include:
   1. Occupancy permits and similar approvals.
   2. Warranties/guarantees and maintenance agreements.
   3. Test/adjust/balance records.
   5. Meter readings.
   7. Changeover information related to Owner's occupancy, use, operation and maintenance.
   8. Final cleaning.
   10. Advice on shifting insurance coverage.
   11. Record Drawings and Specifications.
   12. Final progress photographs.
   13. List of incomplete Work, recognized as exceptions to Architect's Certificate of Substantial Completion.

J. Final Payment Application: Administrative actions and submittals that must precede or coincide with submittal of final payment application for payment include following:
   1. Completion of project closeout requirements.
   2. Completion of items specified for completion after Substantial Completion.
   3. Assurance that unsettled claims will be settled.
4. Assurance that Work not complete and accepted will be completed without undue delay.
5. Transmittal of required project construction records to Owner.
6. Proof that taxes, fees and similar obligations have been paid.
7. Removal of temporary facilities, controls, and services.
8. Removal of surplus materials, rubbish and similar elements.
9. Change of door locks to Owner's access.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION 01 2976
PART 1  GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Administrative and supervisory requirements necessary for Project coordination
      including, but not necessarily limited to:
      a. Coordination.
      b. Administrative and supervisory personnel.
      c. General installation provisions.
      d. Cleaning and protection.

B. Related Sections:
   1. Section 01 3300: Submittal Procedures; product and material submittals.
   2. Section 01 7423: Cleaning; general project cleaning

C. Related Requirements:
   1. Refer to District's Division 00 Documents, including General Conditions, for
      requirements related to Contractor's Construction Schedule and Submittal
      Schedule.

1.02 COORDINATION

A. Coordination: Coordinate construction activities included under various Sections of
   these Specifications to assure efficient and orderly installation of each part of Work.

B. Coordinate construction operations included under different Sections of Specifications
   that are dependent upon each other for proper installation, connection, and operation.
   1. Where installation of one part of Work is dependent on installation of other
      components, either before or after its own installation, schedule construction
      activities in sequence required to obtain best results.
   2. Where availability of space is limited, coordinate installation of different
      components to assure maximum accessibility for required maintenance, service
      and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.

C. Where necessary, prepare memoranda for distribution to each party involved outlining
   special procedures required for coordination. Include such items as required notices,
   reports, and attendance at meetings.
   1. Prepare similar memoranda for Owner and separate Contractors where
      coordination of their Work is required.

D. Administrative Procedures: Coordinate scheduling and timing of required
   administrative procedures with other construction activities to avoid conflicts and
   ensure orderly progress of Work.
   1. Such administrative activities include, but are not limited to, following:
      a. Preparation of schedules.
      b. Installation and removal of temporary facilities.
      c. Delivery and processing of submittals.
d. Progress meetings.
e. Project Close-out activities.

E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water and materials.
1. Salvage materials and equipment involved in performance of, but not actually incorporated in, Work.
2. Refer to other sections for disposition of salvaged materials that are designated as Owner’s property.

1.03 SUBMITTALS

A. Staff Names: Within fifteen days of Notice to Proceed, submit list of Contractor’s principal staff assignments, including Superintendent and other personnel in attendance at Project Site
1. Identify individuals, their duties and responsibilities
   a. List their addresses and telephone numbers.
2. Post copies of list in Project meeting room, temporary field office and each temporary telephone.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION

3.01 GENERAL INSTALLATION PROVISIONS

A. Inspection of Conditions: Require installer of each major component to inspect both substrate and conditions under which Work is to be performed.
1. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.

B. Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations, to extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.

C. Inspect materials or equipment immediately upon delivery and again prior to installation.
1. Reject damaged and defective items.

D. Provide attachment and connection devices and methods necessary for securing Work.
1. Secure Work true to line and level.
2. Allow for expansion and building movement.

1. Arrange joints in exposed Work to obtain best visual effect.
2. Refer questionable choices to Architect for final decision.

F. Recheck measurements and dimensions before starting each installation.

G. Install each component during weather conditions and Project status that will ensure best possible results.
1. Isolate each part of completed construction from incompatible material as necessary to prevent deterioration.

H. Coordinate temporary enclosures with required inspections and tests, to minimize necessity of uncovering completed construction for that purpose.

I. Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within industry for particular application indicated.
   1. Comply with requirements of Chapter 11B of CBC for accessible mounting heights of toilet accessories and like items.
   2. Refer questionable mounting height decisions to Architect for final decision.

3.02 CLEANING AND PROTECTION

A. Comply with requirements of Section 01 7423.

B. During handling and installation, clean and protect construction in progress and adjoining materials in place.
   1. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

C. Clean and maintain completed construction as frequently as necessary through remainder of construction period.
   2. Adjust and lubricate operable components to ensure operability without damaging effects.

D. Limiting Exposures: Supervise construction activities to ensure that no part of construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during construction period.

END OF SECTION 01 3113
PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Administrative and procedural requirements for project meetings including but not limited to:
      a. Pre-Construction Conference
      b. Progress Meetings
      c. Scheduling Conference

B. Related Sections:
   1. Section 01 3113: Project Coordination

C. Related Requirements:
   1. Refer to various Sections for pre-construction and pre-installation meeting requirements
   2. Refer to District's Division 00 Documents, including General Conditions, for requirements related to Contractor's Construction Schedule.

1.02 PRE-CONSTRUCTION CONFERENCE

A. Schedule pre-construction conference and organizational meeting at Project Site or other convenient location no later than 15 days after execution of Agreement and prior to commencement of construction activities.
   1. Conduct meeting to review responsibilities and personnel assignments.

B. Attendees: Owner, Architect and their consultants, Contractor and his superintendent, major subcontractors, manufacturers, suppliers and other concerned parties shall each be represented at conference by persons familiar with and authorized to conclude matters relating to Work.

C. Agenda: Discuss items of significance that could affect progress including such topics as:
   1. Tentative construction schedule.
   2. Critical Work sequencing.
   3. Designation of responsible personnel.
   4. Procedures for processing field decisions and Change Orders.
   5. Procedures for processing Applications for Payment.
   7. Submittal of Shop Drawings, Product Data and Samples.
   8. Preparation of Record Documents.
   10. Office, Work and storage areas.
   11. Equipment deliveries and priorities.
   12. Safety procedures.
   13. First aid.
15. Working hours.

1.03 PROGRESS MEETINGS

A. Conduct weekly progress meetings at Project Site.
   1. Coordinate dates of meetings with preparation of payment request.

B. Attendees: In addition to representatives of Owner and Architect, each subcontractor, supplier or other entity concerned with current progress or involved in planning, coordination or performance of future activities shall be represented at these meetings by persons familiar with Project and authorized to conclude matters relating to progress.

C. Agenda: Review and correct or approve minutes of previous progress meeting.
   1. Review other items of significance that could affect progress.
   2. Include topics for discussion as appropriate to current status of Project.
   3. Contractor's Construction Schedule: Review progress since last meeting.
      a. Determine where each activity is in relation to Contractor's Construction Schedule, whether on time or ahead or behind schedule.
      b. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so.
      c. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within Contract Time.
   4. Review present and future needs of each entity present, including such items as:
      a. Interface requirements.
      b. Time.
      c. Sequences
      d. Coordination of Work.
      e. Deliveries.
      f. Off-site fabrication problems.
      g. Access.
      h. Site utilization.
      i. Temporary facilities and services.
      j. Hours of Work.
      k. Hazards and risks.
      l. Housekeeping.
      m. Quality and Work standards.
      n. Construction progress
      o. Progress Schedule and Submittals.
      p. Change Orders.
      q. Documentation of information for payment requests.

D. Meeting Records: Owner or Architect shall record minutes of each meeting and furnish copies within reasonable time to Owner, Contractor, and other attendees.
   1. Unless written objections to contents of meeting minutes is received by Architect within five days of distribution of meeting minutes, it shall be understood and agreed that minutes are true and complete record of meeting.
   2. Schedule Updating: Revise construction schedule after each progress meeting where revisions to schedule have been made or recognized.
      a. Issue revised schedule within seven calendar days of meeting.
PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION 01 3119
SECTION 01 3300

SUBMITTAL PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Administrative and procedural requirements for submittals required for performance of Work, including:
      a. Submittal schedule.
      b. Product data.
      c. Shop drawings.
      d. Samples
      e. Verified reports
      f. Deferred Approvals

B. Related Sections:
   1. Section 01 3113: Project Coordination
   2. Section 01 4100: Regulatory Requirements; submittals to regulatory agencies.
   3. Section 01 4200: References; submittals to regulatory agencies.
   4. Section 01 4500: Quality Control: inspection and testing submittals
   5. Section 01 6000: Products Requirements; request for substitution submittals.

C. Related Requirements:
   1. Refer to Division 02 through 33 Sections where more specific submittal Requirements are indicated
   2. Refer to District's Division 00 Documents, including General Conditions, and other Division 01 Sections, for additional requirements.

D. Administrative Submittals:
   1. Include, but are not limited to:
      a. Permits.
      b. Applications for Payment.
      c. Performance and Payment Bonds.
      d. Insurance Certificates.
      e. Inspection and Test Reports.
      f. Schedule of Values.
      g. Progress Schedule.
      h. Listing or designation of subcontractors.
      i. Record Drawings.

E. Contractor's submittal and Architect's acceptance of Product Data, Shop Drawings, or Samples that relate to construction activities not complying with Contract Documents does not constitute acceptable or valid request for substitution, nor does it constitute approval.

F. Product Data, Shop Drawing and Sample Submittals containing substitutions for specified items will be rejected and returned as not in compliance with Contract...
1.02 SUBMITTAL PROCEDURES AND REQUIREMENTS

A. Coordination:
   1. Coordinate preparation and processing of submittals with performance of construction activities.
   2. Designate in Progress Schedule, or in separate coordinated schedule, dates for submission and dates reviewed shop drawings, product data and samples will be needed for each product.
      a. Identify items requiring long lead times.
      b. Submittals for long lead time items are to be submitted as soon as possible, but not later than fifteen days after Notice of Award of Contract.

B. Timing of Submittals:
   1. Make submittals promptly in accordance with approved schedule, sufficiently in advance of performance of related construction activities, and in such sequence as to not cause delay in Work or in Work of other contractors.
   2. Schedule submissions at least 21 working days before dates reviewed submittals will be needed.

C. Number of Submittals Required:
   1. Number stated in each specification section, or as follows:
      a. Product Data and Shop Drawings: One electronic copy as specified under “Electronic Submittals”.
      b. Samples: Number stated in each specification section or, if not stated, minimum of four.
      c. Warranties, Maintenance Agreements, Industry Standards, and Operation/Maintenance Manuals: Two copies.

D. Submittal Preparation:
   1. Place permanent label or title block on each submittal for identification.
   2. Indicate name of entity that prepared each submittal on label or title block.
   3. Include following information on label for processing and recording action taken:
      a. Project name.
      b. Date.
      c. Submittal reference number assigned by Contractor; this number should not be specification section number.
      d. Specification section number to which submittal applies.
         1) Do not reference drawing/detail numbers unless accompanied by specification section number.
   4. Accompany submittals with transmittal form containing:
      a. Date.
      b. Project title and number.
      c. Name and address of:
         1) Architect.
         2) Contractor.
         3) Subcontractor.
         4) Supplier
         5) Manufacturer.
         6) Separate detailer, when pertinent.
d. Number of each shop drawing, product data and sample submitted.

e. Notification of deviations from Contract Documents.
f. Other pertinent data.

E. Submittals shall include:
1. Data and revision dates:
2. Project title and number.
4. Identification of product or material.
5. Relation to adjacent structure or materials.
6. Field dimensions, clearly identified as such.
7. Specification section number.
8. Applicable standards, such as ASTM number or Federal Specification.
9. Blank space, 8 inches x 3 inches, for Contractor and Architect stamps.
11. Contractor’s stamp, initialed or signed, certifying review of submittal, verification of field measurements, and compliance with Contract Documents.
   a. Submittals without Contractor’s stamp and signature will be returned by Architect without review.

F. Processing:
1. Allow sufficient review time so that installation will not be delayed as result of time required to process submittals, including time for resubmittals.
2. Allow minimum of 21 days from date of receipt of complete submittal for Architect’s initial review and return of submittals.
3. Allow additional time if processing must be delayed to permit coordination with subsequent submittals.
4. Architect reserves right to withhold action on submittal requiring coordination with other submittals until related submittals are received.
5. Architect will promptly advise Contractor when submittal being processed must be delayed for coordination.
6. No extension of Contract Time will be authorized because of failure to transmit submittals to Architect sufficiently in advance of Work to permit processing.

G. Electronic Submittals: Make electronic submittals consisting of one color PDF of each document, Product Data Sheet, or Shop Drawing.
1. Should full size hard copies of Submittals be required by District, Contractor, or Consultant, Architect will provide one marked-up color copy of PDF to Owner, Contractor, or Consultant for their use in printing additional copies.
2. Architect will review and return marked-up PDFs to Contractor.
3. One copy of each PDF shall be marked-up and maintained as “Record Document”.

1.03 PRODUCT DATA

A. Collect Product Data into single submittal for each element of construction or system.
1. Do not include Material Safety Data Sheets/Safety Data Sheets (MSDS/SDS) in submittals to Architect.
   a. MSDS/SDS sheets will not be reviewed by Architect and will not be returned.
B. Product Data includes standard printed information on manufactured products that has not been specially prepared for this Project, including, but not limited to following items:
   1. Manufacturer’s product specifications and installation instructions.
   2. Catalog cuts.
   4. Roughing-in diagrams and templates.
   5. Standard wiring diagrams.
   7. Standard product operating and maintenance manuals.

C. Modify standard data sheets to delete information which is not applicable to Project.
   1. Where Product Data must be specially prepared because standard printed data is not suitable for use, submit as shop drawings.
      a. Mark each copy to show applicable choices and options.
      b. Where printed Product Data includes information on several products, some of which are not required, mark copies to indicate applicable information.
   c. Include following information:
      1) Manufacturer’s printed recommendations.
      2) Compliance with recognized trade association standards.
      3) Compliance with recognized testing agency standards.
      4) Application of testing agency labels and seals.
      5) Notation of dimensions and clearances required and as verified by Field measurement.
      6) Notation of coordination requirements.

D. Supplement standard information to provide additional information specifically applicable to Project:
   1. Clearly mark each copy to show applicable choices and options and identify pertinent materials, products, or models.
   2. Show dimensions and clearances required.
   3. Show performance characteristics and capacities.
   4. Show wiring or piping diagrams and controls.

E. Do not submit Product Data until compliance with requirements of Contract Documents has been confirmed.
   1. Unless noncompliance with Contract Document provisions is observed, submittal may serve as the final submittal.

F. Submittals: Make electronic submittals as specified in “General Submittal Procedures and Requirements” Article.

G. Distribution: Furnish copies of final submittal to installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities.
   1. Show distribution on transmittal forms.
   2. Do not proceed with installation until applicable copy of Product Data is in installer’s possession.

H. Do not permit use of unmarked copies of Product Data in connection with construction.
1.04 SHOP DRAWINGS

A. Shop drawings are technical drawings and data that have been specially prepared for Project, including but not limited to following items:
   1. Prepared information, drawn to accurate scale.
   2. Fabrication and installation drawings.
   5. Templates.
   6. Patterns.
   7. Coordination drawings (for use on Project Site).
   8. Schedules.
   9. Design mix formulas.
   10. Contractor's engineering calculations.

B. Include following information:
   1. Dimensions.
   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. Sheet Size: Except for templates, patterns and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 inch by 11 inch but no larger than 30 inch by 42 inch.

C. Highlight, encircle, or otherwise indicate deviations from Contract Documents.

D. Do not reproduce Contract Documents or copy standard information as basis of Shop Drawings.

E. Standard information prepared without specific reference to Project is not considered Shop Drawings.

F. Submittals: Make electronic submittals as specified in “General Submittal Procedures” Article.

G. Do not use Shop Drawings without appropriate final stamp indicating action taken in connection with construction.

H. Contractor may request use of Architect’s computer-generated drawings in electronic format.
   1. Software for CAD formats requested by Contractor not currently available to Architect will be provided by Contractor at his own expense.
   2. Contractor must complete CAD Drawing Request Form (Attachment A) and submit it to Architect in timely manner.

1.05 SAMPLES

A. Samples are physical examples of Work, including, but not limited to, following items:
   1. Partial sections of manufactured or fabricated work
   2. Small cuts or containers of materials.
   3. Complete units of repetitively-used materials.
   4. Swatches showing color, texture and pattern.
5. Color Range Sets:
6. Units of Work to be used for independent inspection and testing.

B. Office Samples:
   1. Sufficient size and quantity to clearly illustrate:
      a. Functional characteristics of product or material, with integrally related parts and attachment devices.
      b. Full range of color, texture and pattern.
   2. Where size and quantity are not specified, provide minimum of four samples, 12 inches by 12 inches, minimum size, where samples are required

C. Field Samples and Mock-Ups:
   1. Erect at Project Site in location acceptable to Architect.
   2. Construct each sample or mock-up complete, including Work of trades required in finished Work.
   3. Size of area as specified in respective specification section.
   4. Remove mock-ups at conclusion of Work or when acceptable to Architect.

1.06 VERIFIED REPORTS

A. Submit Verified Reports to Division of State Architect (DSA). Comply with California Code of Regulations, Title 24, Part 1, Sections 4-336 and 4-343.

1.07 DEFERRED APPROVALS

A. Submit detailed plans, specifications and engineering calculations for deferred approval items.

B. Calculations and drawings of structural nature shall be prepared and signed by registered Structural Engineer licensed in State of California.
   1. Provide cover sheet for calculations indicating following:
      a. Westberg + White Project Number
      b. DSA Project Number
      c. Project Name, with address and Date.
      d. Provide 7 by 9 inch clear space on 8-1/2 by 11 inch calculation cover sheet.
   2. Provide 7 by 9 inch clear space on upper right hand side and to left of title block on full size Drawings.

C. Submit 6 full size copies of plans and calculations on 8-1/2 by 11 inch bond paper with wet signatures in blue.
   1. Prior to DSA review, Architect review may be returned for corrections
      a. Resubmit 6 sets of plans with corrections – no clouds
      b. Up to 3 sets of plans and calculations will be sent to DSA by Architect for approval.
   2. Should corrections be required by DSA, make corrections and submit 6 sets of plans and calculations, along with DSA checkset, to Architect.
   3. After DSA approval, 1 electronic set will be returned to Contractor.
D. Do not start fabrication and installation of Deferred Approval items until detailed plans, specifications and engineering calculations have been approved by Division of the State Architect.

1.08 MISCELLANEOUS SUBMITTALS – WORK RELATED

A. Including, but not limited to, following types of submittals:
   1. Specially prepared warranties/guarantees.
   2. Standard printed warranties.
   4. Printed industry standards.
   5. Collected and bound operating/maintenance manuals.
   7. Maintenance tools and spare parts.

1.09 CONTRACTOR RESPONSIBILITIES

A. As defined in General Conditions of the Contract and following:
   1. Review shops drawings, product data and samples prior to submission to Architect.
   2. Determine and Verify:
   3. Field measurements.
   4. Field construction criteria.
   5. Catalog numbers and similar data.
   7. Coordinate each submittal with requirements of Work and of Contract Documents.
   9. Do not begin fabrication of Work that requires submittals until return of submittals with Architect approval.

1.10 RESUBMITTAL REQUIREMENTS

A. Shop Drawings:
   1. Revise initial drawings as required and resubmit as specified for initial submittal.
   2. Indicate on drawings changes that have been made other than those requested by Architect.

B. Product Data and Samples: New data and samples, same as required for initial submittal.

1.11 DISTRIBUTION OF SUBMITTALS AFTER REVIEW

A. Distribute reproductions of Shop Drawings and copies of Product Data which carry Architect/Engineer stamp to:
   1. Project Site file.
   2. Record Documents file.
   3. Other affected contractors.
   4. Subcontractors.
   5. Supplier or Fabricator.
   6. Owner's Inspector.
B. Distribute samples that carry Architect’s review stamps as directed by Architect.

1.12 ARCHITECT’S ACTION

A. Except for submittals for record, information or similar purposes, where action and return is required or requested, Architect will review each submittal, mark to indicate action taken, and return promptly.
   1. Compliance with specified characteristics is Contractor’s responsibility.

B. Action Stamp:
   1. Architect will stamp each submittal with uniform, self-explanatory action stamp.
   2. Stamp will be appropriately marked, as follows, to indicate action taken:
      a. Final Unrestricted Release: Where submittals are marked "No Exception Taken", that part of Work covered by submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.
      b. Final-But-Restricted Release: When submittals are marked "Make Correction Noted", that part of Work covered by submittal may proceed provided it complies with notations or corrections on submittal and requirements of Contract Documents.
         1) Final acceptance will depend on that compliance.
      c. Returned for Re-submittal: When submittal is marked "Revise and Resubmit", do not proceed with that part of Work covered by submittal, including purchasing, fabrication, delivery, or other activity.
         1) Revise or prepare new submittal in accordance with notations.
         2) Resubmit without delay.
         3) Repeat if necessary to obtain different action mark.
         4) Do not permit submittals marked "Rejected" or "Revise and Resubmit" to be used at Project Site, or elsewhere where Work is in progress.
      d. Other Action: Where submittal is primarily for information or record purposes, special processing or other activity, submittal will be returned, marked "Action Not Required".

PART 2 – PRODUCTS (Not Applicable)
PART 3 – EXECUTION (Not Applicable)

END OF SECTION 01 3300
ATTACHMENT A - CAD DRAWING REQUEST FORM

Date: _______________________________ Westberg + White Job No.______________
Project: ______________________________ Project Architect: ____________________

We (Contractor)_________________________________________________request the
following listed CAD file sheet numbers for use in the execution of our Work under the Contract
Documents of the subject project and hereby assume all and sole responsibility of field
verification and coordination with the Work of associated trades.

The attached computer-based information for the Project is provided to the Contractor (The
User) as a courtesy for their sole convenience. The User recognizes that computer-based
information is easily changeable, that changes are difficult to detect and that use or conversion
of the information provided may introduce errors, inaccuracies or anomalies that Westberg +
White, Inc., and their consultants can neither predict nor control. The delivery of this electronic
data does not constitute the delivery of the professional work product of Westberg + White, Inc.,
and their consultants and Westberg + White, Inc., and their consultants shall not be responsible
for any modifications made to the electronic files or any products derived from electronic files
that are not prepared by Westberg + White, Inc., and their consultants.

By accepting and utilizing this electronic data in lieu of the corresponding drawings and
specifications prepared by Westberg + White, Inc., and their consultants, the User agrees that
such data is an instrument of service of Westberg + White, Inc., and their consultants, who shall
be deemed to be the authors of the drawings and data and shall retain all common law,
statutory law and other rights, including copyrights. The User, by accepting the electronic files,
agrees to assume all risk and liabilities associated with the use of the information provided by
Westberg + White, Inc., and their consultants and understands that Westberg + White, Inc., and
their consultants make no claim or warranty as to the suitability or usefulness of the information
for any purpose. The User also agrees, to the fullest extent permitted by law, to hold harmless
and indemnify Westberg + White, Inc., and their consultants from and against any and all
claims, liabilities, losses, damages and cost, including but not limited to attorney’s fees, arising
from or in connection with the use, misuse, modification, or misinterpretation of the electronic
data provided by Westberg + White, Inc., and their consultants.

Use of the attached computer-based information indicates acceptance and constitutes
agreement to abide by the terms and conditions of this agreement.

<table>
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<tr>
<th>Sheet No.</th>
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Requested File Format: Requested File Deliverable:
☐ DXF       ☐ CD Rom
☐ DWG (Auto CAD Version 2004,       ☐ E-Mail (Zipped Files) unless
requested otherwise)

Contractor’s E-mail address___________________________________
Signed: __________________________________________ Date:____________
Print Name: ____________________________________________ Title:_____________
“L” TOWER BUILDING
SEISMIC AND CODE UPGRADES
RIO HONDO COLLEGE

Company: ________________________________

Address: ________________________________

Phone: ________________________________

Total payment enclosed herewith at the rate of $30.00 per sheet: $___________________

Make checks payable to Westberg + White, Inc.
PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. General regulatory requirements pertaining to Work supplementary to other regulatory requirements mentioned or referenced elsewhere in Contract Documents.

1.02 REQUIREMENTS OF REGULATORY AGENCIES

A. Pertaining statutes, ordinances, laws, rules, codes, regulations, standards, and lawful orders of public authorities having jurisdiction of Work are incorporated into these Contract Documents same as if repeated in full, and as such are intended where reference is made in either singular or plural to Code or Building Code unless otherwise specified including, without limitation, those in list below.
   1. Contractor shall make available at Project Site such copies of listed documents applicable to Work as Architect or Owner may request including mentioned portions of California Code of Regulations (CCR).

B. Project shall be fully governed under State of California's Codes Section Group 1, Chapter 4, Part 1, CCR, Title 24, as it pertains to school construction:
   1. Inspector and continuous inspections of Work shall be per Sections 4-333(b) and 4-342.
   2. Tests and testing laboratory per Section 4-335. (Owner shall pay for testing laboratory.)
   3. Special inspection per Section 4-333(c).
   4. Contractor shall submit verified reports per Sections 4-336 and 4-343(c).
   5. Administration:
      a. Duties of Architect and Engineers shall be per Sections 4-333(a) and 4-341.
      b. Duties of Contractor shall be per Section 4-343.
      c. Verified Reports per Section 4-336.

C. Public regulatory requirements: Statutes, ordinances, laws, rules, codes, regulations, and standards shall include, but not be limited to, following:
   1. California Code of Regulations (CCR):
      a. Title 19 - Public Safety.
      b. Title 24, Part 1 – 2013 California Administrative Code
      e. Title 24, Part 4 – 2013 California Mechanical Code (CMC).
      g. Title 24, Part 6 – 2013 California Energy Code
      h. Title 24, Part 7 – 2013 California Elevator Safety Construction Code (CESCC)
      i. Title 24, Part 9 – 2013 California Fire Code (CFC).
j. Title 24, Part 12 – 2013 California Reference Standards Code
2. Other statutes, ordinances, laws, regulations, rules, orders, and codes specified in other Sections of Specifications or bearing on Work.

1.03 GOVERNING REGULATIONS/AUTHORITIES

A. Architect has contacted authorities having jurisdiction where necessary to obtain information necessary for preparation of Contract Documents
1. Information may or may not be of significance to Contractor.
2. Owner and Architect, at request of Contractor, are to contact authorities having jurisdiction directly for information and decisions having bearing on Work.

1.04 SUBMITTALS

A. Permits, Licenses, and Certificates:
1. Submit for Owner's records, copies of following, including but not limited to:
2. Permits
3. Licenses
4. Certifications
5. Inspection reports
6. Releases
7. Jurisdictional settlements
8. Notices
9. Receipts for fee payments
10. Judgments, and similar documents
11. Correspondence, and records established in conjunction with compliance with standards and regulations bearing upon performance of Work.

PART 2 – PRODUCTS  (Not Applicable)
PART 3 – EXECUTION  (Not Applicable)

END OF SECTION 01 4100
SECTION 01 4200

REFERENCES

PART 1 - GENERAL

1.01 DEFINITIONS

A. Basic contract definitions are included in General Conditions of the Contract.

B. Indicated: Term “Indicated” refers to graphic representations, notes or schedules on Drawings, or other paragraphs or schedules in Specifications, and similar requirements in contract documents.
1. Where terms such as “shown”, “noted”, “scheduled”, and “specified” are used, it is to help locate the reference; no limitation of location is intended except as specifically noted.

C. Directed: Terms such as “directed”, “requested”, “authorized,” “selected”, “approved”, “required”, and “permitted” mean “directed by Architect”, “requested by Architect”, and similar phrases.
1. No implied meaning shall be interpreted to extend Architect’s responsibility into Contractor’s area of construction supervision.

D. Approved: Term “approved,” where used in conjunction with Architect’s action on Contractor’s submittals, applications, and requests, is limited to Architect’s duties and responsibilities as stated in General Conditions of the Contract.

E. Regulations: Term “regulations” includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within construction industry that control performance of Work.

F. Furnish: Term “furnish” is used to mean “supply and deliver to Project Site, ready for unloading, unpacking, assembly, installation, and similar operations.”

G. Install: term “install” is used to describe operations at Project Site including actual “unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimensions, finishing, curing, protecting, cleaning, and similar operations.”

H. Provide: Term “provide” means “furnish and install, complete and ready for intended use.”

I. Installer: “Installer” is Contractor or entity engaged by Contractor, either as employee, subcontractor, or sub-subcontractor, for performance of particular construction activity, including installation, erection, application, and similar operations.
1. Installers are required to be experienced in operations they are engaged to perform.

J. Project Site: Project Site is space available to Contractor for performance of construction activities, either exclusively or in conjunction with others performing other construction activities as part of Project.
1. Extent of Project Site is shown on drawings and may or may not be identical with description of land upon which Project is to be built.
K. Testing Laboratories: “Testing Laboratory” is an independent entity engaged to perform specific inspections or tests, either at Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.02 INDUSTRY STANDARDS

A. Applicability of Standards: Except where Contract Documents include more stringent requirements, applicable construction industry standards have same force and effect as if bound or copied directly into Contract Documents.
   1. Such standards are made part of Contract Documents by reference.
   2. Individual Sections indicate which codes and standards Contractor must make available at Project Site for reference.

B. Publication Dates: Comply with standard in effect as of date of Contract Documents.

C. Copies of Standards: Each entity engaged in construction on Project is required to be familiar with industry standards.
   1. Applicable standards are not bound with Contract Documents.
   2. Where copies of standards are required by individual specification sections or are needed for performance of required construction activity, Contractor shall obtain copies directly from the publication source.

D. Conflicting Requirements: Where compliance with two or more standards is specified, and standards establish different or conflicting requirements for minimum quantities or quality levels, refer requirements that are different, but apparently equal, and uncertainties to Architect for decision before proceeding.

1.03 GOVERNING REGULATIONS/AUTHORITIES

A. Architect has contacted authorities having jurisdiction where necessary to obtain information necessary for preparation of Contract Documents
   1. That information may or may not be of significance to Contractor.
   2. Owner and Architect, at request of Contractor, are to contact authorities having jurisdiction directly for information and decisions having bearing on Work.

1.04 SUBMITTALS

A. Provide copies of following for Owner's records:
   1. Permits
   2. Licenses
   3. Certifications
   4. Inspection reports
   5. Releases
   6. Jurisdictional settlements
   7. Notices
   8. Receipts for fee payments
   9. Judgments and similar documents
   10. Correspondence and records established in conjunction with compliance with standards and regulations bearing upon performance of Work.
PART 2 - PRODUCTS  (Not Applicable)

PART 3 - EXECUTION  (Not Applicable)

END OF SECTION 01 4200
SECTION 01 4500
QUALITY CONTROL

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
1. Administrative and procedural requirements for quality control services.
2. Quality control services include inspections, tests, and related actions, including reports performed by Contractor, by independent agencies, and by governing authorities.
   a. They do not include contract enforcement activities performed by Architect.
3. Inspection and testing services are required to verify compliance with requirements specified or indicated.
   a. These services do not relieve Contractor of responsibility for compliance with Contract Document requirements.
4. Requirements for Contractor to provide quality control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

B. Related Sections:
1. Section 01 7329: Cutting and Patching; requirements for repair and restoration of construction disturbed by inspection and testing activities

C. Related Requirements Specified Elsewhere:
1. Inspections and testing required by laws, ordinances, rules, regulations or orders of public authorities: General Conditions.
2. Certification of Products: Respective specification sections.
4. Tests and Standards: Each specification section listed.

1.02 SELECTION OF TESTING AGENCY

A. Owner will select and employ consultant, testing laboratory or inspection agency to perform specified services.

B. Employment of Testing Laboratory in no way relieves Contractor of his obligation to perform Work in accord with Contract.

1.03 PROJECT INSPECTOR

A. Owner will select and employ Project Inspector

1.04 PAYMENT

A. Costs of quality control services will be initially paid for by Owner. Following quality control services, chargeable to Contractor, will be reimbursed to Owner by deductive change order:
1. Batch Plant Inspection.
2. Taking and testing cores from masonry and concrete.
3. Testing of reinforcing steel and structural steel test specimens.
4. Shop and field welding inspection of structural steel.
5. Shop and field fabrication inspection of structural steel.
6. Roofing inspection and testing.

1.05 DEFICIENCIES

A. Cost of tests or inspections due to following will be reimbursed to Owner by deductive change order.
   1. Retesting because of failure of initial samples.
   2. Additional costs due to overtime work or extra shifts work because of improper scheduling of Work or of delivery of materials by Contractor.
   3. Failure to properly notify laboratory.
   4. Changes in sources, lots or suppliers of materials after original tests.
   5. Changes in methods or materials of construction requested by Contractor that require testing, inspection, or other related services in excess of that required by original design.
   6. Concrete mix designs in excess of first successful design for each concrete type.
   7. Overtime or extra shift work requiring overtime work by Owner's Inspector.

1.06 TESTS AND INSPECTION

A. Testing laboratory or Owner's representative, and not Contractor, will make selection of material required to be tested.

B. Notify Owner's representative sufficient time in advance of manufacture of material to be supplied by him under Contract Documents, which must, by terms of Contract be tested, in order that Owner may arrange for testing of same at source of supply.

C. Material shipped by Contractor from source of supply prior to having satisfactorily passed such testing and inspection or prior to receipt of notice from said representative that such testing and inspection will not be required shall not be incorporated in job.

1.07 TESTING AGENCY SERVICES

A. Cooperate with Architect and Contractor
   1. Provide qualified personnel promptly on notice.

B. Perform specified inspections, sampling and testing of materials and methods of construction:
   1. Comply with specified standards; ASTM, other recognized authorities, and as specified.

C. Attend pre-construction conference and progress meetings when requested by Architect or Owner.

D. Perform additional services as required by Owner.
E. Submittals: Promptly submit copies of reports of inspections and tests, mill analysis, concrete mix designs and certifications per applicable sections of specification.

1. Submit one copy of test reports to:
   a. Owner.
   b. Architect.
   c. Structural Engineer.
   d. Contractor.
   e. Project Inspector.

2. Include tests made, regardless of whether such tests indicate that material is satisfactory or unsatisfactory.

3. Report samples taken but not tested.

4. Report records of special sampling operations as required.

5. Show in report that material or materials were sampled and tested in accordance with requirements of Title 24 and with approved specifications.

6. Show specified design strength in test reports.
   a. State definitely in test reports whether or not material or materials tested comply with requirements.

F. Report Data: Written reports of each inspection, test, or similar service include, but are not limited to, following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making inspection or test.
8. Complete inspection or test data.
9. Test results and interpretation of test results.
10. Ambient conditions at time of sample taking and testing.
11. Comments or professional opinion on whether inspected or tested Work complies with Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting.

G. Testing Agency is not authorized to:

1. Release, revoke, alter, or enlarge requirements of Contract Documents or approve or accept portions of Work.
2. Perform duties of Contractor.

1.08 INSPECTION BY OWNER

A. Provide full access to Owner and his representative for purpose of inspection of parts of Work and to shops wherein Work is in preparation.

1. Maintain proper facilities and provide safe access for such inspection.

B. Owner retains right to reject materials and workmanship which are defective, or to require their correction.

1. Satisfactorily correct rejected workmanship and remove rejected materials from premises without charge to Owner.

2. When Contractor does not correct such rejected work within reasonable time, fixed by written notice, Owner may correct same and charge expense to Contractor.
C. Should it be considered necessary or advisable by Owner at or before final acceptance of entire Work to make examination of Work already completed by removing or tearing out same, upon request, promptly furnish necessary facilities, labor, and materials.  
1. When such Work is found to be defective due to fault of Contractor or his subcontractor, defray expenses of such examinations and of satisfactory reconstruction. 
2. Should such Work be found to meet requirements of Contract, Contractor will be allowed additional cost of labor and material necessarily involved in examination and replacement. 

1.09 WORK BY OWNER’S PROJECT INSPECTOR 

A. Concrete slump tests. 
B. Concrete cylinder samples. 
C. Continuous inspection of masonry work. 
D. Mortar and grout prism. 

1.10 CONTRACTOR’S RESPONSIBILITIES 

A. Cooperate with agencies performing required inspections, tests, and similar services, and provide reasonable auxiliary services as requested. 
B. Provide to agency, selected preliminary representative samples of materials to be tested, in required quantities or assist agency in taking samples. 
C. Furnish incidental labor and facilities:  
   1. To provide access to Work. 
   2. To obtain and handle samples at Site. 
   3. To facilitate inspections and tests. 
   4. For agency's exclusive use for storage and curing of test samples. 
   5. To provide security and protection of samples and test equipment at Project Site. 
D. Notify testing agency sufficiently in advance of operations to permit assignment of personnel and scheduling of tests. 
E. Coordination: Coordinate sequence of activities to accommodate required services with minimum of delay. 
   1. Coordinate activities to avoid necessity of removing and replacing construction to accommodate inspections and tests. 
   2. Contractor is responsible for scheduling times for inspections, tests, taking samples, and similar activities. 

1.11 MISCELLANEOUS TESTS AND INSPECTIONS 

A. Soil and Compaction Testing and Inspection: Performed by project geotechnical (soils) engineer employed and paid by Owner.
B. Special Tests: Special tests requested by Owner or Architect or DSA will be paid for by Owner, except that if such tests fail, deduct costs from Contract Price by Change Order.

PART 2 – PRODUCTS  (Not Applicable)

PART 3 – EXECUTION

3.01 REPAIR AND PROTECTION

A. General: Upon completion of inspection, testing, sample taking and similar services, repair damaged construction and restore substrates and finishes.
   1. Comply with requirements of Section 01 7329.

B. Protect construction exposed by or for quality control service activities, and protect repaired construction.

C. Repair and protection is Contractor's responsibility, regardless of assignment of responsibility for inspection, testing, or similar services.

3.02 SCHEDULE OF TESTS, INSPECTIONS, AND METHODS

   1. ACI – American Concrete Institute.

B. Excavations, Foundations and Retaining Walls (Chapter 18A):
   1. Site Grading: 1803A.3
   2. Compacted Fill Material: 1803A.5

C. Inspection (Chapter 17A):
   1. Site Soil and Backfill: 1704A.6

D. Concrete (Chapters 17A and 19A):
   1. Materials:
      a. Portland Cement Tests: 1705A.3.1, 1913A.1
      b. Concrete Aggregates: 1705A.3.1, 1903A.4
      c. Reinforcing Bars: 1705A.3.1 1913A.2
   2. Concrete Quality:
      a. Proportions of Concrete: ACI 313 – Section 5.2, 5.3, and 5.4
      b. Strength Tests of Concrete: 1905A.1.1, ACI 313 – Section 5.6
      c. Mixing: ACI 313
      d. Splitting Tensile Tests: 1905A.1.4, 1.5
      e. Placing Record: 1704A.4.7
   3. Concrete Inspection:
      a. Job Site: ACI 313 – Section 5.7
      b. Batch Plant and Material Tests: 1705A.3.2
      c. Waiver of Batch Plant and Material Tests: 1705A.3.3
      d. Reinforcing Bar Welding: 1903A.8, Table 1705A.2.1
      e. Post Installed Anchors: 1913A.7e. Pre-Placement Record: 1704A.4.6
E. Structural Steel (Chapters 17A and 22A):
   1. Materials:
      a. Structural Steel: 2205A.1
      b. Cold Formed Steel: 2210A.1
      c. Identification: 2203A.1
   2. Structural Steel Quality:
      a. Tests of Structural and Cold Formed Steel: 2211A.1
      b. Tests of High Strength Bolts, Nuts, Washers: 2213A.1
      c. Tests of End Welded Studs: 2213A.2
   3. Inspection of Structural Steel:
      a. Shop Fabrication: 1704A.2.5, 1705A.2
      b. Welding: 1705A.2.2.1
      c. High Strength Bolt Installation: 1705A.2.2, Table 1705A.2.1

F. Aluminum (Chapter 20A):
   1. Materials:
      a. Alloys: 2001A.2
      b. Identification: 2001A.4
   2. Inspection:

END OF SECTION 01 4500
SECTION 01 5000
TEMPORARY FACILITIES AND CONTROLS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Temporary facilities required for this Work include, but are not necessarily limited to:
      a. Temporary utilities such as heat, water, electricity, and telephone.
      b. Field offices and sheds
      c. Sanitary facilities.
      d. Construction aids.
      e. Barriers.
      f. Temporary controls.
      g. Project identification and signs.
   2. Equipment furnished by subcontractors shall comply with requirements of pertinent safety regulations.
      a. Ladders, planks, hoists, and similar items normally furnished by individual trades in execution of their own portions of Work are not part of this Section.

B. Related Sections:
   1. Division 32 Sections for additional traffic control requirements.
   c. Related Requirements:
      1. Refer to District’s Division 00 Documents, including General Conditions, and other Division 01 Sections, for additional requirements.
      2. Permanent installation and hook-up of various utility lines are described in other pertinent sections.

1.02 PROJECT CONDITIONS

A. Use means necessary to maintain temporary facilities in proper and safe condition throughout progress of Work.

PART 2 – PRODUCTS

2.01 UTILITIES

A. Water:
   1. Provide necessary temporary water lines and water supply and upon completion of Work, remove such temporary facility.
   2. Provide and pay for water needed for construction.

B. Electricity:
   1. Provide necessary temporary wiring and upon completion of Work, remove such temporary facility.
   2. Provide area distribution boxes so located that individual trades may furnish and use 100 foot maximum length extension cords to obtain adequate power and artificial lighting at points where needed for work, inspection, and safety.
3. Provide and pay for electricity needed for construction.

C. Heating: Provide and maintain heat necessary for proper conduct of operations needed in Work.

D. Telephone:
   1. Make necessary arrangements and pay costs for installation and operation of telephone service to Contractor's office on Project Site and Owner's inspector's office on Project Site.
   2. Install telephone on separate line for each temporary office.
      a. Where office has more than one occupant, provide telephone for each additional occupant.
   3. Coin operated telephones are not acceptable.

2.02 FIELD OFFICES AND SHEDS

A. Contractor's Facilities:
   1. Provide field office building and sheds adequate in size and accommodation for Contractor's offices, supply, and storage.

B. Provide and maintain on premises, where directed, watertight storage sheds for materials which might be damaged by weather, including storage facilities for concrete test samples or other material samples required for Work.

2.03 SANITARY FACILITIES

A. Sanitary facilities include temporary toilets, wash facilities, and drinking water fixtures.
   1. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.
   2. Install where facilities will best serve Project's needs.
   3. Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility.
   4. Provide covered waste containers for used material.

B. Temporary Toilet Units: Provide self-contained, single-occupant toilet units of chemical, aerated recirculation, or combustion type.
   1. Provide units properly vented and fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.
   2. Provide separate facilities for male and female personnel.

C. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel involved in handling materials that require wash-up for healthy and sanitary condition.
   1. Dispose of drainage properly.
   2. Supply cleaning compounds appropriate for each condition.
   3. Provide safety showers, eyewash fountains, and similar facilities for convenience, safety, and sanitation of personnel.

D. Drinking-Water Facilities: Provide containerized, tap-dispenser, bottled water drinking water units, including paper supply.
2.04 CONSTRUCTION AIDS

A. Provide construction aids and equipment required by personnel and to facilitate execution of Work
   1. Scaffolds, staging, ladders, stairs, ramps, runways, platforms, railings, hoists, cranes, chutes and other such facilities and equipment.

B. Provide necessary facilities and means of access to structure so that Building Inspectors, Special Inspectors, Architect and Structural Engineer may inspect structure or portions of structure as necessary.
   1. Means of access includes, but is not limited to, ladders, scaffolds,

2.05 BARRIERS

A. Temporary Fencing: Provide temporary fence around entire construction area as required for safety and protection.
   1. Construction: Provide chain link fencing not less than six feet in height, complete with metal or wood posts and required bracing, and with suitably locked truck and pedestrian gates as required.
   2. Provide opaque, fabric or plastic windscreen material, full height and run of fencing, including gates.

B. Tree and Plant Protection: Preserve and protect existing trees and plants at Project Site that are designated to remain, and those adjacent to Project Site.
   1. Provide temporary barriers around each, or around each group of trees or plants.

2.06 TEMPORARY CONTROLS

A. Contractor shall be responsible for specific safety requirements by governmental authorities, including requirements of latest Occupational Safety and Health Act (OSHA) and Cal/OSHA.

B. Provide and maintain methods, equipment, and temporary construction, as necessary to provide controls over environmental conditions at construction site and related areas under Contractor’s control.
   1. Remove physical evidence of temporary facilities at completion of Work.
   2. Comply with requirements of authorities having jurisdiction.

C. Dust Control: Provide positive methods and apply dust control materials to minimize raising dust from construction operations, and provide positive means to prevent airborne dust from dispersing into atmosphere.

D. Water Control: Provide methods to control surface water to prevent damage to Project, Site, or adjoining properties.
   1. Control fill, grading and ditching to direct surface drainage away from excavations, pits, tunnels and other construction areas and to direct drainage to proper runoff.
   2. Provide, operate and maintain hydraulic equipment of adequate capacity to control surface water.
   3. Dispose of drainage water in manner to prevent flooding, erosion, or other damage to Project Site or to adjoining areas.

E. Debris Control: Maintain areas under Contractor’s control free of extraneous debris.
1. Prevent accumulation of debris at construction site, storage and parking areas, or along access roads.
2. Provide containers for deposit of debris as specified in Section 01 7419.

F. Pollution Control:
1. Provide methods, means and facilities required to prevent contamination of soil, water and atmosphere by discharge of noxious substances from construction operations.
2. Provide equipment and personnel to perform emergency measures required to contain spillage, and to remove contaminated soils and liquids.
3. Take special measures to prevent harmful substances from entering public waters.
   a. Prevent disposal of wastes, effluents, chemicals, and other such substances in sanitary or storm sewers.

G. Temporary Fire Protection: Install and maintain temporary fire protection facilities of types needed to protect against reasonably predictable and controllable fire losses.
2. Prohibit smoking in construction areas.
3. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
4. Develop and supervise overall fire prevention and protection program for personnel at Project Site.
   a. Review needs with local fire department and establish procedures to be followed.
   b. Instruct personnel in methods and procedures.
   c. Post warnings and information.

2.07 PROJECT IDENTIFICATION AND TEMPORARY SIGNS

A. Prepare project identification and other signs of size indicated.
1. Install signs where indicated to inform public and persons seeking entrance to Project.
2. Support on posts or framing of preservative treated wood or steel.
3. Do not permit installation of unauthorized signs.

B. Project Identification Sign: Provide one painted sign, of not less than 32 sq. ft. area, with painted graphic content to include:
1. Title of Project.
2. Name of Owner.
3. Names and Titles of:
   a. Architect.
   b. Professional Consultants.
4. Prime Contractor.
5. Graphic Design, Style of Lettering, and colors: As designated by Architect.
6. Erect on Site at lighted location of high public visibility, adjacent to main entrance to Project Site, as approved by Architect.

C. Provide temporary on-site informational signs.
1. As required by codes, laws and regulatory agencies
2. To identify key elements of the construction facilities.
3. To direct traffic.
2.08 OWNERSHIP OF TEMPORARY FACILITIES AND CONTROLS

A. Items provided by Contractor under this Section remain property of Contractor
   1. Remove such items from job site immediately upon completion of Work.

PART 3 – EXECUTION

3.01 MAINTENANCE AND REMOVAL

A. Maintain temporary facilities as long as needed for safe and proper completion of Work.

B. Remove such temporary facilities as rapidly as progress of Work will permit, or as directed by Architect.

END OF SECTION 01 5000
SECTION 01 5713
TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Prevention of erosion due to construction activities.
B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.
C. Restoration of areas eroded due to insufficient preventive measures.
D. Performance bond.
E. Compensation of Owner for fines levied by authorities having jurisdiction due to non-compliance by Contractor.

1.02 RELATED REQUIREMENTS

A. Section 31 1000 - Site Clearing: Limits on clearing; disposition of vegetative clearing debris.
B. Section 31 2200 - Grading: Temporary and permanent grade changes for erosion control.

1.03 REFERENCE STANDARDS

B. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; current edition.

1.04 PERFORMANCE REQUIREMENTS

A. Comply with all requirements of U.S. Environmental Protection Agency for erosion and sedimentation control, as specified for the National Pollutant Discharge Elimination System (NPDES), Phases I and II, under requirements for the 2003 Construction General Permit (CGP).
B. Comply with all requirements of The California State Construction General Permit Order 2009-0009-DWQ for erosion and sedimentation control, even though this project is not required by law to comply.
D. Develop and follow an Erosion and Sedimentation Prevention Plan and submit periodic inspection reports.
E. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.

F. Provide to Owner a Performance Bond covering erosion and sedimentation preventive measures only, in an amount equal to 100 percent of the cost of erosion and sedimentation control work.

G. Timing: Put preventive measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.

H. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.
   1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.
   2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 25 years.

I. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
   1. Control movement of sediment and soil from temporary stockpiles of soil.
   2. Prevent development of ruts due to equipment and vehicular traffic.
   3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

J. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.
   1. Prevent windblown soil from leaving the project site.
   2. Prevent tracking of mud onto public roads outside site.
   3. Prevent mud and sediment from flowing onto sidewalks and pavements.
   4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

K. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
   1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
   2. If sediment basins are used as temporary preventive measures, pump dry and remove deposited sediment after each storm.

L. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
   1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.

M. Open Water: Prevent standing water that could become stagnant.
N. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

1.05 SUBMITTALS

A. Erosion and Sedimentation Control Plan:
   1. Include:
      a. Site plan identifying soils and vegetation, existing erosion problems, and areas vulnerable to erosion due to topography, soils, vegetation, or drainage.
      b. Site plan showing grading; new improvements; temporary roads, traffic accesses, and other temporary construction; and proposed preventive measures.
      c. Where extensive areas of soil will be disturbed, include storm water flow and volume calculations, soil loss predictions, and proposed preventive measures.
      d. Schedule of temporary preventive measures, in relation to ground disturbing activities.
      e. Other information required by law.
      f. Format required by law is acceptable, provided any additional information specified is also included.
   2. Obtain the approval of the Plan by authorities having jurisdiction.
   3. Obtain the approval of the Plan by Owner.

B. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements, signed by legally authorized official of manufacturer; indicate actual minimum average roll values; identify fabric by roll identification numbers.

C. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Gravel: Conforming to Greenbook standard.

B. Grass Seed For Temporary Cover: Select a species appropriate to climate, planting season, and intended purpose. If same area will later be planted with permanent vegetation, do not use species known to be excessively competitive or prone to volunteer in subsequent seasons.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.
3.02 PREPARATION

A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.03 SCOPE OF PREVENTIVE MEASURES

A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.

B. Construction Entrances: Traffic-bearing aggregate surface.
   1. Width: As required; 20 feet (7 m), minimum.
   2. Length: 50 feet (16 m), minimum.
   3. Provide at each construction entrance from public right-of-way.
   4. Where necessary to prevent tracking of mud onto right-of-way, provide wheel washing area out of direct traffic lane, with drain into sediment trap or basin.

C. Linear Sediment Barriers: Made of silt fences or gravel bags.
   1. Provide linear sediment barriers as indicated on drawings.

D. Storm Drain Curb Inlet Sediment Trap: As detailed on drawings.

E. Storm Drain Drop Inlet Sediment Traps: As detailed on drawings.

F. Soil Stockpiles: Protect using one of the following measures:
   1. Cover with polyethylene film, secured by placing soil on outer edges.
   2. Cover with mulch at least 4 inches (100 mm) thickness of pine needles, sawdust, bark, wood chips, or shredded leaves, or 6 inches (150 mm) of straw or hay.

3.04 INSTALLATION

A. Traffic-Bearing Aggregate Surface:
   1. Excavate minimum of 6 inches (150 mm).
   2. Place geotextile fabric full width and length, with minimum 12 inch (300 mm) overlap at joints.
   3. Place and compact at least 6 inches (150 mm) of 1.5 to 3.5 inch (40 to 90 mm) diameter stone.

B. Silt Fences:
   1. Store and handle fabric in accordance with ASTM D4873.
   2. Where slope gradient is less than 3:1 or barriers will be in place less than 6 months, use nominal 16 inch (405 mm) high barriers with minimum 36 inch (905 mm) long posts spaced at 6 feet (1830 mm) maximum, with fabric embedded at least 4 inches (100 mm) in ground.
   3. Where slope gradient is steeper than 3:1 or barriers will be in place over 6 months, use nominal 28 inch (710 mm) high barriers, minimum 48 inch (1220 mm) long posts spaced at 6 feet (1830 mm) maximum, with fabric embedded at least 6 inches (150 mm) in ground.
   4. Where slope gradient is steeper than 3:1 and vertical height of slope between barriers is more than 20 feet (6 m), use nominal 32 inch (810 mm) high barriers with woven wire reinforcement and steel posts spaced at 4 feet (1220 mm) maximum, with fabric embedded at least 6 inches (150 mm) in ground.
5. Install with top of fabric at nominal height and embedment as specified.
6. Do not splice fabric width; minimize splices in fabric length; splice at post only, overlapping at least 18 inches (460 mm), with extra post.
7. Wherever runoff will flow around end of barrier or over the top, provide temporary splash pad or other outlet protection; at such outlets in the run of the barrier, make barrier not more than 12 inches (300 mm) high with post spacing not more than 4 feet (1220 mm).

3.05 MAINTENANCE

A. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches (13 mm) or more rainfall at the project site, and daily during prolonged rainfall.

B. Repair deficiencies immediately.

C. Silt Fences:
   1. Promptly replace fabric that deteriorates unless need for fence has passed.
   2. Remove silt deposits that exceed one-third of the height of the fence.
   3. Repair fences that are undercut by runoff or otherwise damaged, whether by runoff or other causes.

D. Clean out temporary sediment control structures weekly and relocate soil on site.

E. Place sediment in appropriate locations on site; do not remove from site.

3.06 CLEAN UP

A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Engineer.

B. Clean out temporary sediment control structures that are to remain as permanent measures.

C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

END OF SECTION 01 5713
SECTION 01 6000

PRODUCT REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Following Administrative and Procedural Requirements:
      a. Selection of products for use in Project
      b. Product delivery, storage, and handling.
      c. Manufacturers' standard warranties on products.
      d. Special warranties.
      e. Product substitutions.

B. Related Sections:
   1. Section 01 4200: References; for applicable industry standards for products specified.
   2. Section 01 7700: Closeout Procedures; for submitting warranties for contract closeout.

C. Related Requirements::
   1. Specific requirements for warranties on products and installations specified to be warranted are included in appropriate Sections in Divisions 02 through 33 Sections.
   2. Refer to District's Division 00 Documents, including General Conditions, and other Division 01 Sections, for additional requirements.

1.02 QUALITY ASSURANCE

A. To fullest extent possible, provide products of same kind, from single source.

1.03 SUBMITTALS

A. Product Listing Schedule: Prepare schedule showing products specified in tabular form acceptable to Architect.
   1. Include generic names of products required.
   2. Include manufacturer's name and proprietary product names for each item listed.
   3. Form: Prepare Product Listing Schedule with information on each item tabulated under following column headings:
      a. Related Specification Section number.
      b. Generic name used in Contract Documents.
      c. Proprietary name, model number and similar designations.
      d. Manufacturer's name and address.
      e. Supplier's name and address.
   4. Completed Schedule: Within fifteen days after date of commencement of Work, submit four copies of completed Product Listing Schedule.
      a. Furnish written explanation for omissions of data, and for known variations from Contract requirements.
1.04 DEFINITIONS

A. Definitions used in this Article are not intended to change meaning of other terms used in Contract Documents, such as "specialties", "systems", "structure", "finishes", "accessories", and similar terms.
   1. Such terms are self-explanatory and have well recognized meanings in construction industry.

B. Products: Items purchased for incorporating into Work, whether purchased for Project or taken from previously purchased stock. term "product" includes terms "material," "equipment," and terms of similar intent.
   1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature, that is current as of date of Contract Documents.
   2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise.
      a. Products salvaged or recycled from other projects are not considered new products.

C. Substitutions: Changes in products, materials, equipment, and methods of construction required by Contract Documents and proposed by Contractor
   1. Following are not considered substitutions:
      a. Substitutions requested during bidding period, and accepted by written Addendum prior to opening of bids or award of Contract.
   2. Revisions to Contract Documents requested by Owner or Architect.
   4. Compliance with governing regulations and orders issued by governing authorities.

D. Basis-of-Design Product Specification: Where specific manufacturer's product is named and accompanied by words "Basis of Design", including make or model number or other designation, to establish significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

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

F. 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.

1.05 REQUESTS FOR SUBSTITUTIONS

A. Requests for Substitutions received after award of Contract will be considered only in case of substantiated product unavailability, or other conditions beyond control of Contractor.
B. Substitution Requests: Submit one electronic copy (PDF) of each request for consideration.
   1. Identify product or fabrication or installation method to be replaced.
   2. Include Specification Section number and title and Drawing numbers and titles.
      a. Refer to Article 2.02, in this Section.
   3. Substitution Request Form: Use form provided by Owner; other forms will not be accepted.
      a. Requests received without properly completed substitution request form will be rejected without further review.
   4. Documentation: Show compliance with specified requirements for substitutions and following, as applicable:
      a. Statement indicating why specified material or product cannot be provided.
         1) Submit statement on official letterhead of Contractor, supplier, or manufacturer, signed by an officer of the Company.
         2) Statement will be subject to independent verification by Architect.
      b. Product identification, including manufacturer's name and address.
      c. Coordination information, including list of changes or modifications needed to other parts of Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
      d. Detailed, side-by-side comparison of significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
      e. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
      f. Structural calculations, where applicable or requested, prepared and signed by Structural Engineer licensed in California.
      g. Samples, where applicable or requested.
      h. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
      i. Material test reports from qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
      j. Research/evaluation reports evidencing compliance with building code in effect for Project, from model code organization acceptable to authorities having jurisdiction.
      k. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for Work, including effect on overall Contract Time.
         1) When specified product or method of construction cannot be provided within Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
      l. Cost information, including proposal of change, when occurring, in Contract Sum.
      m. Designation of availability of maintenance services, sources of replacement materials.
      n. Contractor's certification that proposed substitution complies with requirements in Contract Documents and is appropriate for applications indicated.
      o. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
C. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 01 3300.
   1. Show compliance with requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle products using means and methods that will prevent damage, deterioration and loss, including theft; comply with manufacturer's written instructions.
   1. Schedule delivery to minimize long term storage at Project Site and to prevent overcrowding of construction spaces.
   2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other losses.
   3. Deliver products to Project Site in undamaged condition in manufacturer's original sealed container, or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting and installing.
   4. Inspect products on delivery to ensure compliance with Contract Documents, and to ensure products are undamaged and properly protected.
   5. Store products in manner to facilitate inspection and measurement of quantity or counting of units.
   6. Store materials in manner that will not endanger Project structure.
   7. Store products subject to damage by elements under cover in weathertight enclosure above ground, with ventilation adequate to prevent condensation.
   8. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
   9. Protect stored products from damage.

1.07 PRODUCT WARRANTIES

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

B. Special Warranties: Prepare written document that contains appropriate terms and 2. identification, ready for execution.
   3. Submit draft for approval before final execution.
   4. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
   5. Refer to Division 2 through 32 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 01 7700 and General Conditions.

PART 2 – PRODUCTS

2.01 PRODUCT SELECTION

A. General Product Requirements: Provide products that comply with Contract Documents, that are undamaged and, unless otherwise indicated, unused at time of installation.
1. Provide products complete with accessories, trim, finish, safety guards and other devices and details needed for complete installation and for intended use and effect.

2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.

3. Owner reserves right to limit selection to products with warranties not in conflict with requirements of Contract Documents.

4. Where products are accompanied by term "as selected", Architect will make selection.

5. Where products are accompanied by term "match sample", sample to be matched is Architect's.


7. Or Equal: Where products are specified by name and accompanied by term "or equal", or "or approved equal", or "or approved", comply with provisions in "Product Substitutions" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures: Procedures for product selection include following:

1. Product: Where Specification paragraphs or subparagraphs titled "Product" name single product and manufacturer, provide product named.
   a. Substitutions may be considered, unless otherwise indicated.

2. Manufacturer/Source: Where Specification paragraphs or subparagraphs titled "Manufacturer" or "Source" name single manufacturers or sources, provide product by manufacturer or from source named that complies with requirements.
   a. Substitutions may be considered, unless otherwise indicated.

3. Products: Where Specification paragraphs or subparagraphs titled "Products" introduce list of names of both products and manufacturers, provide one of products listed that complies with requirements.
   a. Where products or manufacturers are specified by name, accompanied by term "or equal", or "or approved equal" comply with provisions in "Product Substitutions" Article to obtain approval for use of unnamed product.

4. Manufacturers: Where Specification paragraphs or subparagraphs titled "Manufacturers" introduce list of manufacturers' names, provide product by one of manufacturers listed that complies with requirements.
   a. Where manufacturers are specified by name, accompanied by term "or equal", or "or approved equal" comply with provisions in "Product Substitutions" Article to obtain approval for use of an unnamed product.

5. Product Options: Where Specification paragraph titled "Product Options" indicate that size, profiles, and dimensional requirements on Drawings are based on specific product or system, provide either specific product or system indicated or comparable product or system by another manufacturer.
   a. Comply with provisions in "Product Substitutions" Article to obtain approval for use of unnamed product.

6. Basis-of-Design Products: Where Specification paragraphs or subparagraphs titled "Basis-of-Design Product" are included and also introduce or refer to list of manufacturers' names, provide either specified product or comparable product by one of other named manufacturers.
   a. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on product named.
   b. Comply with provisions in "Product Substitutions" Article to obtain approval for use of unnamed product.
   c. Substitutions may be considered.
   a. Architect's decision will be final on whether proposed product matches satisfactorily.
   b. Where no product is available within specified category that matches satisfactorily and complies with other specified requirements, comply with provisions of Contract Documents on "substitutions" for selection of matching product.

8. Visual Selection Specification: Where Specifications include phrase "as selected from manufacturer's colors, patterns, textures" or similar phrase, select product and manufacturer that complies with other specified requirements.
   a. Standard Range: Where Specifications include phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that does not include premium items.
   b. Full Range: Where Specifications include phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that includes both standard and premium items.

9. Performance Specification Requirements: Where Specifications require compliance with performance requirements, provide products that comply with requirements, and are recommended by manufacturer for application indicated.
   a. General overall performance of product is implied where product is specified for specific application.
   b. Manufacturer's recommendations may be contained in product literature, or by manufacturer's certification of performance.

2.02 PRODUCT SUBSTITUTIONS

A. Timing: Requests for Substitutions are restricted to before bid opening as stated in Instruction to Bidders.
   1. Requests received after that time may be considered or rejected at discretion of Architect.
   2. Architect will consider request for substitution after commencement of Work only when specified product or construction method cannot be provided within Contract Time, cannot receive necessary approvals, cannot be provided in manner compatible with or coordinate with other materials or cannot provide required warranty.

B. Conditions: Contractor's substitution request will be received and considered by Architect when following conditions are satisfied, as determined by Architect; otherwise requests will be returned without action except to record noncompliance with these requirements
   1. Burden of proof of merit of proposed substitution is upon proposer.
   2. Extensive revisions to Contract Documents are not required.
   3. Requested substitution is consistent with Contract Documents and will produce indicated results.
   4. Request is timely, fully documented and properly submitted.
   5. Request is directly related to "or equal" clause or similar language in Contract Documents.
   6. Specified product or construction method cannot be provided within Contract Time.
a. Request will not be considered when product or method cannot be provided as result of failure to pursue Work promptly, failure to identify items requiring long lead times, or failure to coordinate activities properly.

7. Specified product or construction method cannot receive necessary approval by governing authority, and requested substitution can be approved.

8. Substantial advantage is offered Owner, in cost, time, energy conservation, or other considerations of merit, after deducting additional responsibilities Owner must assume.
   a. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner or separate Contractors, and similar considerations.

9. Specified product or construction method cannot be provided in manner that is compatible with other materials, and where Contractor certifies that requested substitution will overcome incompatibility.

10. Specified product or construction method cannot be coordinated with other materials, and where Contractor certifies that requested substitution can be coordinated.

11. Specified product or construction method cannot provide warranty required by Contract Documents and where Contractor certifies that requested substitution provide required warranty.

12. When requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of Work, is uniform and consistent, is compatible with other products, and is acceptable to contractors involved.

C. Architects Action: When necessary, within one week of receipt of request for substitution, Architect will request additional information or documentation for evaluation of request for substitution.
   1. Within 2 weeks of receipt of request, or one week of receipt of additional information or documentation, whichever is later, Architect will notify Contractor of acceptance or rejection of requested substitution.
   2. Form of Acceptance: Change Order.
   3. Use product specified when Architect cannot make decision on use of proposed Substitution within time allocated.
   4. Architect will not be responsible for locating or securing information which is not included in substantiating data.
   5. Architect's decision of acceptance or rejection of requested substitution shall be final.

D. Architect's cost for evaluating substitutions requested by Contractor, including making subsequent revisions to drawings, specifications and other resulting documentation, will be paid by Owner with reimbursement from Contractor by deductive change order.

E. Contractor's submittal and Architect's acceptance of Shop Drawings, Product Data or Samples that relate to construction activities not complying with Contract Documents does not constitute an acceptable or valid request for substitution, nor does it constitute approval.

PART 3 – EXECUTION

3.01 INSTALLATION OF PRODUCTS

A. Comply with manufacturer's instructions and recommendations for installation of products in applications indicated.
1. Anchor each product securely in place, accurately located and aligned with other Work.
2. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

END OF SECTION 01 6000
SECTION 01 7123
FIELD ENGINEERING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Contractor shall enter into agreement with Civil Engineer of Record for engineering services required for Project.
   2. Survey work required in execution of Project.
   3. Civil, structural or other professional engineering services specified, or required to execute Contractor’s construction methods.
   4. Contractor furnished assistance.
   5. Verification of conditions.

B. Related Sections:
   1. Section 01 3300: Submittal Procedures
   2. Section 01 7700: Closeout Procedures.

C. Related Requirements:
   1. Refer to District’s Division 00 Documents, including General Conditions, for additional requirements.

1.02 QUALITY ASSURANCE

A. Qualifications of Surveyor or Engineer: Engage registered Civil Engineer or licensed Land Surveyor acceptable to both Contractor and Owner who is qualified to perform land surveying.
   1. Furnish to Owner prior to start of Work, name and license (or registration number) issued by State of California, Board of Registration for Professional Engineers and Land Surveyors.
   2. Provide notice to Owner during course of construction should identification of individual responsible for this work change, and obtain approval of Owner for replacement.

B. Field engineering services furnished during course of this Project shall be under direct supervision and control of named individual civil engineer or land surveyor.

1.03 SUBMITTALS

A. Comply with pertinent provisions of Section 01 3300.

B. Name and address of Surveyor or professional engineer to Architect, including changes as they may occur.

C. Upon request of Architect, submit documentation to verify accuracy of field engineering work.
D. Submit certificate signed by registered Civil Engineer or Land Surveyor certifying that elevations and locations of improvements are in conformance, or non-conformance, with Contract Documents.

E. Record Drawings:
   1. At Project completion, obtain and pay for CD’s and Files of Project Plans.
      a. Clearly indicate differences between original drawings and completed Work within specified tolerances.
   2. Show as-built locations by coordinates of utilities onsite with top of pipe elevations at major grade and alignment changes.
   3. Completed record drawing transparencies shall be dated, signed and certified as correct by Licensed Surveyor or Civil Engineer.
   4. Comply with requirements of Section 01 7700.

PART 2 – PRODUCTS
   (Not Applicable)

PART 3 – EXECUTION

3.01 SURVEY REFERENCE POINTS

A. Existing horizontal and vertical control points for Project are those designated on Drawings.

B. Locate and protect control points prior to starting site work, and preserve permanent reference points during construction.
   1. Make no changes or relocations without prior written notice to Architect.
   2. Report to Architect when reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
   3. Identify and protect survey monuments on Project Site discovered during construction, which are not referenced on Project Drawings.
      a. Tie out such monuments and notify Architect prior to allowing them to be disturbed.
   4. Replace permanent boundary markers disturbed during construction with new permanent monuments and file required Record of Survey or Corner Record in accordance with applicable State and County laws, at no additional cost to Owner.

3.02 PROJECT SURVEY REQUIREMENTS

A. Establish minimum of two permanent horizontal and vertical control points on Project Site, remote from building area referenced to data established by survey control points.
   1. Record locations, with horizontal and vertical data, on Project Record Documents, including description of monuments in place.

B. Establish lines and levels, locations and dimensions, by instrumentation or similar technical appropriate means:
   1. Site Improvements:
      a. Utility lines, including, but not limited to, storm drains, sewers, water mains, gas, electric and telephone lines.
      b. Provide adequate horizontal control to locate lines and provide vertical control in proportion to slope of line as required for accurate construction.
   2. Building Lines and Levels: Furnish building corner offsets as required to adequately locate buildings.
3. Provide control lines and levels required for Mechanical and Electrical work.
4. Provide grade stakes and elevations as required to construct paved areas, landscaped areas, and other areas as required.
   a. Calculate and layout subgrade elevations and intermediate controls as required to provide smooth transitions between the spot elevations indicated on plans.
   b. From time to time, verify layout of Work by same methods.
5. Provide batter boards or other similar control for drainage, utility, and other onsite structures as required.

3.03 RECORDS

A. Maintain complete, accurate surveyor's log of control and survey work as it progresses.
   1. Make this log available for reference.

END OF SECTION 01 7123
PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes
1. Administrative and procedural requirements for cutting and patching.

B. Related Sections:
1. Section 01 1100: Summary of Work
2. Division 22 and 23 Sections for cutting, patching, or relocating plumbing and mechanical items.
3. Division 26 Sections for cutting, patching, or relocating electrical systems.

1.02 QUALITY ASSURANCE

A. Requirements for Structural Work: Do not cut and patch structural elements in manner that would reduce their load-carrying capacity or load-deflection ratio.

B. Operational and Safety Limitations: Do not cut and patch operating elements or safety related components in manner that would result in reducing their capacity to perform as intended or result in increased maintenance or decreased operational life or safety.
1. Obtain approval before cutting and patching following operating elements or safety related systems:
   a. Shoring, bracing, and sheeting.
   b. Primary operational systems and equipment.
   c. Air or smoke barriers.
   d. Water, moisture, or vapor barriers.
   e. Membranes and flashings.
   f. Fire protection systems.
   g. Noise and vibration control elements and systems.
   h. Control systems.
   i. Communication systems.
   j. Conveying systems.
   k. Electrical wiring systems.

C. Visual Requirements: Do not cut and patch construction exposed on exterior or in occupied spaces, in manner that would, in Architect's opinion, reduce aesthetic qualities, or result in visual evidence of cutting and patching.
1. Remove and replace Work that has been cut and patched in visually unsatisfactory manner.
2. Engage recognized experienced and specialized fabricator to cut and patch following categories of exposed Work:
   a. Processed concrete finishes.
   b. Stucco and plaster.
PART 2 – PRODUCTS

2.01 MATERIALS

A. Use materials that are identical to existing materials.
   1. Where identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to fullest extent possible with regard to visual effect.
   2. Use materials whose installed performance will equal or surpass that of existing materials.

PART 3 – EXECUTION

3.01 INSPECTION

A. Before cutting existing surfaces, examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Take corrective action before proceeding if unsafe or unsatisfactory conditions are encountered.

3.02 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect existing construction during cutting and patching to prevent damage.
   1. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Take precautions necessary to avoid cutting existing pipe, conduit or ductwork serving building, but scheduled to be removed or relocated until provisions have been made to bypass them.

3.03 PERFORMANCE

A. General: Employ skilled workmen to perform cutting and patching.
   1. Proceed with cutting and patching at earliest feasible time and complete without delay.
   2. Cut existing construction to provide for installation of other components or performance of other construction activities and subsequent fitting and patching required to restore surfaces to their original condition.

B. Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction.
   1. In general, where cutting is required use hand or small power tools designed for sawing or grinding, not hammering and chopping.
   2. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces.
      a. Temporarily cover openings when not in use.
   3. To avoid marring existing finished surfaces, cut or drill from exposed or finished side into concealed surfaces.
4. Cut through concrete and masonry using cutting machine such as carborundum saw or diamond core drill.

5. By-pass utility services such as pipe or conduit, before cutting, where services are shown or required to be removed, relocated or abandoned.

6. Cut-off pipe or conduit in walls or partitions to be removed.
   a. Cap, valve or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.

C. Patching: Patch with durable seams that are as invisible as possible.
   1. Comply with specified tolerances.
      a. Where feasible, inspect and test patched areas to demonstrate integrity of installation.
      b. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in manner that will eliminate evidence of patching and refinishing.

3.04 CLEANING

A. Thoroughly clean areas and spaces where cutting and patching is performed or used as access.

END OF SECTION 01 7329
SECTION 01 7419
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. References.
   2. System description for construction and demolition waste management.

B. Related Sections:
   1. Section 01 3300 – Submittal Procedures.
   2. Section 01 4100 – Regulatory Requirements.
   3. Section 01 5000 – Temporary Facilities and Controls.
   4. Section 01 7423 – Cleaning.
   5. Section 01 7700 – Closeout Procedures.

1.02 REFERENCES


B. California Code of Regulations, Title 14 – Natural Resources
   1. Division 7 – Department of Resources Recycling and Recovery

1.03 SYSTEM DESCRIPTION

A. Collection and separation of construction and demolition waste materials generated on-site as follows:
   1. Re-use or recycling on-site.
   2. Transportation to approved recyclers or re-use organizations.
   3. Transportation to legally designated landfills for purpose of recycling, salvaging, or reusing minimum of 50 percent of construction and demolition waste generated.

1.04 SUBMITTALS

A. Construction and Demolition Waste Management Plan (Exhibit 1):
   1. Within 10 calendar days after Notice to Proceed and prior to waste removal, submit following to Owner for review and approval:
      a. Materials to be recycled, re-used, or salvaged, either on-site or off-site.
      b. Estimates of construction and demolition waste quantity (in tons) by type of material.
         1) If waste is measured by volume, give factors for conversion to weight in tons.
      c. Procedures for recycling/re-use program.
      d. Permit or license and location of Project waste disposal areas.
      e. Site Plan for placement of waste containers.

B. Construction and Demolition Waste Management Monthly Progress Report (Exhibit 2):
   1. Submit Summary of waste generated by Project, monthly with Application for Payment. Include following:
a. Firms accepting recovered or waste materials.
b. Type and location of accepting facilities (landfill, recovery facility, or used materials yard).
   1) If materials are re-used or recycled on job site, location should be designated as “On-site Re-use/Recycling.
c. Type of materials and net weight (tons) of each.
d. Value of materials or disposal fee paid.
e. Attach weigh bills and other documentation confirming amount and disposal location of waste materials.

C. Construction and Demolition Waste Management Final Compliance Report:
   1. Final update of Waste Management Plan to provide summary of total waste generated by Project.

D. Waste management Report for Contractors (Exhibit 3):
   1. Complete attached form and submit to Owner.

E. Solid Waste Management and Recycling Plan (Exhibit 4):
   1. Complete attached form and submit to Owner.

PART 2 – PRODUCTS  (Not Applicable)

PART 3 – EXECUTION

3.01 IMPLEMENTATION

A. Implement approved Waste Management Plan including collecting, segregating, storing, transporting and documenting each type of waste material generated, recycled or re-used, or disposed in landfills.

B. Designate on-site person to be responsible for instruction workers and overseeing sorting and recording of waste/recyclable materials.

C. Include waste management and recycling in worker orientation and as agenda item for regular job meetings.

D. Limit recycle and waste bin areas to approved areas indicated on Waste management Plan.
   1. Keep recycle and waste bins neat and clearly marked to avoid contamination of materials.

3.02 ATTACHMENTS

A. Exhibit 1: Construction and Demolition Waste Management Plan.


END OF SECTION 01 7419
EXHIBIT 1

CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT PLAN

CONSTRUCTION/MAINTENANCE/ALTERATION AND DEMOLITION PROJECTS

PROJECT NAME: __________________________________________________________

PROJECT NO: __________________________________________________________

NAME OF COMPANY: _______________________________________________________

CONTACT PERSON: _________________________________________________________

TELEPHONE: __________________________________________________________________

PROJECT SITE LOCATION: __________________________________________________

PROJECT TYPE:

___New Construction   ____Demolition    ___Maintenance/Alteration Projects

PROJECT SIZE (SQ.FT.): _____________________________________________________

DATE AND ESTIMATED PERIOD _______________________________________________
EXHIBIT 1 FORM

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Tons Estimated Recycle</th>
<th>Tons Estimated Reuse</th>
<th>Tons Estimated Salvage</th>
<th>Tons Estimated Landfill</th>
<th>Proposed Disposal or Recycling Facility</th>
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Column 1: “Material Type” – Enter type of materials targeted for recycling, reuse, or requiring disposal.

Columns 2 through 4: “Estimated Generation” – Enter estimated quantities (tons) of recyclable, reusable, or salvageable waste materials anticipated to be generated and state number of salvageable items.

Column 5: “Estimated Landfill” – Enter quantities (tons) of materials to be disposed in landfill.

Column 6: “Disposal Location” – Enter end-destination of recycled, salvaged, and disposed materials.

General:
1. Attach proposed Recycling and Waste Bin Location Plan.
2. Attach name and contact data for each recycling or disposal destination to be used.
EXHIBIT 2

CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT MONTHLY PROGRESS REPORT

CONSTRUCTION/MAINTENANCE/ALTERATION AND DEMOLITION PROJECTS

PROJECT NAME: __________________________________________________________

PROJECT NO: __________________________________________________________

NAME OF COMPANY: _____________________________________________________

CONTACT PERSON: _______________________________________________________

TELEPHONE: ____________________________________________________________

PROJECT SITE LOCATION: _______________________________________________

PROJECT TYPE:

___ New Construction   ____ Demolition   ___ Maintenance/Alteration Projects

PROJECT SIZE (SQ.FT.): __________________________________________________

DATE AND ESTIMATED PERIOD: ____________________________________________
**EXHIBIT 2 FORM**

<table>
<thead>
<tr>
<th>1 Material Type</th>
<th>2 Tons Actual Recycle</th>
<th>3 Tons Actual Reuse</th>
<th>4 Tons Actual Salvage</th>
<th>5 Tons Actual Landfill Name</th>
<th>6 Disposal or Recycling Facility (e.g. Onsite, of Facility)</th>
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Total

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Column 5: “Estimated Landfill” – Enter quantities (tons) of materials to be disposed in landfill.

Column 6: “Disposal Location” – Enter end-destination of recycled, salvaged, and disposed materials.

General:  
(1) Attach proposed Recycling and Waste Bin Location Plan.  
(2) Attach name and contact data for each recycling or disposal destination to be used.
EXHIBIT 3

Waste Management Report for Contractors

Complete this form each time materials are removed from Project Site or reused onsite. Submit to Owner’s Project Manager.

PROJECT SITE LOCATION:_____________________________________ DATE:___________

COMPANY:__________________________________________________________________

MATERIAL:___________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

WAS THE MATERIAL RECYCLED: YES_____NO_____

VOLUME/WEIGHT:____________________________________________________________

RECYCLING COMPANY OR DISPOSAL SITE:_______________________________________________________________________

SUBMITTED BY:_________________________________________________________________________

PHONE NUMBER:____________________________________________________________
EXHIBIT 4

SOLID WASTE MANAGEMENT AND RECYCLING PLAN

Prepare Waste Management and Recycling Plan by completing the following form for Construction and Demolition materials produced because of Work performed at Citrus Community College District. Owner requires that Contractors recycle materials when there is viable recycling company available.

Owner’s Environmental Health and Safety Supervisor will assist applicants in developing and implementing Waste Management and Recycling Plan.

COMPANY NAME: __________________________ CONTACT: ____________________________

ADDRESS: ___________________________ PHONE: ____________________________

PROJECT SITE: ______________________________________________________________

Please fill out following form for submittal.
Form will help to identify types of materials, estimated quantities of materials, and how material will be transported and recycled or disposed.

If you have questions regarding this form or recycling and disposal, please call James Poper, Director of Facilities Services at 562.908.3441
EXHIBIT 4 FORM

Circle the material that will be generated at the construction site, estimate the quantity, list how the materials will be transported, and write in where the materials will be taken.

<table>
<thead>
<tr>
<th>MATERIALS</th>
<th>ESTIMATED QUANTITY (in yards and tons)</th>
<th>HAULER (List hauler’s name if not self-haul)</th>
<th>RECYCLING COMPANY OR DISPOSAL SITE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salvage and used building</td>
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<tr>
<td>Wood</td>
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<tr>
<td>Plant Debris</td>
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<tr>
<td>Wallboard</td>
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<td>Corrugated cardboard</td>
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<tr>
<td>Metals</td>
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<tr>
<td>Masonry/Tile</td>
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<tr>
<td>Concrete/Asphalt</td>
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<tr>
<td>Toilets (porcelain)</td>
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<tr>
<td>Carpet Padding (foam)</td>
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<tr>
<td>Other</td>
<td></td>
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<tr>
<td>Mixed Loads (i.e. trash)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

FOR DISTRICT USE ONLY:

Approval Status:

_____ Approved

_____ Further explanation needed, see attached

_____ Denied

Reviewed by: __________________________ Date: _______________
SECTION 01 7423

CLEANING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Performance of cleaning, during progress of Work, and at completion of Work, as required by General Conditions.

B. Related Sections:

C. Related Requirements:
   1. Refer to District’s Division 00 Documents, including General Conditions, for additional requirements.

1.02 QUALITY ASSURANCE

A. Verify that requirements of cleanliness are being met.

B. Final Cleaning: Use only professional cleaning company experienced in commercial cleaning.

1.03 DISPOSAL REQUIREMENTS

A. Conduct cleaning and disposal operations in compliance with applicable codes, ordinances, regulations, and anti-pollution laws.

B. In addition to specified requirements, comply with applicable requirements of fire and governing authorities having jurisdiction.

1.04 PAYMENT WITHHELD

A. Architect reserves right to withhold certification of payment requests for failure on part of Contractor to regularly clean Project in conformance with requirements of this Section.

PART 2 – PRODUCTS

2.01 CLEANING MATERIALS AND EQUIPMENT

A. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.

B. Use only those cleaning materials and methods recommended by manufacturer of surface material to be cleaned.

C. Use cleaning materials only on surfaces recommended by cleaning products manufacturer.
PART 3 – EXECUTION

3.01 PROGRESS CLEANING DURING CONSTRUCTION

A. Execute periodic cleaning to keep Work, Project Site and adjacent properties free from accumulations of waste materials, rubbish and windblown debris, resulting from construction operations.
   1. Maintain stored items in orderly arrangement allowing maximum access and providing required protection of materials.
      a. Provide on-site containers for collection of waste materials, debris and rubbish.
   2. Provide adequate storage for waste materials awaiting removal from Project Site, observing requirements for fire protection and protection of environment.
   3. Handle hazardous, dangerous or unsanitary waste materials separately from other waste material by placing it in proper containers.
   4. Burying or burning of waste materials is not permitted.
   5. Remove waste materials, debris and rubbish from Project Site periodically and dispose of at legal disposal areas away from Project Site.

B. Project Site:
   1. Inspect Project Site daily and pick up scrap, debris, and waste material.
      a. Place waste material in designated containers.
   2. Flammable waste shall be kept in sealed metal containers until removed from Project Site.
   3. Maintain Project Site clear of debris so as not to impede construction and fire department access

C. Structures:
   1. Weekly, and more often if necessary, inspect structures and pick up scrap, debris, and waste material.
      a. Remove items and place in designated container.
   2. Weekly, sweep interior spaces clean. Space shall be free from dust and other material capable of being removed by handheld broom, (i.e.: “broom clean”).
   3. As required preparatory to installation of succeeding material, clean structures or pertinent portions thereof to degree of cleanliness recommended by manufacturer of succeeding material.
   4. Following installation of finish floor materials, clean finish floor daily, and more often if necessary.
      a. Provide adequate protection of finish where Work is being performed in space in which finish materials have been installed.
      b. “Clean”, for purpose of this subparagraph, shall be interpreted as meaning free from foreign materials that, in opinion of Architect, may be injurious to finish floor material, (i.e.: “vacuum clean”).

3.02 DUST CONTROL

A. Clean interior spaces prior to start of finish painting and continue cleaning on as-needed basis until painting is finished.

B. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.
3.03 FINAL CLEANING

A. Prior to completion of Work, remove from Project Site, tools, surplus materials, equipment, scrap, debris, and waste.

B. Employ experienced workers or professional cleaners for final cleaning.
   1. Comply with manufacturer's instructions.

C. Complete following cleaning operations before requesting inspection for Certification of Substantial Completion:
   1. Site: Clean Site, including landscape development areas, of rubbish, litter and other foreign substances.
      a. Sweep paved areas broom clean, including public paved areas directly adjacent to Project Site.
         1) Remove stains, spills and other foreign deposits.
      b. Rake grounds that are neither paved nor planted, to smooth even-textured surface and remove resultant debris.
   2. Exterior and Interior: Clean exposed exterior and interior hard-suraced finishes to dust-free condition
      a. Remove traces of soils, waste material, smudges and other foreign matter.
      b. Remove traces of splashed material from adjacent surfaces.
      c. Remove materials using equipment as instructed by manufacturer of surface materials to be cleaned.
      d. Leave concrete floors broom clean.
   3. Carpeted Surfaces:
      a. Use only dry-chemical method of cleaning.
      b. Do not use steam cleaning or water based cleaning on carpet.
      c. Use materials and methods fully approved by carpet manufacturer, as instructed in manufacturer's published literature.
      d. Vacuum carpet.
   4. Labels: Remove labels that are not permanent labels.
   5. Transparent Materials: Clean transparent material, including mirrors and glass in doors and windows.
      a. Remove glazing compound and other substances that are noticeable vision obscuring materials.
      b. Replace chipped or broken glass and other damaged transparent materials.
      c. Restore reflective surfaces to their original reflective condition.
      d. Clean glass inside and outside.
      e. Polished Surfaces:
         1) Apply polish recommended by manufacturer of material being polished to surfaces requiring routine application of buffed polish.

D. Ventilating Systems:
   1. Clean permanent filters and replace disposable filters if units were operated during construction.
   2. Clean ducts, blowers and coils if units were operated without filters during construction.

E. Wipe surfaces of mechanical and electrical equipment.
   1. Remove excess lubrication and other substances.
   2. Clean plumbing fixtures to sanitary condition.
   3. Clean light fixtures and lamps.
F. Comply with regulations of authorities having jurisdiction and safety standards for cleaning.
   1. Do not burn waste materials.
   2. Do not bury debris or excess materials on Owner's property.
   3. Do not discharge volatile, harmful or dangerous materials into drainage systems.
   4. Remove waste materials from Project Site and dispose of in lawful manner.
   5. Where extra materials of value remaining after completion of associated Work have become Owner's property, arrange for disposition of these materials as directed.

G. Prior to final completion, or Owner occupancy, Contractor shall conduct inspection of sight-exposed interior and exterior surfaces, and work areas, to verify that entire Work is clean.

3.04 CLEANING DURING OWNER’S OCCUPANCY

A. Should Owner occupy portion of Project prior to its completion by Contractor, acceptance by Owner/Architect shall be in accordance with General Conditions of the Contract.

END OF SECTION 01 7423
PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Administrative and procedural requirements for Project Closeout, including but not limited to:
      a. Inspection procedures.
      b. Substantial Completion
      c. Final Acceptance

B. Related Sections:
   1. Section 01 7423: Cleaning
   2. Section 01 7839: Project Record Documents

C. Related Requirements:
   1. Closeout requirements for specific construction activities are included in appropriate Sections in Divisions 02 through 33.

1.02 BENEFICIAL OCCUPANCY AND ACCEPTANCE OF SUBSTANTIAL COMPLETION

A. Comply with CCR, Title 24, Part 1 - Administrative Code, Section 4-336 CCR (Schools)] Requirements for Closeout Procedures.
   1. Comply with additional requirements in District’s Division 00 Sections and General Conditions of the Contract.

B. Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, complete following (List exceptions in request):
   1. In application for payment that coincides with, or first follows, date Substantial Completion is claimed, show one hundred percent completion for portion of Work claimed as substantially complete.
      a. Include supporting documents for completion as indicated in Contract documents and statement showing accounting of changes to Contract sum.
      b. If one hundred percent completion cannot be shown, include list of incomplete items, value of incomplete construction, and reasons Work is not complete.
   2. Make required submittals of specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents, along with record drawings and similar final record information in accordance with requirements in Section 01 7839.
   3. Complete final clean up requirements in accordance with Section 01 7423, including touch-up painting.
      a. Touch-up and otherwise repair and restore marred exposed finishes.

C. Inspection Procedures: Upon receipt of request for inspection, Architect will either proceed with inspection or advise Contractor of unfilled requirements.
   1. Should Architect and Owner determine that Work is not substantially complete:
a. Architect will promptly notify Contractor in writing, giving reason(s) for his determination.
b. In conjunction with Inspector of Record and Construction Manager, Architect will prepare list of items (Punch List) to be completed or corrected.
   1) Punch List may be developed for less than entire project, when approved by Architect and Owner.
c. Contractor shall remedy deficiencies and notify Architect when Work is ready for re-inspection.
d. Architect will prepare Certificate of Substantial Completion, accompanied by Punch List, following inspection, or advise Contractor of construction that must be completed or corrected before certificate will be issued.

2. Architect will repeat inspection when requested and if assured that Work has been substantially completed in each phase, will submit Certificate of Substantial Completion to Contractor and Owner for their written acceptance of responsibilities assigned them in Certificate.
   a. Owner reserves right to occupy each completed phase upon issuance of Certificate of Substantial Completion.

3. Results of completed inspection will form basis of requirements for final acceptance.

D. Mandatory Substantial Completion Submittals include, but are not necessarily limited to:
   1. Redlined' As-Built Set (marked up drawings).
   2. On As-Built Set and Specifications manual record revisions to original contract document with contrasting color.
   3. Operation and Maintenance Manuals for items specified in pertinent Sections and for other items approved by Architect.
   4. Warranties and Guarantees.
   5. Training.
   7. Evidence of payment and release of liens, when requested by Owner.
   8. List of Subcontractors, service organizations and principal vendors, including current names, addresses and telephone numbers, where they may be contacted for emergency service, including nights, weekends, and holidays.

1.03 FINAL ACCEPTANCE

A. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete following (List exceptions in request):
   1. Contractor shall prepare and submit notice (Project Closeout Request) that Work is ready for final inspection and acceptance.
   2. Architect, and Owner’s Inspector to verify that Punch List items are complete.
   3. Should Architect or Owner’s Inspector determine Work is incomplete or defective:
      a. Architect or Owner’s Inspector will promptly notify Contractor in writing, listing incomplete or defective work.
      b. Contractor shall remedy deficiencies promptly and notify Owner’s Inspector when ready for re-inspection.

B. Reinspection Procedure: Architect will reinspect Work upon receipt of notice that Work, including inspection list items from earlier inspections, has been completed, except items whose completion has been delayed because of circumstances acceptable to Architect.
1. Upon completion of reinspection, Architect will prepare certificate of final acceptance, or advise Contractor of work that is incomplete, or of obligations that have not been fulfilled but are required for final acceptance.
2. If necessary, reinspection will be repeated.
3. When Architect determines Work is acceptable under Contract Documents, he will notify Owner’s Inspector that Project is complete per Contract Drawings and Specifications.
4. Upon acceptance, Contractor must certify that Project has been completed in compliance with Contract Documents.
   a. Copy of this report shall be submitted to following:
      1) Architect.
      2) Owner’s Inspector.

C. Final Payment Procedure.
   1. Submit following in accordance with requirements of Section 01 7839:
      a. Final payment request with releases and supporting documentation not previously submitted and accepted.
      b. Include certificates of insurance for products and completed operations where required.
   2. Updated final statement, accounting for final additional changes to Contract Sum.
   3. Certified copy of Architect’s final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, and list has been endorsed and dated by Architect.
   4. Consent of surety to final payment.
   5. Comply with additional requirements in District’s Division 00 Sections and General Conditions of the Contract.

PART 2 – PRODUCTS  
(Not Applicable)

PART 3 – EXECUTION  
(Not Applicable)

END OF SECTION 01 7700
SECTION 01 7839
PROJECT RECORD DOCUMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Administrative and procedural requirements for preparing, maintaining, and submitting following:
      a. Project Record Documents.
      b. Operating and Maintenance Data and Manuals.
      c. Warranties, Guarantees, and Bonds.
      d. Spare parts and Maintenance Materials.
      e. Instructions to Owner’s Personnel.

B. Related Sections:
   1. Separate Specification Sections requiring Record Documents.

C. Related Requirements:
   1. Refer to District’s Division 00 Documents, including General Conditions, for additional requirements.

1.02 PROJECT RECORD DOCUMENTS

A. Dedicated Record Set: Maintain one set of Contract Drawings and one copy of Project Specifications for use during construction to record changes made during construction.
   1. Revisions shall be recorded with contrasting color.
   2. Do not use record documents for construction purposes.

B. Record Documents and Shop Drawings:
   1. Record in concise and neat manner and on continual basis actual revisions to Work.
   2. Include reference to appropriate document with date revision/change was approved or directed.
   3. Changes/Revisions to Drawings and Specifications include, but are not limited to:
      a. Changes made by RFI and CO.
      b. Changes made to shop drawings.
   4. Mark set to show actual installation where installation varies substantially from Work as originally shown.
      a. Mark whichever drawing is most capable of showing conditions fully and accurately.
      b. Where shop drawings are used, record cross-reference at corresponding location on Contract drawings.
      c. Give particular attention to concealed elements that would be difficult to measure and record at later date.
   5. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of Work.
6. Mark new information that is important to Owner, but was not shown on Contract Drawings or shop drawings.
7. Note related Change Order numbers where applicable.
8. Label each document “PROJECT RECORD” in neat large printed letters.
9. Record information concurrently with construction progress.
   a. Do not conceal Work until required information is recorded.
10. Legibly mark each item to record actual construction including:
   b. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
      1) Identify drains and sewers by invert elevation.
   c. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of Work.
   d. Identify ducts, dampers, valves, access doors and control equipment wiring.
   e. Field changes of dimension and detail.
   f. Details not on original Drawings.
C. Store Record Documents and Samples in Contractor's Field Office, separate from documents used for construction.
   1. Protect record documents from deterioration and loss in secure, fire-resistive location.
   2. Provide access to record documents for Architect's reference during normal working hours.
   3. Provide files and racks for storage of Documents
   4. Provide secure storage space for storage of samples.
   5. Maintain documents in clean, dry, legible condition and in good order.
      a. Replace soiled or illegible documents.
D. Record Specifications: Maintain one complete copy of Project Manual, including addenda, and one copy of other written construction documents such as Change Orders and modifications issued in printed form during construction.
   1. Legibly mark these documents and record at each product section description of actual products installed to show substantial variations in actual Work performed in comparison with text of specifications and modifications including following:
      a. Manufacturer's name, trade name, product model and number and supplier.
      b. Give particular attention to substitutions, selection of options and similar information on elements that are concealed or cannot otherwise be readily discerned later by direct observation, including following:
         1) Authorized product substitutions or alternates utilized.
         2) Changes made by Addenda and Modifications.
   2. Note related record drawing information and product data.
   3. Upon completion of Work, submit record specifications to Architect for Owner's records.
E. Owner's Project Inspector will verify that Project Record Documents are fully updated prior to approving Payment Applications.
   1. Obtain Owner's Inspector's signature on record set verifying information.
F. Record drawings will be reviewed by Architect for completeness and acceptance.
G. As-Built Drawings: Shall be turned over to Owner in following manner:
   1. Separate each discipline (i.e. Civil, Architectural, Mechanical, Electrical, Plumbing, and so on)
   2. Identify disciplines of Drawings by adding white tag.
   3. Tag each discipline.
   4. Tag shall be size No. 8, 8-11/16 by 2-3/4 inches.
   5. Legibly write on tag name of Project, and discipline inside tube.
   6. Each discipline shall be separately tubed by using U-Line tube or equal.
   7. Size of tube: 4 inches minimum and 6 inches maximum.

H. Record of Electronic (Digital) Files: Immediately before inspection of Substantial Completion, review marked-up Record Set with Architect and Owner’s Inspector.
   1. When authorized, prepare full set of corrected digital files of Record Documents.
   2. Submit following documents:
      a. Scan sheets in As-Built Set, furnish annotated PDF electronic files.
      b. CD or CD’s of PDF files and file labeling is to include following information:
         1) Project name.
         2) Date.
         3) Name of Architect.
         4) Name of Contractor
         5) Disciplines included in CD (i.e. Title sheet, Civil, Architectural, Structural, Mechanical, and so on)
         6) Labeling and indexing of files contain within CD shall be in Sequential order to match Title Sheet of Contract Documents.

I. RFI’s: Furnish one copy of RFI’s questions and answers submitted on Project.
   1. Submit RFI binder in following manner:
      a. Binder: 8-1/2 by 11 inch three-ring D binder with vinyl-covers at the front and spine.
      b. Provide new white binders.
      c. Project Name.
      d. Label binder with front and spine cover labeled “RFI’s”.
      e. Furnish tab for each individual RFI.
      f. Submit RFI Binder(s) inside Bankers Box (11 by 15 inches) or equal size, box or boxes, shall include two labels on face and side of box.
      g. Boxes should be labeled as follows:
         1) Use Avery Label 6573 or equal size.
         2) Type Bid No., Project Name, Number of boxes (i.e. Box 1 of 5).
            a) Refer top attached sample label at end section.
         3) Label’s Font for labels: Use Vernada, size 48 for Bid No.
            a) Use Vernada, size 16 for rest of content on label.

1.03 OPERATING AND MAINTENANCE DATA AND MANUALS

A. Submit two sets prior to Substantial Completion inspection for Architect’s review and approval.

B. Manual Format:
   1. Prepare data in form of instructional manual for use by Owner’s personnel.
      a. Binders
1) Commercial quality, heavy-duty, three-ring D binders with durable and cleanable vinyl-covers at front and spine, with internal pockets to hold CD.
2) Size: 8-1/2 by 11 inches
3) Provide new white binders.

b. Identify Project Name/Building Name and Project Number on cover of manual.

2. Table of Contents: Include in each volume, neatly typewritten.
   a. Identify Contractor, name of responsible principal, address, and phone number.
   b. List each product included, indexed to content of volume.
   c. List, with each product, name, address, and telephone number of subcontractor or installer and maintenance contractor, as appropriate and nearest source of supply for parts and replacement.
   d. Identify location of installed equipment.
   e. Submit M&O Manuals inside “Bankers Box” (11 by 15 inches) or equal size, box.
      1) Include (2) labels on face and side of boxes.
      2) Boxes should be labeled as follows:
         a) Use Avery Label 6573 or equal size.
         b) Type Bid No., Project Name, Project’s, Number of boxes (i.e. Box 1 of 5).
         c) Refer to attached sample label at end of this Section.
      3) Font for Labels: Use Vernada, 48 point for Bid No.
         a) Use Vernada, 16 point for rest of content on label.

3. Product Data:
   a. Include only those sheets which are pertinent to specific product.
   b. Annotate each sheet to clearly identify specific product or part installed.
   c. Include CD with Product Data information.
      1) Maintenance schedules and equipment list must be in editable Word or Excel spreadsheet format.

4. Drawings:
   a. Supplement product data with Drawings as necessary to clearly illustrate relations of component parts of equipment and systems.
   b. Coordinate Drawings with information in Project Record Documents to ensure correct illustration of completed installation.
   c. Do not use Project Record Documents as maintenance drawings.
   d. Full size and half size hard copies of Drawings are required.

5. Copy of each warranty and service contract as specified.

1.04 WARRANTIES, GUARANTEES, AND BONDS

A. Disclaimers and Limitations: Manufacturer’s disclaimers and limitations on product warranties do not relieve Contractor of warranty on Work that incorporates products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with Contractor.

B. Manufacturer’s warranties and guarantees not withstanding, warrant entire Work against defects in materials and workmanship for twelve months from Date of Acceptance of Substantial Completion.
   1. Warranties and guarantees between Contractor and manufacturers and Contractor and suppliers shall not affect warranties or guarantees between Contractor and Owner.
1.05 WARRANTY REQUIREMENTS

A. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as result of such failure or that must be removed and replaced to provide access for correction of warranted Work.

B. Reinstatement of Warranty: When Work covered by warranty has failed and been corrected by replacement or rebuilding, reinstate warranty by written endorsement.
   1. Reinstated warranty shall be equal to original warranty with equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that Work covered by warranty has failed, replace or rebuild Work to an acceptable condition complying with requirements of Contract documents.
   1. Contractor is responsible for cost of replacing or rebuilding defective Work regardless of whether Owner has benefited from use of Work through portion of its anticipated useful service life.

D. Owner's Recourse: Written warranties made to Owner are in addition to implied warranties, and shall not limit duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which Owner can enforce such other duties, obligations, rights, or remedies.
   1. Rejection of Warranties: Owner reserves right to reject warranties and to limit selections to products with warranties not in conflict with requirements of Contract Documents.

E. Owner reserves right to refuse to accept Work for Project where special warranty, certification, or similar commitment is required on such Work or part of Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

F. Warranties and guarantees shall be submitted to Contractor for Architect's review and approval prior to final payment.

G. For warranty items delayed, warranty period shall not start until items have been completed.

H. Furnish two original copies with wet signatures of warranties and guarantees on Project.

I. Organize warranties/guarantees into orderly sequence base on Table of Contents by Project Specifications:
   1. Bind warranties/guarantees in 8-1/2 by 11 inch heavy-duty, three ring binders, same as specified in Article 1.03.
   2. Identify each binder on front and spine with printed sheet “WARRANTIES”, project name and name of contractor.
   3. Contractor to issue Contractor’s and Subcontractor’s Warranties/Guarantees using attached Warranties/Guarantees form found on Page 8 of this Section.
1.06 SUBMITTALS

A. Submit written warranties to Architect prior to date certified for Substantial Completion.
   1. When Architect's Certificate of Substantial Completion designates commencement date for warranties other than date of Substantial Completion for Work, or designated portion of Work, submit written warranties upon request of Architect.

1.07 MANUAL FOR EQUIPMENT AND SYSTEMS

A. Submit (2) copies of final approved manual to Owner's Inspector prior to final payment.

B. Content for each unit of mechanical equipment and each mechanical system, as applicable and appropriate, including but not limited to following:
   1. Description of units, or system and component parts.
   2. Operating procedures.
   4. Servicing and lubrication schedule, with list of lubricants required.
   5. As-installed control diagrams by controls manufacturer.
   6. Other data as required in various specification sections.

C. Content, for each electrical and electronic system, as applicable and appropriate, including but not limited to following:
   1. Description of system and component parts.
   2. Circuit directories of panel boards.
   3. As-installed color-coded wiring diagrams.
   4. Operating procedures.
   5. Maintenance procedures.
   6. Other data as required in individual sections.

D. Prepare and include additional data as may be required for instruction of Owner's personnel.

E. Additional requirements for operating and maintenance data: As may be specified in individual Sections.

F. Provide complete information for products specified in individual Sections.

1.08 INSTRUCTION OF OWNER’S PERSONNEL

A. Provide instruction/training to Owner personnel as indicated in individual specification sections and as required.

B. Provide to Owner, date and list (signatures) of Owner personnel who attended training.
   1. Schedule instructional meeting or meetings after instructional manuals have been submitted, reviewed, and approved by Architect.
   2. Coordinate meetings to include tier subcontractors.

C. Instruction sessions will be held in Owner designated area on Project Site and at Owner’s convenience.
1. Amount of time required for each session shall be as specified in individual sections.

D. Review contents of Manuals with Owner's personnel in full detail to explain every aspect of operation and maintenance.

1.09 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification Sections.

PART 2 – PRODUCTS  (Not Applicable)
PART 3 – EXECUTION  (Not Applicable)

END OF SECTION 01 7839
WARRANTY/GUARANTEE FORM

FOR_______________________________________________________________WORK

We, the undersigned, do hereby warranty and guaranty that the parts of the Work described above which we have furnished or installed for:

Project Name: (Insert Project Name)

Owner: (Insert Owner’s Name)

Location: (Insert Project Location)

Are in accordance with the Contract Documents and that all said work as installed with fulfill or exceed all the Warranty and Guaranty requirements. We agree to repair or replace work installed by us, together with any other work which is displaced or damaged by so doing, that proves to be defective in workmanship, material, or operation within a period of:

(Insert written years) year(s)

from the date of filing of the Notice of Completion, ordinary wear and tear and unusual neglect or abuse excepted.

In the event of our failure to comply with the above-mentioned conditions within a reasonable time period determined by the Owner, after notification in writing, we, the undersigned, all collectively and separately, hereby authorize the Owner to have said defective work repaired and/or replaced and made good, and agree to pay to the Owner upon demand all monies that the Owner may expend in making good said defective work, including all collection costs and reasonable attorney fees.

Date:

(Insert Name of Contractor)                              (Insert Name of Subcontractor, Manufacturer or Supplier)

Signature:                                               Signature:

Name: Name:

Title: Title:

State License No.                                       State License No.:

Local Representative: For maintenance, repair, or replacement service, contact:

Name:

Address:

Phone:
Bid No. XXXX

[Project Name]  DSA No. N/A

RFI BINDERS 01 OF 04

- BINDERS 01 OF 04: RFI'S 001 THRU 5
- BINDERS 02 OF 04: RFI'S 051 THRU 100
- BINDERS 03 OF 04: RFI'S 101 THRU 150
- BINDERS 04 OF 04: RFI'S 151 THRU 200

Box 1 of 5
SECTION 02 4119

SELECTIVE DEMOLITION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Furnishing labor, materials and equipment necessary for performance of
      selective demolition as indicated, specified, or required, but not limited
      to, following:
      a. Protection of existing improvements to remain.
      b. Cleaning existing improvements to remain.
      c. Disconnecting and capping utilities.
      d. Removing debris, waste materials, and equipment.
      e. Removal of items for performance of Work.
      f. Removal of salvageable items to be retained by Owner.

B. Related Sections:
   1. Section 01 1100: Summary of Work
   2. Section 01 3119: Project Meetings
   3. Section 01 5000: Temporary Facilities and Controls
   4. Section 01 7329: Cutting and Patching
   5. Section 01 7423: Cleaning
   6. Respective Sections of Divisions 21 through 23 and 26 through 28; for cutting,
      patching, or relocating plumbing, mechanical, and electrical items.

C. Section requires selective removal and subsequent legal off-site disposal of
   following:
   1. Portions of existing interior and exterior walls, doors, and windows.
   2. Mechanical equipment.
   3. Electrical conduit, wiring and panels.
   4. Plumbing fixtures and fittings.
   5. Concrete walkways, ramps, and floor slabs.
   6. Floor finishes and wall coverings.
   7. Ceiling tiles and metal ceiling grid systems.
   8. Cabinetwork and other mounted furnishings as required to accommodate new
      construction.
   9. Coordinate removal from Project Site of debris removed by other trades.
   10. Refer to Plumbing, Mechanical, and Electrical Specifications and Demolition
       Drawings.

1.02 REFERENCES

A. California Code of Regulations (CCR), Title 24, 2013 edition:
   1. Part 2, California Building Code (CBC), Volumes 1 and 2.
   2. Part 9, California Fire Code (CFC).
1.03 QUALITY ASSURANCE

A. Demolition Firm Qualifications: Engage experienced firm that has successfully completed selective demolition work similar to that indicated for this Project.

B. Pre-Demolition Conference: Conduct conference at Project Site to comply with Pre-Installation Conference requirements of Section 01 3119.
   1. Conduct walkthrough with Owner’s Project Representative to confirm Owner property items have been removed from scheduled Work areas.
   2. Identify and mark remaining property items and schedule their removal and delivery to Owner.

C. Coordinate demolition for correct limits and methods.
   1. Schedule demolition work to minimize inconvenience to public, and Owner’s facility operations.

1.04 SUBMITTALS

A. Comply with pertinent portions of Section 01 3300.

B. Prior to cutting which affects structural safety, submit written request to Architect for permission to proceed with cutting.

C. Shop Drawings: Indicating extent of items and systems to be removed.
   1. Indicate items to be salvaged or items to be protected during demolition.
   2. Indicate locations of utility terminations and extent of abandoned lines to be removed.
      a. Include details indicating methods and location of utility terminations.

D. Schedule of Removal: Indicate elements to be demolished and removed and proposed timing for Work.
   1. Coordinate with Work of other trades.

E. Record Drawings: At project closeout according to Section 01 7839.
   1. Identify and accurately locate capped utilities and other subsurface structural, plumbing, mechanical, or electrical conditions.

1.05 DEFINITIONS

A. Remove: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain Owner's property.

B. Remove and Salvage: Items indicated to be removed and salvaged remain Owner's property.
   1. Remove, clean, and pack or crate items to protect against damage.
   2. Identify contents of containers and deliver to Owner’s designated storage area.

C. Remove and Reinstall: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage.
   1. Reinstall items in same locations or in locations indicated.

D. Existing to Remain: Protect construction indicated to remain against damage and soiling during selective demolition.
1. When permitted by Architect, items may be removed to suitable, protected storage location during selective demolition and then cleaned and reinstalled in their original locations.

1.06 PROJECT CONDITIONS

A. Occupancy: Owner will occupy portions of campus immediately adjacent to areas of selective demolition.
   1. Conduct selective demolition work in manner that will minimize need for disruption of Owner’s normal operations.
   2. Provide minimum of 48 hour advance notice to Owner of demolition activities that will affect Owner’s normal operation.

B. Protections: Ensure safety of Contractor, Owner personnel, and general public.
   1. Institute measures designed to avoid physical harm to public or property damage to facilities from inadequate or improper means and methods; improper shoring, bracing and structural support; or poorly fenced off areas.

C. Traffic: Conduct demolition operations and debris removal in manner to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.
   1. Do not close, block or otherwise obstruct streets, walks or other occupied or used facilities without written permission from authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways where required by governing regulations.
   3. Refer to Section 01 5000 for additional requirements.

D. Drawings may not indicate in detail Demolition Work to be performed.
   1. Examine existing conditions to determine full extent of required demolition.
   2. When conditions are encountered that vary from those indicated, promptly Notify Architect for direction or clarification before proceeding.

E. Condition of Structures: Owner assumes no responsibility for actual condition of items or structures to be demolished.
   1. Conditions existing at time of contractor inspection for bidding purposes will be maintained by Owner insofar as practicable.
   2. Minor variations within structure may occur by Owner’s removal and salvage operations prior to start of selective demolition work.

F. Asbestos or Hazardous Waste: It is understood and agreed that this contract does not contemplate handling of asbestos or hazardous waste material.
   1. Should asbestos or other hazardous waste material be encountered, notify Owner immediately.
   2. Do not disturb, handle or attempt to remove.

G. Damages: Promptly repair damages caused to adjacent facilities by demolition Work.
   1. Repair damage to existing improvements or damage due to excessive demolition.
1.07 REGULATORY REQUIREMENTS

A. Intent of Drawings and Specifications is that Work of selective demolition is to be in accordance with CCR, Title 24.
   1. Should existing conditions such as deterioration or noncomplying construction be discovered which is not covered by Contract Documents, and finished Work will not comply with CCR, Title 24:
      a. Architect will submit Construction Change Document (CCD) - DSA Form 140, or separate set of plans and specifications, detailing and specifying required Work to, and approved by Division of the State Architect before proceeding with Work.
   2. Comply with CCR Title 24, Part 2 - CBC, and Part 9 - CFC, Article 87 – “Fire Safety During Construction, Alteration or Demolition of a Building.”
   3. Comply with governing EPA notification regulations before starting selective demolition Work.
   4. Comply with requirements of Section 01 500 and hauling and disposal regulations of authorities having jurisdiction.

1.08 MATERIALS OWNERSHIP

A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials become Contractor's property and shall be removed from Project Site in accordance with requirements of Section 01 7419.

PART 2 – PRODUCTS

2.01 HANDLING OF MATERIALS

A. Items scheduled for salvage by Owner shall be delivered to location designated by Owner.
   1. Items shall be cleaned, packaged and labeled for storage.

B. Items scheduled for reuse shall be stored on Project Site, secured from theft, and protected from damage, and other deleterious conditions.

C. District is responsible for removal and testing of materials suspected of asbestos or lead contamination.
   1. Asbestos abatement reports are available from District.
   2. Cease material removal and alert District immediately if suspect materials are discovered.

2.02 PRODUCTS FOR PATCHING, EXTENDING AND MATCHING

A. Provide same products or types of construction as that in existing structure, as needed to patch, extend or match existing Work.
   1. Where identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to fullest extent possible.
   2. Use materials whose installed performance equals or surpasses that of existing materials.
3. Generally Contract Documents will not define products or standards of workmanship present in existing construction.

4. Determine products by inspection and necessary testing, and workmanship by use of existing as sample of comparison.

B. Presence of product, finish, or type of construction, requires that patching, extending, or matching, be performed as necessary to make Work complete and consistent to identical standards of quality.

PART 3 – EXECUTION

3.01 GENERAL

A. Preparation:

1. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain.

2. Provide safeguards, including warning signs, lights and barricades, for Owner and protection of workers, occupants, and public and to ensure safe passage of people around selective demolition area.

3. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, complying with requirements of Section 01 5000, and where required by authorities having jurisdiction.

4. Protect existing site improvements, appurtenances, and landscaping to remain.

   a. Erect plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.

5. Provide temporary weather protection, during interval between demolition and removal of existing construction, on exterior surfaces and new construction, to ensure that no water leakage or damage occurs to structure or interior areas.

   a. Protect walls, ceilings, floors, and other existing finish work that are to remain and are exposed during selective demolition operations.

B. Protection:

1. Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement or collapse of structures to be selectively demolished and to protect adjacent facilities to remain.

2. Should human safety appear to be threatened by conditions of existing construction or that existing construction appears to be endangered take immediate measures to ensure human safety.

   a. Cease operations in threatened area and immediately notify Project Inspector.

   b. Take precautions to support structure until determination is made for continuing operations.

   c. Strengthen or add new supports when required during progress of selective demolition.

3. Always have fully charged, portable fire extinguisher with each demolition crew on-site.

3.02 EXAMINATION

A. Examine existing conditions, including elements subject to movement or damage during remodeling work.
B. After uncovering Work, examine conditions affecting installation of new work.

C. Discrepancies:
   1. Where uncovered conditions are not as anticipated, immediately notify Architect and secure needed directions.
   2. Do not proceed in areas of discrepancy until such discrepancies have been fully resolved.

D. Time extensions or increase or decrease of costs resulting from such changes will be adjusted in manner provided in General Conditions.

3.03 UTILITY SERVICES

A. Maintain existing utilities indicated to remain, keep in service, and protect against damage during demolition operations.
   1. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction.
   2. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.
   3. Provide not less than 72 hours notice to Owner if shutdown of service is required during changeover.

B. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services serving building to be selectively demolished.
   1. Owner will arrange to shut off indicated utilities when requested by Contractor.
   2. Arrange to shut off indicated utilities with utility companies.
   3. Where utility services are required to be removed, relocated, or abandoned, provide bypass connections to maintain continuity of service to other parts of building before proceeding with selective demolition.
   4. Cut off pipe or conduit in walls or partitions to be removed.
   5. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

C. Utility Requirements: Refer to Division 21 through 23, 26 through 28, 31, and 33 Sections for shutting off, disconnecting, removing, and sealing or capping utility services.
   1. Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.04 POLLUTION CONTROLS

A. Use water mist, temporary enclosures, and other suitable methods to limit spread of dust and dirt.
   1. Comply with governing environmental protection regulations.
   2. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as flooding and pollution.

B. Remove and transport debris in manner that will prevent spillage on adjacent surfaces and areas.

C. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations.
   1. Return adjacent areas to condition existing before start of selective demolition.
3.05 SELECTIVE DEMOLITION

A. Adhere to Project Schedule and notify Owner of changes to Schedule imposed by unforeseen site conditions or Owner operational activities.

B. Perform selective demolition in systematic manner.
   1. Use such methods as required to complete Work indicated in accordance with Project Schedule and governing regulations.

C. Remove existing construction only to extent necessary for proper installation of new work and interfacing with existing construction.
   1. Cut back finished surfaces to straight, plumb or level lines as required for smooth transition.
   2. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level.
      a. Do not throw or drop materials.

3.06 CUTTING EXISTING CONCRETE

A. Cutting of existing concrete shall be performed by skilled workers familiar with requirements and space necessary for placing concrete.
   1. Perform concrete cutting with concrete cutting wheels and hand chisels.
   2. Do not damage concrete intended to remain.

B. Extent of cutting of concrete shall be as indicated or as required by existing field conditions.
   1. Replace concrete demolished in excess of amounts indicated.

C. Prior to cutting or coring concrete, determine locations of hidden utilities or other existing improvements and provide necessary measures to protect them from damage.

3.07 REMOVAL OF EXISTING PLUMBING AND ELECTRICAL EQUIPMENT AND SERVICES

A. Remove existing plumbing and electrical equipment, fixtures, and services not indicated for reuse or necessary for completion of Work.
   1. Remove abandoned lines and cap unused portions of active lines.
   2. Comply with additional requirements specified in Divisions 21 through 28 Sections.

3.08 REMOVAL OF OTHER MATERIALS

A. Woodwork: Cut or remove to joint or panel line.

B. Roofing: Remove as required, including accessory components such as insulation and flashings.
   1. At penetrations through existing roofing, trim cut edges back to sound roofing with openings restricted to minimum size necessary to receive Work.

C. Sheet Metal: Remove back to joint, lap, or connection.
   1. Secure loose and unfastened ends or edges and provide watertight condition and reseal as required.
D. Glass: Remove broken or damaged glass and clean rebates and stops of glazing channels.

E. Modular Materials: Acoustical ceiling panels, resilient tile, and ceramic tile.
1. Remove to natural joint without leaving damaged or defective Work where joining new construction.
2. After flooring removal, clean substrates to remove setting materials and adhesives.

F. Gypsum Board: Remove to panel joint line on stud or support line.

G. Plaster: Saw cut plaster on straight lines, leaving minimum 2 inch width of firmly attached metal lath for installing new lath and plaster.

H. Carpet: Remove and recycle damaged and worn material.

I. Vinyl Tile: Prior to removal, confirm with District that tile and mastic contain no asbestos or other hazardous material.

J. Remove existing improvements not specifically indicated or required but necessary to perform new Work.
1. Cut to clean lines, allowing for installation of new Work.

3.09 PATCHING

A. Review Section 01 7329 for additional requirements.
1. Patch or repair materials to remain when damaged by performance of Work.
2. Finish material and appearance of patch or repair Work shall match existing.

3.10 CLEANING

A. Clean existing materials to remain with appropriate tools and equipment.

B. Protect existing improvements during cleaning operations.

C. Debris shall be dampened by fog water spray prior to transporting by truck.

D. Debris pick-up area shall be kept broom clean and shall be washed daily with clean water.

E. Remove waste and debris, other than items to be salvaged.
1. Turn over salvaged items to Owner, or store and protect for reuse where required.
2. Comply with additional requirements in Section 01 7419.

F. Continuously clean up and remove items as Work progresses and legally dispose of off Project Site.
1. Comply with requirements of Section 01 7423.

END OF SECTION 02 4119
SECTION 03 3000

CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Formwork for cast-in-place concrete and installation of embedded items.
   2. Reinforcing steel for concrete unless specifically noted otherwise.
   3. Reinforced concrete with compressive strength as shown.
   5. Concrete floor sealer
   6. Concrete finishing
   7. Stair fill for metal pan stairs.

B. Related Sections:
   1. Section 05 5000: Metal Fabrications; concrete filled metal pan stairs.
   2. Section 07 9200: Joint Sealants

1.02 REFERENCES


B. ASTM International (ASTM):
   1. ASTM C-94 – Standard Specification for Ready-Mixed Concrete
   4. ASTM C685 – Standard Specification for Concrete Made By Volumetric Batching and Continuous Mixing
   5. ASTM A 1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
   6. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
   7. ASTM D1752 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

C. American Concrete Institute (ACI):
   1. ACI 301 – Specification for Structural Concrete for Buildings.
   2. ACI 304 – Recommended Practice for Measuring, Mixing and Placing Concrete.
   3. ACI 305 – Recommended Practice for Hot Weather Concreting.
   5. ACI 318 – Building Code Requirements for Reinforced Concrete.
   6. ACI 347 – Recommended Practice for Concrete Formwork

E. The Engineered Wood Association (APA):
   1. Voluntary Product Standard Structural Plywood (PS 1-09)
   2. Guide to Plywood Grades

F. West Coast Lumber Inspection Bureau (WCLIB):

1.03 QUALITY ASSURANCE

A. Formwork and Accessories:
   1. Design Criteria: Formwork shall conform to ACI 347.
      a. Formwork:
         1) Shall prevent leakage or washing out of cement mortar.
         2) Shall resist spread, shifting, and settling.
         3) Shall reproduce accurately required lines, grades, and surfaces within tolerances specified.
      b. Safety: Contractor shall be responsible for adequate strength and safety of formwork including falsework and shoring.
   2. Allowable Tolerances: Formwork shall produce concrete within tolerance limits recommended in ACI 347, unless otherwise noted.

B. Reinforcing:
   1. Welders' Qualifications: Welders shall be qualified in accordance with AWS D1.4 and AWS D1.
   2. Reinforcing steel shall not be permitted to rust where there is danger of staining exposed surfaces of adjacent concrete.
      a. Contractor shall replace rust-stained concrete at his expense.
   3. Allowable Tolerances: Reinforcing steel shall be placed within tolerances permitted by ACI 318, Section 7.5 unless otherwise approved by Architect.
   4. Owner's Testing Agency will provide tests in accordance with CBC Chapter 17A.
      a. Collect mill test reports for reinforcement.
      b. Take samples from bundles at fabricators.
         1) When bundles are identified by heat number and accompanied by mill analysis, two specimens shall be taken from each ten tons, or fraction thereof, of each size and grade.
         2) When reinforcement is not positively identified by heat numbers or when random sampling is intended, two specimens shall be taken from each 2 tons, or fraction thereof, of each size and grade.
   3. Test for tensile and bending strengths.
      a. Provide inspection of welding, including prior fit-up, welding equipment, weld quality and welder certification in accordance with AWS D1.4 and AWS D1.8
      b. Chemical analysis sufficient to determine carbon equivalent and minimum preheat temperature shall be performed when reinforcement does not conform to low-alloy steel requirements of CBC Section 1903A.8.

C. Concrete:
   1. Testing Laboratory Qualifications: Testing Laboratory shall be under direction of registered Civil Engineer licensed in State of California and shall have operated successfully for four years prior to this Work, and shall conform to requirements of ASTM E329.
   2. Requirements of ACI 301 shall govern work, materials and equipment related to this Section.
a. Specifications set minimum results required, and references to procedures are intended to establish minimal guides.

3. Contractor shall be responsible for quality of concrete in place and shall bear burden of proof that concrete meets minimum requirements.

4. Placing of concrete by means of pumping will be acceptable method of placement providing that Contractor can demonstrate that:
   a. Specified concrete strengths will be met.
   b. Equipment has record of satisfactory performance under similar conditions and using similar mix.
   c. Trial batches have been made.

1.04 SUBMITTALS

A. Contractor's Testing Laboratory's certificate of compliance.

B. Contractor shall submit:
   1. Certified copies of mix designs for each concrete class specified including compressive strength test reports.
   2. Certification that materials meet requirements specified.
   3. Samples as requested by Architect.
   4. Certification from vendor that samples originate from and are representative of each lot proposed for use.

C. Owner's Testing Agency will submit reports on tests and inspections performed to Owner, Architect, Contractor, and Division of the State Architect.

D. Reinforcing Steel Reports: Certified mill test reports (tensile and bending) for each heat or melt of steel prior to delivery of material to Project Site.
   1. Where reinforcing is to be welded, mill test reports shall verify weldability of steel.

E. Shop Drawings:
   1. Reinforcing Steel:
      a. Show bending and placing details, size and location of reinforcing steel.
      b. Include diagrammatic wall elevations at 1/4-inch equals one foot scale to clearly show position and erection marks of bars including marginal bars around openings with dowels, splices, and similar items
   2. Cast-in-place Concrete:
      a. Show construction joint locations and details.

F. Mix Designs: Prepare mix designs for Architect's review and include following information in mix design data:
   1. Design:
      a. Project name, address, Site location, and location of design usage.
      b. Contractor, Sub-Contractor, Supplier and Plant Location.
      c. Mix Number.
      d. Specified compressive strength, maximum aggregate size, slump, and placement method.
      e. Application and location in structure.
      f. Signature and stamp of licensed civil engineer responsible for mix design.
   2. Materials:
      a. Design Method.
      b. Water-Cement Ratio.
      c. Cement: Type, amount, and compliance with specified criteria statement.
d. Aggregates: Source(s), gradations (Individual and combined).
e. Admixtures: Brand, classification, dosage, addition method.
f. Water source.
g. Test Results, Batch Quantities, Yield (calculations).

3. Special Considerations:
   a. Unit Weight.
   b. Other considerations relative to placement, curing, finish, and testing.

G. Schedule of placing for Architect's review before starting Work.

H. Samples: Formwork and accessories, upon request of Architect.

1.05 PROJECT CONDITIONS

A. Sequencing Schedule for Formwork:
   1. Ensure timely delivery of embedded items.
   2. Be responsible for cutting and patching necessitated by failure to place embedded
      items.
   3. Plan erection and removal to permit proper sequence of concrete placing without
      damage to concrete.

1.06 DELIVERY, STORAGE, AND HANDLING

A. General:
   1. Ensure storage facilities are weather tight and dry.
   2. Deliver and store packaged materials in original containers with seals unbroken
      and labels intact until time of use.

B. Reinforcing:
   1. Deliver reinforcement and accessories to Project Site not more than 48-hours
      before placement.
   2. Store in manner to prevent excessive rusting and fouling with grease, dirt, or other
      bond-weakening coatings.
   3. Take precautions to maintain identification after bundles are broken.

C. Cast-in-Place Concrete:
   1. Store bulk cement in bins capable of preventing exposure to moisture.
   2. Use sacked cement in chronological order of delivery.
      a. Store each shipment so that it may be readily distinguishable from other
         shipments.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Formwork and Accessories:
   1. Forming Materials:
      a. Panel or board forms at Contractor's option.
      1) Panel Forms: Minimum 5/8 inch thick exterior grade plywood with sealed
         edges, PS 1 grade Plyform Class I and II B-B Exterior or HDO Exterior.
      2. Wood Framing: WCLIB standard grade or better Douglas Fir.
3. Form Ties and Spreaders: Metal type acting as spreaders, leaving no metal within one inch of concrete face and no fractures, spalls, depressions or other surface disfigurations greater than 3/4 inch in diameter.

4. Expansion Joint Filler:
   a. Fiber Type: Premolded asphalt-impregnated fiber, ASTM D1751, 1/4 inch thick unless otherwise noted.
   b. Provide one of following, or approved equal:
      1) W. R. Meadows, Inc. - Sealtight Fibre Expansion Joint (Basis-of-Design)
      2) J.D. Russell Company – Fiberflex Fiber Expansion Joint
      3) Right / Pointe Company – Fibre Expansion Joint
      4) SpecChem Fiber Expansion Joint
   c. Cork Type: Preformed cork, ASTM D1752, Type II, 1/2-inch size unless otherwise noted.
      1) Right / Pointe Company – Cork-Standard Expansion Joint, or approved equal.

4. Form Sealer: Grace Construction Products – Formfilm, or approved equal.

5. Release Agent:
   a. Must not stain or otherwise adversely affect architectural concrete surfaces.
   b. Provide one of following, or approved equal:
      1) Nox-Crete Co. – Nox-Crete Form Coating
      2) Industrial Synthetics Corp. – Synthex

B. Reinforcing:
1. Bars: New billet steel, ASTM A615 Grade 60, and ASTM A706, Grade 60, where welded.
   a. Refer to Structural Drawings for use of Grade 40 bars.
2. Tie Wires and Spirals: ASTM A82.
3. Bar Supports: As required for assembling and supporting reinforcement in place.
   a. Typical: CRSI Class B pregalvanized.
   b. Concrete adobes for foundations and slabs on grade.
4. Threaded coupler: Lenton Standard coupler by ERICO or approved equal.
   a. Coupler shall develop 125-percent of specified yield strength reinforcement.

C. Concrete:
1. General Requirements:
   a. Cement and aggregates shall have proven history of successful use with one another.
      1) Sources of cement and aggregate shall remain unchanged throughout work unless Architect approves request for change made at least 10 days prior to anticipated date of casting.
   b. Ready-mixed concrete shall meet requirements of ASTM C94.
   c. Deviations in properties of materials tested by Owner's Testing Agency shall be cause for their rejection pending additional test results and redesign of mix by Contractor's Testing Laboratory.
   d. No frozen aggregates will be permitted.
2. Cement:
   a. Conforming to ASTM C150, Type II / V, low alkali.
   b. Use one brand of cement throughout Project, unless otherwise acceptable to Architect.
3. Aggregates:
   a. Conform to Section 1903A.1, Chapter 19A, Concrete, CCR, Title 24, Part 2 CBC, and following:
      b. Coarse Aggregate: Conforming to ASTM C 33.
         1) Consisting of clean, hard, fine grained, sound crushed rock, or washed gravel, or combination of both.
         2) Free from oil, organic matter or other deleterious substances and shall not contain more than two percent by weight of shale or cherty material.
   c. Fines: ASTM C33. Sand equivalent shall be not less than 75 when tested as per ASTM D2419.
   d. Provide aggregates from single source for exposed concrete.

D. Under Slab Moisture Barrier:
   1. Vapor Retarder: Minimum 15 mil thick, complying with ASTM E 1745, Class A and following:
      a. Water Vapor Permeance (ASTM E 96, Method A, or ASTM F 1249): Maximum 0.02 perms.
   2. Product and Manufacturer:
      a. Griffolyn 15 Mil Green by Reef Industries, Inc.
      c. Perminator 15 mil by W.R. Meadows, Inc.
      d. Stego Wrap Vapor Barrier 15 mil by Stego Industries, LLC
      e. Vaporblock VB15 by Raven Industries.
   3. Installation shall be in accordance with manufacturer’s instructions and ASTM E 1643 and following:
      a. Provide vapor retarder sheet over prepared base material where shown.
         1) Use only materials resistant to decay when tested in accordance with ASTM E 154.
         2) Do not use polyethylene sheet.

E. Water: Clean and potable, free from impurities detrimental to concrete.

F. Concrete Admixtures:
   1. Use of concrete admixtures is subject to approval of Structural Engineer.
   2. Use of calcium chloride or admixtures containing calcium chloride is prohibited.
   3. If approved, provide admixtures produced by establish reputable manufacturers.
      a. Use in compliance with manufacturer’s printed directions.
      b. Do not use admixtures which have not been incorporated and tested in accepted mix designs.
   4. If approved, following types of admixtures may be used, conforming to manufacturer’s recommendations for use:
      a. Water Reducing: Conforming to ASTM C 494, Type A.
      b. Accelerating or Retarding: Conforming to ASTM C 494

G. Fly Ash:
   1. Fly ash conforming to ASTM C 618, Class N or F may be used at Contractor’s option.
      a. Use of Class C is not permitted.
3. Do not substitute more than 15 percent by weight of fly ash or other pozzolan, for ASTM C 150, Portland Cement.

H. Non-Shrink, Non-Metallic Grout: Premixed high strength grout requiring only addition of water at Project Site.
   1. Five Star Grout by Five Star Products, Inc.
   2. MasterFlow 928 by BASF Corporation, Construction Chemicals
   3. SikaGrout 428 FS by Sika Corporation

I. Curing Materials:
   1. Concrete Curing Paper: Conforming to ASTM C 171, non-staining, reinforced type.
      b. Approved equal.
   2. Liquid Curing Compound: Conforming to ASTM C 309, Type 1, Class B, approved standard product resin type.
      a. Deliver in unopened labeled containers.
      b. Water based acrylic polymer blend, free of wax or oil, compatible with subsequent applied finishes or floor coverings.
      c. Do not apply curing compounds in areas designated to receive floor coverings.

J. Concrete Floor Sealer: Lithium-Silicate sealer, hardener, and densifier for concrete.
   1. Lithium-Silicate sealer, hardener, and densifier for concrete.
      a. Conslideck LS by Prosoco, Inc.
      b. LiON Hard by L&M Construction Chemicals.
      c. Ultrasil Li+ by Euclid Chemical Company.

2.02 SOURCE QUALITY CONTROL

A. Plywood shall bear APA grade-trademark.

B. Owner's Testing Agency will:
   1. Review mix designs, certificates of compliance, and samples of materials Contractor proposes to use.
   2. Test and inspect materials, as necessary, in accordance with ACI 318 and CBC Sections 1903A and 1905A for compliance with requirements.
   3. Take samples as required from Contractor's designated sources.
   4. Take one grab sample for each 100 tons of Portland cement except that, when used in bulk loading ready-mix plants where separate bins for pretested cement are not available, take grab samples for each shipment of cement placed in bin with not less than one sample being taken for each day's pour and subsequently test such samples if required by Architect who may be so advised by DSA.
   5. Test coarse, intermediate, and fine aggregate by use of solution of sodium or magnesium sulfate, or both whenever in judgment of Architect such tests are necessary to determine quality of material.
      a. Perform such tests in accordance with ASTM C88.
      b. Loss shall not exceed 6 percent of either fine intermediate or coarse aggregate.
      c. Aggregate failing to comply with this requirement may be used in Work provided it contains less than 2 percent of shale and other deleterious particles and shows loss in soundness test of not more than 10 percent when tested in sodium sulphate solution.
d. Test aggregates as required by CBC Section 1903A.6.
6. Test for sand equivalent of fine aggregate in accordance with California Test 217.
7. Test for cleanness value of coarse and intermediate aggregate in accordance with California Test 227.
8. Inspect plant prior to starting Work to verify following:
   a. Plant is equipped with approved metering devices for determining moisture content of fine aggregate.
   b. Other plant quality controls are adequate.
9. Continuously inspect quality and quantity of materials used in transit mixed concrete, in batched aggregates and ready-mixed concrete at mixing plant or other location per CBC Section 1905A.1 and ACI 318 Chapter 5, where other materials are measured.

C. Waiver of Batch Plant Inspection:
1. Continuous batch plant inspection may be waived in accordance with CBC Section 1705A.3.3
2. When batch plant inspection is waived, following requirements shall apply:
   a. Qualified technician of Testing Agency shall check first batch at start of day.
   b. Licensed weighmaster to positively identify materials as to quantity and certify to each load by batch ticket.
   c. Batch tickets, including material quantities and weights:
      1) Shall accompany load
      2) Shall be transmitted to inspector of record (Project Inspector) by truck driver with load identified thereon.
      3) Load shall not be placed without batch ticket identifying mix.
      4) Inspector will keep daily record of placements, identifying each truck, its load, time of receipt, and approximate location of deposit in structure, and will transmit copy of daily record to enforcement agency.

2.03 MIXES

A. General Requirements:
1. Contractor shall perform tests or assemble necessary data indicating conformance with Specifications.
2. For each mix submit data showing that proposed mix will attain required strength in accordance with requirements of CBC Section 1905A.1
3. Contractor shall instruct Laboratory to base mix design on use of materials tested and approved by Owner's Testing Agency.
4. Mix design shall include compression strength test reports per CBC Section 1904A and 1905A.1.
5. Mix shall be designed, tested, and adjusted if necessary in ample time before first concrete is scheduled to be placed. Laboratory data and strength test results for revised mix design shall be submitted to Architect prior to using in Project.
6. Insure mix designs will produce concrete to strengths specified and of uniform density without segregation.
7. If mix yield exceeds 1-cubic yard, modify mix design to no more than one cubic yard without changing cement content.
8. Contractor's mix designs shall be subject to review by Architect and Owner's Testing Agency.
9. Introduction of calcium chloride will not be permitted.
10. Admixtures will not be permitted unless DSA approves, Architect reviews, Contractor modifies mix designs as necessary, and modifications are accepted by Owner's Testing Agency.
   a. Refer to CBC 1905A, ACI 318 Sections 3.2 and 3.6

B. Patching Mortar: Mix in proportions by volume of one part cement to two parts fine sand.

C. Stair Fill Mix: For steel pan stair treads and landings.
   1. Portland cement, fine and coarse aggregate
   2. Minimum 2500 psi compressive strength at 28 days
   3. Coarse Aggregate: Maximum 3/8 inch, size No.8, conforming to ASTM C 33
   4. Water/Cement Ratio: 0.45 maximum.
   5. Laboratory mix not required

D. Non-Shrink, Non-Metallic Grout: Follow approved manufacturer's printed instructions and recommendations.

2.04 MIXING

A. Batching Plant Conditions:
   1. Ensure equipment and plant will afford accurate weighing, minimize segregation and will efficiently handle materials to satisfaction of Architect and Owner’s Testing Agency.
   2. Use approved moisture meter capable of determining moisture content of sand.

B. General Requirements:
   1. Thoroughly clean concrete equipment before use for architectural concrete mixes to avoid contamination.
   2. Mix cement, fine and coarse aggregates, admixtures and water to exact proportions of mix designs.
      a. Method of mixing shall comply with ACI 318 Section 5.8.
   3. Measure fine and coarse aggregates separately according to approved method which provides accurate control and easy checking.
   4. Adjust grading to improve workability; do not add water unless otherwise directed.
   5. Maintain proportions, values, or factors of approved mixes throughout Work.
   6. Mix concrete in transit mixers five minutes immediately prior to discharge in addition to mixing as called for by ACI 304 and ASTM C 94.

C. Admixtures: Use automatic metering dispenser to introduce admixture into mix.
   1. Dispenser shall be recommended and calibrated by admixture manufacturer.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine areas where formwork will be constructed and verify that:
   1. Excavations are sufficient to permit placement, inspection and removal of forms.
   2. Excavations for earth forms have been neatly and accurately cut.
   3. Conditions are otherwise proper for formwork construction.
   4. Do not start work until unsatisfactory conditions have been corrected.

B. Examine units of Work to be cast and verify that:
1. Construction of formwork is complete.
2. Required reinforcement, inserts, and embedded items are in place.
3. Form ties at construction joints are tight.
4. Concrete-receiving places are free of debris.
5. Depths of depressed slab conditions are correct for delayed finish noted and for its proper bonding to concrete.
6. Conveying equipment is clean and properly operating.
7. Architect has reviewed formwork and reinforcing steel and that preparations have been checked with Project Inspector.

C  Do not begin casting before unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Obtain necessary information for coordination of formwork with items to be embedded in concrete and other related work.

B. Ensure availability of sufficient labor, equipment and materials to place concrete correctly in accordance with scheduled casting.

C. Protect finished surfaces adjacent to concrete-receiving places.

D. Clean transportation and handling equipment at frequent intervals and flush thoroughly with water before each day's run.
   1. Do not discharge wash water into concrete form.

E. Construction Joints:
   1. Clean and roughen construction joint contact surfaces by removing surface laitance and exposing sound mortar.
   2. Sandblasting and bush-hammering are acceptable methods.

3.03 FORMWORK CONSTRUCTION

A. General:
   1. Design, erect, support, brace, and maintain formwork to support vertical and lateral, static, and dynamic loads that might be applied until concrete structure can support such loads.
      a. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position.
      b. Maintain formwork construction tolerances complying with ACI 347.
   2. Construct forms to sizes, shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb Work in finished structures.
      a. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in Work.
      b. Use selected materials to obtain required finishes.
      c. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.
   3. Frame openings where indicated on Architectural, Structural, Mechanical, Plumbing and Electrical Drawings.

B. Earth Forms:
   1. Construct wood edge strips at top sides of excavations.
2. Provide forms for footings wherever concrete cannot be placed against solid earth excavation.
3. Remove loose dirt and debris prior to concrete pours.
4. Foundation concrete may be placed directly into neat excavations provided foundation trench walls are stable as determined by Geotechnical Engineer, subject to approval of DSA.
   a. In such case, minimum formwork shown on Drawings is mandatory to insure clean excavations immediately prior to and during placing of concrete.
   b. Refer to Structural Drawings for footing requirements where footings are not formed.

C. Walls and Other Formed Elements:
1. Erect outside forms for exposed exterior walls first and obtain Architect's approval before reinforcement is placed and of reinforcement before interior form is erected.
2. Carefully align inside and outside forms before tightening ties.
3. Plywood Forms: Insure vertical joints are plumb and horizontal joints are level; arrange joints and ties in geometrical pattern as approved by Architect.
4. Form inside corners at exposed conditions with mitered boards or plywood so that no concrete is placed against form ends.
5. After erection, seal cracks, holes, slits, gaps, and apertures in forms so that they will withstand the pressure and will remain completely watertight.
6. Provide means to seal bottom of forms at construction joints such as foam tape or other gasket devices.
7. Apply coating of release agent prior to erection of formwork following approved manufacturer's recommendations.

D. Slab Forms:
1. Establish levels and set screeds.
2. Depress slabs where required to receive special floor finishes.

E. Cleanouts and Openings: Provide on interior face of wall forms as required for effective removal of loose dirt, debris and waste material, for inspection of reinforcing and for introduction of vibrators where Architect deems necessary.

F. Expansion Joints:
1. Provide in exterior concrete paving on grade at maximum 24 feet on center or as noted and at intersections with vertical surfaces, curbs, manholes or other penetrations through paving.
2. Use fiber type expansion joint fillers typically and depress 1/4 inch unless otherwise noted.
3. Use cork type expansion joint fillers at conditions with non-bituminous waterproofing, liquid waterproofing, or sealant systems.

G. Construction Joints:
1. Provide where shown on Drawings as directed by Architect and per ACI 318, Section 6.4.
2. Provide key indentations at joints.
3. Provide pour strips on inside face of forms at horizontal joints, but remove strips and thoroughly clean out reglets before placing subsequent portions of wall.
4. Prevent formations of shoulders and ledges.
5. Provide means for drawing forms into firm contact with concrete before placing additional concrete over previous pours where shrinking and warping has separated concrete from forms.

H. Embedded Items:
1. Properly locate, unless locating is specified elsewhere, and place inserts and embedded items required by other trades prior to casting concrete.

3.04 REINFORCING PLACEMENT

A. General:
1. Place bars as noted.
2. Reinforcement shall be continuous.
   a. Refer to Structural Drawings for lap splice schedule.
   b. Stagger splices where possible.
   c. Contact lap splices shall be securely wired together to maintain alignment.
3. Ensure placement will permit concrete protection in conformance with CRSI or to extent shown.
4. Support and fasten bars securely with spacers, chairs or ties to permit their being walked upon without displacement or movement both before and during placement of concrete.
   a. Wire-tie bar intersections.
5. Do not bend bars around openings or sleeves.
   a. Wherever conduits, piping, inserts, or sleeves, and like items interfere with placing of reinforcement, obtain Architect's approval of placing before concreting.
6. Do not field bend bars unless expressly noted in the Contract Documents.

B. Prior to placing concrete, verify reinforcement has been bent, positioned, and secured in accordance with Drawings; ensure removal of oil, grease, dirt, or other bond-weakening coatings; replace severely rust-pitted reinforcing bars.

C. Quality Assurance:
1. Project Inspector will inspect placement of reinforcement and notify Structural Engineer of discrepancies in placement.
2. Owner's Testing Agency will inspect shop and field welding of reinforcing bars in accordance with CBC Section 1705A.2.2.1

3.05 CONCRETE PLACEMENT

A. Project Inspector, Architect, Structural Engineer, Testing Laboratory and DSA shall be notified at least 48 hours before placing concrete.

B. Place concrete in accordance with CBC Section 1905A and ACI 318, Chapter 5.
   1. Medium broom finish on exterior flatwork, unless otherwise indicated.
   2. Steel trowel for interior slabs, unless otherwise indicated.

C. Place concrete in cycles as continuous operation to permit proper and thorough integration and to complete scheduled placement.
   1. Do not place concrete where sun, wind, heat, or facilities prevent proper finishing and curing.
D. Convey concrete as rapidly and directly as practicable to preserve quality and to prevent separation from re-handling and flowing.
   1. Do not deposit concrete initially set.
   2. Cast concrete within ninety minutes after adding water unless otherwise noted.
   3. Re-tempering of concrete which has partially set will not be permitted.

E. Take precautions to avoid damage to under-slab moisture barrier and displacement of reinforcement and formwork.

F. Deposit concrete vertically in its final position.
   1. Avoid free falls in excess of six feet where reinforcement will cause segregation and in typical conditions unless Architect approves otherwise.

G. Keep forms and reinforcement clean above pour line by removing clinging concrete with wire brush before casting next lift. Also remove leakage through forms.

H. Interruption in casting longer than 60-minutes shall be cause for discontinuing casting for remainder of day.
   1. In this event, cut back concrete and provide construction joints as Architect directs
   2. Clean forms and reinforcement as necessary to receive concrete at later time.

I. Hot Weather Concreting: Conform to ACI 305 and following requirements when mean daily temperature rises above 75 degrees F.
   1. Upper temperature limit of concrete mixes shall be established by Contractor for each class of concrete.
      a. Concrete temperature during placing shall not be so high as to cause difficulty from loss of slump, flash set, or cold joints, and shall not exceed 90 degrees F.
      b. Other project climatic conditions detrimental to concrete quality such as relative humidity, wind velocity, and solar radiation shall also be considered.
   2. Trial batches of concrete for each mix design shall be made at limiting mix temperature selected.
      a. In lieu of trial batches, compression strength test reports (20 minimum) at limiting temperature for each proposed mix shall be submitted to Owners testing laboratory for review.
   3. Practices to maintain concrete below maximum limiting temperature shall be in accordance with ACI 305.
      a. Concrete ingredients may be cooled before mixing, or flake ice or well-crushed ice of size that will melt completely during mixing may be substituted for part of mixing water.
   4. Practices to avoid potential problems of hot weather concreting shall be employed by Contractor in accordance with ACI 305.
   5. When temperature of reinforcing steel or steel deck forms is greater than 120 degrees F, reinforcing and forms shall be sprayed with water just prior to placing concrete.

J. Cold Weather Concreting:
   1. No placement of concrete will be allowed at temperatures below 20 degrees Fahrenheit or if mean daily temperature for curing period is anticipated to be below 20 degrees Fahrenheit.
   2. No concrete placement will be allowed on frozen sub-grade.
   3. Conform to ACI 306 and following requirements when mean daily temperature falls below 40 degrees Fahrenheit.
a. Reinforcement, forms, or ground to receive concrete shall be completely free from frost.

b. Concrete at time of placement for footings shall have temperature no lower than 50 degrees Fahrenheit.
   1) For other concrete this minimum temperature at time of placement shall be 60 degrees Fahrenheit.
   2) Maximum temperature shall be 90 degrees Fahrenheit.

c. Concrete shall be maintained at temperature no lower than 50 degrees Fahrenheit for minimum 7-day period after placement by means of blanket insulation, heaters, or other methods as approved by Architect.

d. Contractor shall keep record of concrete surface temperature for first 7-days after each pour.
   1) Record shall be open to inspection by Architect.

K. Consolidating:
   1. Use vibrators for thorough consolidation of concrete.
   2. Provide vibrators for each location during simultaneous placing to ensure timely consolidation around reinforcement, embedded items and into corners of forms; ensure availability of spare vibrators in case of failures.
      a. Vibrate through full depth of freshly placed concrete.
   3. Do not place vibrators against reinforcement, attach to forms, or use to spread concrete.
   4. Exposed Concrete: Vibrate with rubber type heads and, in addition, spade along forms with flat strap or plate.

L. Construction Joints:
   1. Verify location and conformance with typical details
      a. Provide only where designated or approved by Architect.
      b. Comply with CBC Section 1906A.4.
   2. Horizontal and vertical construction joints to be thoroughly sandblasted to clean and roughen entire surface to minimum 1/4-inch relief exposing clean coarse aggregate solidly embedded in mortar matrix.
   3. Just prior to depositing concrete, surface of construction joint shall be thoroughly wetted.

M. Contraction (Control) Joints in Slabs-on-Grade:
   1. Construct contraction joints in slabs-on-ground to form panels of patterns indicated on Shop Drawings.
      a. Use saw cuts 1/8 inch x 1/4 slab depth, unless otherwise indicated.
   2. Time saw cutting to allow sufficient curing of concrete to prevent raveled or broken edges.
   3. Contraction joints in unexposed floor slabs may be formed by saw cuts as soon as possible after slab finishing as may be safely done without dislodging aggregate, maximum 24 hours after pouring.
   4. If joint pattern is not shown, provide joints not exceeding 15 feet in either direction and located to conform to bay spacing wherever possible; at column centerlines, half bays, third-bays

N. Walls and Other Formed Elements:
   1. Space points of deposit to eliminate need for lateral flow.
      a. Placing procedures of concrete in forms permitting escape of mortar, or flow of concrete itself, will not be permitted.
   2. Level top surface upon stopping work.
3. Take special care to fill each part of forms by depositing concrete directly as near final position as possible, and to force concrete under and around reinforcement, embedded items, without displacement.
4. After concrete has taken its initial set, care shall be exercised to avoid jarring forms or placing any strain on ends of projecting reinforcement.
5. Where backfill is placed against a wall, it shall be adequately shored until it has attained design strength.

3.06 CURING

A. General Requirements:
1. Deploy curing measures immediately after casting and for measures other than application of curing compound, extend for seven days.
   a. Architect may recommend longer periods based upon prevailing temperature, wind and relative humidity.
   b. Comply with ACI 313, Section 5.11.
2. Avoid alternate wetting and drying and fluctuations of concrete temperature.
3. Protect fresh concrete from direct rays of sun, rain, freezing, drying winds, soiling, and damage.
4. Do not permit curing method to affect adversely finishes or treatments applied to finish concrete.

B. Curing Method, Typical: Obtain Architect's approval of alternate measures.
1. Keep forms and concrete surfaces moist during period forms are required to remain in place.
2. Apply curing compound, only when approved by Architect, per manufacturers' recommendations.

3.07 FORM REMOVAL

A. Secure the Architect's approval for time and sequence of form removal.

B. Form Removal: Forms shall be removed without damage to concrete, and in no case shall they be removed prior to concrete member attaining specified strength:

<table>
<thead>
<tr>
<th>MEMBER</th>
<th>STRENGTH</th>
<th>MINIMUM TIME*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical surfaces</td>
<td>0.60 f'c</td>
<td>7 days</td>
</tr>
<tr>
<td>of walls</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. *Estimated curing time required to obtain desired strength.
   a. Results of 7-day test cylinder break shall be presented to Architect to demonstrate compliance with above specified strength requirements prior to form removal.
   b. Where 7-day test cylinder break demonstrates strength that is less than that specified, Contractor may elect to take additional cylinders at time of next pour to demonstrate strength requirements.
   c. Contractor shall bear cost of taking and testing additional samples.

C. Forms:
1. Remove forms carefully to avoid damaging corners and edges of exposed concrete.
2. Reuse:
a. Architect will approve reuse of forms provided they are straight, clean, free from nails, dirt, hardened concrete, or other injurious matter and edges and surfaces are in good condition.

b. Clean and repair damage caused by placing, removal, or storage.
   1) Reuse of formwork with repairs or patches which would result in adverse effects to architectural concrete finish will not be permitted.

c. Store formwork in manner to prevent damage or distortion.

d. Reseal as required to achieve concrete of specified quality.

### 3.08 MISCELLANEOUS CONCRETE ITEMS

A. Steel Pan Stairs: Provide wire fabric reinforced concrete fill for steel pan stair treads and landings and associated items.
   1. Cast-in safety inserts and accessories as shown.
   2. Screed, tamp, and finish concrete surfaces as scheduled.

### 3.09 CLEANING, PATCHING, AND DEFECTIVE WORK

A. Where concrete is under strength, out of line, level or plumb, or shows objectionable cracks, honeycombing, rock pockets, voids, spalling, exposed reinforcement, signs of freezing, or is otherwise defective, and, in Architect's judgment, these defects impair proper strength or appearance of Work, Architect will require its removal and replacement at Contractor's expense.

B. Immediately after stripping and before concrete is thoroughly dry, patch minor defects, form-tie holes, honeycombed areas, and similar areas, with patching mortar.
   1. Patch shall match finish of adjacent surface unless otherwise noted.
   2. Remove ledges and bulges.

C. Compact mortar into place and neatly file defective surfaces to produce level, true planes.
   1. After initial set, dress surfaces of patches mechanically or manually to obtain same texture as surrounding surfaces.

D. Rock Pockets:
   1. Cut out to full solid surface and form key.
   2. Thoroughly wet before casting mortar.
   3. Where Architect deems rock pocket too large for satisfactory mortar patching as described, cut out defective section to solid surface, key and pack solid with concrete to produce firm bond and match adjacent surface.

E. Cleaning
   1. Ensure removal of bituminous materials, form release agents, bond breakers, curing compounds if permitted, and other materials employed in concrete work which would otherwise prevent proper application of sealants, liquid waterproofing, and other delayed finishes and treatments.
   2. Where cleaning is required, take care not to damage surrounding surfaces or leave residue from cleaning agents.
3.10 CLEAN UP

A. Perform Work to keep affected portions of Project Site neat, clean, and orderly.
   1. Remove, immediately upon completion of Work, surplus materials, rubbish, and equipment associated with or used in performance.
   2. Be aware that failure to perform clean-up operations within 24 hours of notice by Architect will be considered adequate grounds for having work done by others at no added expense to Owner.

3.11 FIELD QUALITY CONTROL

A. Owner's Testing Agency will:
   1. Perform testing in accordance with ACI 318 and CBC Section 1903A and 1905A.
   2. Review concrete mix designs.
   3. Inspect concrete and grout placement continuously.
   4. Test concrete to control slumps according to ASTM C143.
   5. Continuously monitor concrete temperature as it arrives on Project Site.
   6. Test concrete for required compressive strength in accordance with CBC Section 1704A, 1704A.3, and 1903A:
      a. Make and cure three specimen cylinders according to ASTM C31 for each 50 cubic yards, or fraction thereof, of each class poured at Project Site each day.
      b. Retain one cylinder for 7-day test and two for 28-day test.
      c. Number each cylinder 1A, 1B, 1C, 2A, 2B, 2C, etc; date each set; and keep accurate record of pour each set represents.
      d. Transport specimen cylinders from Project to laboratory after cylinders have cured for 24-hours on Project Site.
      e. Cylinders shall be covered and kept at air temperatures between 60 and 80 degrees Fahrenheit.
      f. Test specimen cylinders at age 7-days and age 28-days for specified strength according to ASTM C39.
      g. Base strength value on average of two cylinders taken for 28-day test.
   7. Test and inspect materials, as necessary, in accordance with ACI 318, MM Test Method 227 (Coarse and Intermediate Aggregates) and MM Test Method 217 (Fine Aggregates), for compliance with requirements specified in this section.

B. Submit ticket for each batch of concrete delivered to Project Site.
   1. Ticket shall bear following information:
      a. Design mix number.
      b. Signature or initials of ready mix representative.
      c. Time of batching.
      d. Weight of cement, aggregates, water and admixtures in each batch with maximum aggregate size.
      e. Total volume of concrete in each batch.
      f. Notation to indicate equipment was checked for contaminants prior to batching.
   2. Pay Owner's Testing Agency for taking core specimens of hardened structure and testing specimen according to ASTM C88 and C42 when laboratory tests of specimen cylinders show compressive strengths below specified minimum.

3.12 PROTECTION

A. Protect concrete from injurious action of elements and defacement during construction operations.
B. Protect exposed corners of concrete from traffic or use which will damage them.

C. Make provisions to keep exposed concrete free from laitance caused by spillage or leaking forms or other contaminants.
   1. Do not allow laitance to penetrate, stain, or harden on surfaces which have been textured.

END OF SECTION 03 3000
SECTION 03 3930
EPOXY-INJECTED CRACK REPAIR

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Pressure injection of cracks in concrete walls, columns and other structural members using epoxy resin adhesive.
   2. Use of method as directed by Structural Engineer.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. ASTM C 882 – Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear
   5. ASTM D 732 – Standard Test Method for Shear Strength of Plastics by Punch Tool

B. American Association of State Highway and Transportation Officials (AASHTO):
   1. AASHTO M-235 – Standard Specification for Epoxy Resin Adhesives

1.03 QUALITY ASSURANCE

A. Manufacturing Qualifications: Manufacturer of specified product shall be ISO 9001/9002 certified and have in existence recognized ongoing quality assurance program independently audited on regular basis.

B. Contractor Qualifications: Contractor shall be qualified in field of concrete repair and protection with successful track record of 5 years or more.
   1. Contractor shall maintain qualified personnel who have received product training by manufacturer's representative.

1.04 SUBMITTALS

A. Product Data: Minimum of three copies of manufacturer's literature, including material product data sheets.
   1. Provide appropriate Material Safety Data Sheets (MSDS) to Contractor only.

1.05 PROJECT CONDITIONS

A. Environmental Conditions: Do not apply material when it is raining or when such conditions appear to be imminent.
   1. Minimum Application Temperature: 40 degrees F and rising.
B. Protection: Precautions should be taken to avoid damage to surfaces near work zone due to mixing and handling of specified product.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original, unopened containers with manufacturer’s name, labels, product identification, and batch numbers.
1. Remove damaged material from Project Site immediately.

B. Store materials off ground and protect from rain, or excessive heat until ready for use.

C. Condition specified product as recommended by manufacturer.

D. Refer to MSDS for complete handling recommendations.

1.07 WARRANTY

A. Manufacturer’s Warranty: Provide written warranty against defects of materials for period of one year, beginning with date of Substantial Completion of Project.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Epoxy Resin Adhesive for Pressure Injection of Cracks:
1. Two-component, 100 percent solids, moisture-tolerant, low-viscosity, high-strength, multipurpose, epoxy resin adhesive.
   a. Conforming to ASTM C 881, Types I, II, and IV, Grade-1, Class C (except for gel time) and AASHTO M-235 specification.
   b. Sikadur 35 Hi-Mod LV, as manufactured by Sika Corporation
   c. Alternate products and manufacturers may be acceptable upon demonstration by Contractor of equivalence in accordance with requirements of Section 01 1600.

2. Component “A” shall be modified epoxy resin of diglycidiether bisphenol A Type or containing suitable viscosity control agents.
   a. It shall not contain butyl glycidyl ether.

3. Component “B” shall be primarily reaction product of selected amine blend with epoxy resin of diglycidiether bisphenol A Type containing suitable viscosity control agents, pigments, and accelerators.

4. Ratio of Component A to Component B shall be 2:1 by volume.
   a. Material shall not contain asbestos.

B. Epoxy Resin Adhesive for Sealing of Cracks and Porting Devices:
1. Two-component, 100 percent solids, solvent-free, moisture-tolerant, high-modulus, high strength, structural epoxy paste adhesive.
   a. Conforming to ASTM C 881, Types I and IV, Grade 3, Class-B/C and AASHTO M-235 specification.
   b. Sikadur 31, Hi-Mod Gel as manufactured by Sika Corporation.
   c. Alternate products and manufacturers may be acceptable upon demonstration by Contractor of equivalence in accordance with requirements of Section 01 1600.
2. Component “A” shall be modified epoxy resin of diglycidiether bisphenol A Type or containing suitable viscosity control agents.
   a. It shall not contain butyl glycidyl ether.
3. Component “B” shall be primarily reaction product of selected amine blend with epoxy resin of diglycidiether bisphenol A type containing suitable viscosity control agents, pigments, and accelerators.
4. Ratio of Component A to Component B shall be 1:1 by volume
   a. Material shall not contain asbestos.

C. Porting Devices as Required for Either Manual or Automated Application:
   1. Porting devices for automated application shall be supplied from manufacturer of pressure injection equipment.

2.02 PERFORMANCE CRITERIA

A. Properties of the mixed epoxy resin adhesive used for pressure injection grouting:
   1. Pot Life: Minimum 25 minutes (60 gram mass) at 73 degrees F
   2. Tack-Free Time:
      - 75 degrees F – 3 to 3.5 hours
      - 40 degrees F – 14 to 6 hours
   4. Color: Clear, Amber

B. Properties of Cured Epoxy Resin Adhesive Used for Pressure Injection of Grout:
   1. Compressive Strength (ASTM D 695), minimum.
      a. 3 day: 10,000 psi
      b. 7 day: 11,000 psi
      c. 28 day: 13,000 psi
   2. Compressive Modulus, PSI: minimum.
      a. 7 day: 320,000 psi
   3. Shear Strength (ASTM D 732), minimum.
      a. 14 day: 5,100 psi
   4. Flexural Strength (ASTM D 790) minimum.
      a. 14 day: 14,000 psi
   5. Tangent Modulus of Elasticity in Bending, minimum.
      a. 14 day: 370,000 psi
   6. Bond Strength (ASTM C 882)
      a. 14 days (moist cure) minimum.
      b. Hardened Concrete to Hardened Concrete: 2,900 psi, minimum.
   7. Water Absorption (ASTM D 570) maximum.
      a. 24 hour: 0.90 percent
   8. Tensile properties (ASTM D 638) minimum.
      a. 7 day tensile Strength: 900 psi min.
      b. Elongation at Break: 5.4 percent

C. Properties of mixed epoxy resin adhesive used for sealing of cracks and porting devices:
   1. Pot Life: min. 60 minutes (500 gram mass) at 73 degrees F
   2. Tack-Free Time: at 73 degrees F 1.5 to 2.5 hours at 30 mils thick
   3. Consistency: Non-Sag paste
   4. Color: Concrete Gray
D. Properties of cured epoxy resin adhesive used for sealing of cracks & porting devices:
   1. Compressive Sgth (ASTM D 695), minimum at 73 degrees F.
      a. 1 day: 13,000 psi
      b. 3 day: 14,000 psi
      c. 28 day: 16,000 psi
   2. Compressive Modulus, psi, minimum.
      a. 7 day: 795,000 psi
   3. Shear Strength (ASTM D 732), minimum.
      a. 14 day: 4,600 psi
   4. Flexural Strength (ASTM D 790) minimum.
      a. 14 day: 6,100 psi
   5. Tangent Modulus of Elasticity in Bending, minimum.
      a. 14 day: $1.67 \times 10^6$ psi
   6. Bond Strength (ASTM C 882)
      a. 14 day (moist cure) minimum.
      b. Hardened Concrete to Hardened Concrete: 2,900 psi, minimum.
   7. Water Absorption (ASTM D 570) maximum.
      a. 24 hour: 0.79 percent
   8. Tensile properties (ASTM D 638), minimum.
      a. 7 day Tensile Strength: 3,300 psi
      b. Elongation at Break: 0.9 percent

PART 3 – EXECUTION

3.01 MIXING AND APPLICATION

A. Mixing Epoxy Resin Adhesive for Sealing Cracks and Porting Devices:
   1. Premix each component.
   2. Proportion equal parts by volume of Component “A” and Component “B” into clean, dry mixing pail.
   3. Mix thoroughly for 3 minutes with jiffy paddle on low-speed (400-600 rpm) drill.
   4. Mix only that quantity of material that can be used within its pot life (60 minutes at 73 degrees F).

B. Mixing Epoxy Resin Adhesive Used for Pressure Injection Grouting:
   1. Manual: Proportion two parts by volume of Component “A” to one part Component “B” into clean, dry mixing pail.
   2. Mix thoroughly for 3 minutes with jiffy paddle on low-speed (400-600 rpm) drill.
   3. Mix only that quantity of material that can be used within its pot life (20-30 minutes at 73 degrees F).

C. Placement Procedure:
   1. Epoxy resin adhesive for sealing cracks and porting device:
      a. Set porting devices as required by equipment manufacturer.
      b. Spacing of porting devices shall be accomplished as required to achieve travel of epoxy resin for pressure injection grouting between ports and fill cracks to maximum.
      c. On structures open on both sides, provide porting devices on opposite sides at staggered elevations.
      d. Apply mixed epoxy resin adhesive for sealing over cracks and around each porting device to provide adequate seal to prevent escape of epoxy resin adhesive for injection grouting.
e. Where required by Structural Engineer, apply epoxy resin adhesive for sealing in such manner that minimal defacing or discoloration of substrate shall result.

2. Epoxy resin adhesive for pressure injection grouting:
   a. Manual: Load mixed epoxy resin adhesive for grouting into disposable caulking cartridge or bulk-loading caulking gun.
      1) Inject prepared cracks with constant pressure in order to achieve maximum filling and penetration without inclusion of air pockets or voids in epoxy resin adhesive.
      2) Begin pressure injection at widest part of crack being injected and continue until there is appearance of epoxy resin adhesive at adjacent port, thus indicating travel.
      3) When travel is indicated, decision to discontinue or continue pressure injection from that port should be made by Contractor based on his experience, with approval of Structural Engineer.
      4) Continue procedure until pressure injectable cracks has been filled.
   b. Automated: Dispense epoxy resin adhesive for grouting under constant pressure in accordance with procedures recommended by equipment manufacturer as required to achieve maximum filling and penetration of prepared cracks without inclusion of air pockets or voids in epoxy resin adhesive.
      1) Pressure injection of single or multiple ports, by use of manifold system, is possible.
      2) Decision should be made by Contractor, with approval of Structural Engineer.
      3) Continue approved procedure until pressure injectable cracks have been filled.

D. When penetration of cracks is impossible, consult Structural Engineer before discontinuing injection procedure.
   1. Where modification of proposed procedure is required to fill cracks, submit modification in writing to Structural Engineer for acceptance prior to proceeding.

E. Adhere to limitations and cautions for epoxy resin adhesive in manufacturer’s current printed literature.

3.02 INSTALLATION

A. Install materials in accordance with safety and weather conditions required by manufacturer, or as modified by applicable rules and regulations of local, state and federal authorities having jurisdiction.

3.03 CLEANING

A. After epoxy resin adhesive for grouting has cured, epoxy resin adhesive for sealing cracks and porting devices shall be removed, as required by Structural Engineer.
   1. Clean substrate in manner to produce finish appearance acceptable to Architect.

B. Uncured epoxy resin adhesive can be cleaned from tools with approved solvent.
   1. Cured epoxy resin adhesive can only be removed mechanically.
C. Leave finished Work and work area in neat, clean condition without evidence of spillovers onto adjacent areas.

END OF SECTION 03 3930
SECTION 03 4913

GLASS FIBER REINFORCED CONCRETE PANELS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Glass-fiber reinforced concrete (GFRC) wall panels
      a. Other shapes shown on Drawings.
   2. Embedded hardware and loose connection hardware
   3. Integrated steel support framing.
   4. Miscellaneous supports, including but not limited to, hardware, anchors, fasteners, inserts, and bracing required to attach panels to structural frame.

B. Related Sections:
   1. Section 01 3300: Submittal Procedures; for deferred approval submittals.
   2. Section 03 3000: Cast-in-Place Concrete; for placing connection anchors in concrete.
   3. Section 05 1200: Structural Steel Framing; for connection attachment to structural steel framing.
   4. Section 05 5000: Metal Fabrications
   5. Section 07 1923: Siloxane Water Repellents
   6. Section 07 9200: Joint Sealants; for elastomeric joint sealants and backup.
   7. Section 08 5113: Aluminum Windows; for windows set into GFRC panels.
   8. Section 09 2216: Non-Structural Metal Framing

C. Work of Other Sections:
   1. Work furnished under this Section, but installed under other Sections:
      a. Embeds to be cast in cast-in-place concrete.
   2. Work installed under this Section, but furnished under other Sections:
      a. Items of other trades embedded in GFRC elements.

1.02 REFERENCES


B. Precast/Prestressed Concrete Institute (PCI):
   1. MNL 117 – Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products
   2. MNL 128 – Recommended Practice for Glass Fiber Reinforced Concrete Panels.
      a. Appendix A.
   3. MNL 130 – Manual for Quality Control for Plants and Production of Glass Fiber Reinforced Concrete Products.

C. ASTM International (ASTM):
   1. ASTM A 27 – Standard Specification for Steel Castings, Carbon, for General Application
5. ASTM A 108 – Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
7. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
10. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
11. ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
12. ASTM C 33 – Standard Specification for Concrete Aggregates
16. ASTM C 494 – Standard Specification for Chemical Admixtures for Concrete
17. ASTM C 618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
18. ASTM C 979 – Standard Specification for Pigments for Integrally Colored Concrete

D. American Welding Society (AWS):
   1. AWS D1.1 – Structural Welding Code – Steel
   2. AWS D1.3 – Structural Welding Code – Sheet Steel
   3. AWS D1.4 – Structural Welding Code – Reinforcing Steel

E. American Institute of Steel Construction (AISC):
      a. Chapter M. M2.7 – Dimensional Tolerances

F. American Iron and Steel Institute (AISI):
   1. North American Specification for the Design of Cold-Formed Steel Structural Members.

1.03 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Certified by Precast/Prestressed Concrete Institute (PCI) Plant Certification Program.
      a. Manufacturer shall be certified at time of bidding.
      b. Certification shall be in Group G.
2. When requested by Architect, submit following:
   a. Written evidence of having experienced personnel, physical facilities, and established quality control procedures.
   b. Evidence of compliance with PCI Plant Certification Program.
3. Erector qualifications: Regularly engaged for at least 5 years in erection of GFRC units similar to those required for Project, with present erection management capability sufficient to erect required units without causing delays.

B. Welders Qualification: In compliance with AWS D1.1 and AWS D1.4.

C. Engineering: Contractor shall be responsible for following:
   1. Engineering of units and their attachment to building structural frame
   2. Obtaining DSA approval of same.
   3. Paying costs and fees of obtaining approvals.
   4. Engineer units for following:
      a. To accommodate loads, including thermal, seismic, and building movements without permanent damage to precast units and supporting structure.
      b. To permit noiseless movement of precast units caused by temperature variations of 180 degrees F.

D. Fasteners and connections are shown schematically.
   a. Final types and sizes shall be determined by California-licensed professional engineer employed by Contractor.
   b. In no case shall fasteners or connections conflict with or require revision of finish profiles of precast units or supporting Work.
   c. Connections to structural frame shall not impose eccentric loading, or induce twisting or warping.
   d. Connections to structural frame shall be able to accommodate misalignment of steel structure within limits allowed by AISC tolerances.
   e. Maintain general design concept shown without increasing or decreasing sizes of members or altering profiles and alignment shown.
   f. Change or redesign of structural support system to accommodate precast concrete Work shall be at Contractor's cost and is responsibility of Contractor's engineer and are subject to DSA, Architect, and Project Structural Engineer approval.

D. Testing: In compliance with testing provisions of PCI MNL 128, Appendix A.

E. Testing Agency: Capable of performing tests as indicated in section 1.2, E of the above standard. and in compliance with applicable ASTM standards.

F. Sample Panel:
   1. After approval of preliminary samples specified, provide where directed, one full size sample section cast in actual mold showing pertinent features of precast elements with specified finish.
   2. Sample will be inspected at casting yard or Project Site by Architect
      a. After approval, sample panel shall become standard for color, texture and workmanship.
      b. Approved sample panel may be incorporated into Work when properly identified for future reference.

G. Mockups: Build mockups to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockup of typical wall area as shown on Drawings separately from building.
2. In addition to GFRC panels, mockups include aluminum windows, joint sealants, metal flashings, copings and related construction as directed by Architect.

H. Preinstallation Conference: Conduct conference at Project Site to comply with requirements of Section 01 3119.

1.04 SUBMITTALS

A. Product Data: Each type of product indicated.
   1. Include GFRC design mixes.

B. Shop Drawings: Show fabrication and installation details for GFRC panels.
   1. Include following.
      a. Erection drawings showing details of construction, reinforcement, anchorage, jointing and erection marks.
      b. Panel elevations, sections, and dimensions.
      c. Thickness of facing mix, GFRC backing, and bonding pads for typical panels.
      d. Finishes.
      e. Joint and connection details.
      f. Erection details.
      g. Panel frame details for typical panels, including sizes, spacings, thicknesses, and yield strengths of various members.
      h. Locations and details of connection hardware attached to structure.
      i. Size, location, and details of flex, gravity, and seismic anchors for typical panels.
      j. Other items sprayed into panels.
      k. Erection sequence for special conditions.
      l. Relationship to adjacent materials.
      m. Descriptions of loose, cast-in, and field hardware.
   2. Test reports for each test board sample.

C. Design Reference Samples: Before production of precast elements, including specified sample panel, submit for initial verification of design intent, four 12 by 12 inch of actual thickness, showing representative finishes, color, and textures of exposed surfaces.

D. Test and Inspection Reports:
   1. GFRC mix designs before commencement of production Work.
   2. GFRC production Work, and for structural welding, as Work progresses and at intervals determined before commencement of Work.
   3. Back-up test data on which GFRC design is based and data on GFRC insert and anchor tests.
   4. Source Quality Control Test Reports: For GFRC, inserts, and anchors.

E. Complete design calculations for precast units and their connections, including loads used in design, signed and sealed by California licensed civil or structural engineer.

F. Qualification Data:
   1. For GFRC manufacturer, including proof of current PCI Plant Certification.
G. Certificates of Compliance:
   1. Required for GFRC constituent materials and primary metal framing
      components to indicate compliance with specified and referenced
      requirements.
      a. Submit before such materials are used.
   2. Welding certificates
   3. Steel Sheet Certification. For steel sheet used in cold-formed steel panel
      framing.
   4. Mill Certificates: For structural-steel shapes and hollow structural sections used
      in panel framing.

H. Mix description: Detailed description of GFRC mix used for approved panels.

1.05 DEFINITIONS

A. Design Reference Sample: Sample of approved GFRC color, finish and texture,
   preapproved by Architect.

1.06 DEFERRED APPROVAL

A. Work of this Section is Deferred Approval item.
   1. Comply with Section 01 3300 for Deferred Approval submittal requirements.

B. Do not start fabrication and installation of Deferred Approval item until detailed
   drawings, specification and engineering calculations have been approved by
   Architect and Division of the State Architect.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Transport and handle GFRC units avoid damage by using equipment which will
   protect units from staining and damage during handling and transport.
   1. Support panels on nonstaining material during shipment.
   2. Place nonstaining resilient spacers between panels.
   3. Lift and support units at designated lift points only.

B. Store GFRC panels to protect from contact with soil, staining, and physical damage.
   1. Do not place precast units on ground.
   2. Store panels with nonstaining resilient supports in same positions as when
      transported.
   3. Store panels on firm, level, and smooth surfaces.
   4. Place stored panels so identification marks are clearly visible.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design: Design of glass fiber reinforced concrete (GFRC) panels is based
   on products as manufactured by Clark Pacific.

B. Subject to compliance with specified requirements, comparable products may be
   submitted by other alternate manufacturers in accordance with requirements for
   product substitutions specified in Section 01 6000 and following:
1. Submit items listed in Article 1.04 and as specified in Section 01 3300, for evaluation of proposed system.
2. Complete Project Shop Drawings for similar project may be submitted for evaluation purposes, however shop drawings engineered specifically for this Project will be required from successful bidder.
3. Tests shall have been made for identical systems within ranges of specified performance criteria.

2.02 MOLD MATERIALS

A. Molds: Rigid, dimensionally stable, nonabsorptive material, warp and buckle free, that will provide continuous GFRC surfaces within tolerances; nonreactive with GFRC and capable of producing required finish surfaces.
   1. Mold-Release Agent: Commercially produced liquid-release agent that will not bond with, stain, or adversely affect GFRC surfaces and will not impair subsequent surface or joint treatments of GFRC.

B. Form Liners: Units of face design, texture, arrangement, and configuration to match GFRC design reference sample.
   1. Provide solid backing and form supports to ensure that form liners remain in place during GFRC application.
   2. Use with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect GFRC surfaces and will not impair subsequent surface or joint treatments of GFRC.

C. Surface Retarder: Chemical liquid set retarder capable of temporarily delaying hardening of newly placed GFRC face mix to depth of reveal specified.

2.03 GFRC MATERIALS

A. Portland Cement: ASTM C 150, Type I, II or III, of color selected to match control sample on file in Project Inspector’s Field Office.
   1. For surfaces exposed to view in Work, use same brand, type, and source of supply throughout GFRC production.

B. Aggregates:
   1. Sand: Washed and dried silica sand or equal with history of successful use in GFRC.
      a. Sand shall pass through No. 20 sieve.
   2. Facing Aggregate: Natural sand or sand manufactured from coarse aggregate conforming to ASTM C 33, except for gradation with maximum of 5 percent passing No. 100 (0.15 mm) sieve and a maximum of 3 percent passing No. 200 (0.075 mm) sieve.
   3. Aggregates shall be clean, hard, strong, durable, inert, and free of staining or deleterious material.
      a. Match sample on file in Project Inspector’s Field Office.

C. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of GFRC and complying with chemical limits of PCI MNL 130.

D. Admixtures: Conforming to ASTM C 260, C 494 or C 618.
   1. Coloring Admixture: Harmless to concrete set, strength and durability, conforming to ASTM C 979
a. Synthetic mineral-oxide pigments or colored water-reducing admixtures
b. Stable at high temperature.
c. Sunlight fast and alkali-resistant.

2. Polymer Curing Admixture: Acrylic thermoplastic copolymer dispersion complying with PCI MNL 130.

3. Air-Entraining Admixture: ASTM C260, containing not more than 0.1 percent chloride ions.

4. Chemical Admixtures: ASTM C494, containing not more than 0.1 percent chloride ions.

E. Glass Fibers: Alkali-resistant fibers specifically formulated for compatibility with aggressive alkaline environment of Portland cement based composites and complying with PCI MNL-128.

2.04 ANCHORS, CONNECTORS, AND MISCELLANEOUS MATERIALS

A. Carbon-Steel Shapes and Plates: ASTM A36.
   1. Finish steel shapes and plates less than 3/16 inch thick as follows:
      a. Zinc coated by hot-dip process according to ASTM A123, after fabrication.

B. Anchors and Inserts: Steel for anchors shall conform to the appropriate requirements of ASTM A29 or A108 with minimum diameter of 1/4 inch.
   1. Yield strength shall conform to design minimum and maximum steel yield strength.
   2. Inserts shall be compatible with or isolated from other materials with which they will come in contact to avoid unwanted chemical or electrochemical reactions.
      A. Ductile materials shall be used.
   3. Finish: Zinc coated by hot-dip process according to ASTM A123 after fabrication, or ASTM A153 as applicable.

   1. Finish steel bars less than 3/16 inch thick as follows:
      a. Zinc coated by hot-dip process according to ASTM A123, after fabrication, or ASTM A153, as applicable.

D. Malleable-Iron Castings: ASTM A47, Grade 32510.

E. Carbon-Steel Castings: ASTM A27, Grade 60-30.

F. Bolts: ASTM A307 or ASTM A325.
   1. Zinc coated by hot-dip process according to ASTM A123, after fabrication, or ASTM A153, as applicable.

G. Joint Sealant:
   1. Comply with requirements of Section 07 9200 and following:
      a. Nonsag, nonstaining, silicone sealant complying with ASTM C 920.
      b. Type and grade required to seal joints in GFRC panels, as recommended in writing by GFRC panel manufacturer or fabricator.
2.05 PANEL FRAME MATERIALS

A. Cold-Formed Steel Framing: Manufacturer's standard C-shaped steel studs, complying with AISI - North American Specification for the Design of Cold-Formed Steel Structural Members.
   1. Minimum uncoated steel thickness of 0.0538 inch of web depth indicated, with stiffened flanges, U-shaped steel track, of following steel sheet:

B. Steel Channels and Angles: ASTM A36.
      a. Conforming to SSPC-Paint 20 on surfaces prepared to comply with SSPC-SP6/NACE No. 3 – Commercial Blast Cleaning.

2.06 GFRC MIXES

A. Trial Mix: Prepare trial mix to insure physical properties.

B. Backing Mix: Proportion backing mix of Portland cement, glass fibers, sand, and admixtures to comply with design requirements.
   1. Provide nominal glass-fiber content of not less than 5 percent by weight of total mix.

C. Face Mix: Proportion face mix of Portland cement, fine aggregates, and admixtures to comply with design requirements.

D. Polymer Curing Admixture: 6 to 7 percent by weight of polymer-curing admixture solids to dry Portland cement.

E. Air Content: 8 to 10 percent; ASTM C185.

F. Coloring Admixture: Add coloring agent, not to exceed 10 percent of cement weight, in proportion required to match approved sample.

2.07 SOURCE QUALITY CONTROL

A. GFRC manufacturer shall have established quality control program in effect prior to letting of Contract.
   1. When requested, copy of this program shall be submitted to Architect.
      a. Quality Control Program shall, as minimum, monitor glass content, spray rate, product physical properties, and curing period and conditions.
      b. Results of such quality control tests and evaluation of such tests shall be available to Architect upon request.
   2. Testing of materials and inspection of production techniques shall be manufacturer's responsibility.
   3. Preparation of test specimens and test procedures shall be in compliance with PCI-MNL 128, Chapter 8 – Quality Control, and Appendix A.

2.08 MOLD FABRICATION

A. Construct molds that will result in finished GFRC complying with profiles, dimensions, and tolerances indicated, without damaging GFRC during stripping.
1. Construct molds to prevent water leakage and loss of cement paste.
2. Coat contact surfaces of molds with form-release agent.

2.09 PANEL FRAME FABRICATION

A. Fabricate panel frames and accessories plumb, square, true to line, with components securely fastened, in accordance with approved Shop Drawings, and requirements of this Section.
   1. Fabricate panel frames using jigs or templates.
   2. Cut cold-formed metal framing members by sawing or shearing
      a. Do not torch cut.
   3. Fasten cold-formed metal framing members by welding.
      a. Comply with AWS D1.3 requirements and following:
         1) Procedures for welding
         2) Appearance and quality of welds
         3) Methods used in correcting welding work.
   4. Fasten framing members of hollow structural sections, steel channels, or steel angles by welding.
      a. Comply with AWS D1.1 requirements and procedures for following:
         1) Welding
         2) Appearance and quality of welds
         3) Methods used in correcting welding work.
   5. Weld flex, gravity, and seismic anchors to panel frames.

B. Reinforce, stiffen, and brace framing assemblies, where necessary, to withstand delivery, handling, and erection stresses.
   1. Lift fabricated assemblies in manner that prevents damage or significant distortion.

C. Galvanizing Repair: Touch up accessible damaged galvanized surfaces according to ASTM A780.

D. Painting Repair: Touch up accessible damaged painted surfaces using same primer as applied in shop.

2.10 GFRC FABRICATION

A. Proportioning and Mixing: For backing mix, meter sand/cement slurry and glass fibers to spray head at rates to achieve design mix proportions and glass-fiber content according to PCI MNL 130 procedures.

B. Spray Application:
   1. Comply with following general procedures:
      a. Spray mist coat over molds to nominal thickness of 1/8 inch on planar surfaces.
      b. Spray or place face mix in thickness indicated on Shop Drawings.
      c. Proceed with spraying backing mix before face mix has set, using procedures that produce uniform thickness and even distribution of glass fibers and matrix.
      d. Consolidate backing mix by rolling or other technique to achieve complete encapsulation of glass fibers and compaction.
e. Measure thickness with pin gage or other acceptable method at least once for each 5 square feet of panel surface.
   1) Take not less than six measurements per panel.

C. Hand form and consolidate intricate details, incorporate formers or infill materials, and over spray before material reaches initial set to ensure complete bonding.

D. Attach panel frame to GFRC before initial set of GFRC backing
   1. Maintain minimum clearance of 1/2 inch from GFRC backing, without anchors protruding into GFRC backing.

E. Build up homogeneous GFRC bonding pads over anchor feet
   1. Maintain minimum thickness of 1/2 inch over top of anchor foot, before initial set of GFRC backing.
   2. Measure pad thickness at 25 percent of anchor locations.

F. Inserts and Embedments: Build up homogeneous GFRC bosses or bonding pads over inserts and embedments to provide sufficient anchorage and embedment to comply with design requirements.

G. Curing: Employ initial curing method that will ensure sufficient strength for removing units from mold.
   1. Comply with PCI MNL 130 procedures.
   2. Keep moisture off of surface of mixes with polymer curing admixtures during first 3 hours of curing.
      a. Maintain temperature between 60 and 120 degrees F during first 12 to 16 hours.
   2. Prevent drying of moist cured mixes during first 24 hours.
      a. Maintain units in surface-damp condition at temperature above 60 degrees F in minimum of 95 percent relative humidity for period of 7 days.

H. Panel Identification:
   1. Mark each GFRC panel to correspond with identification mark on Shop Drawings.
   2. Mark each panel with its casting date.

2.11 FABRICATION TOLERANCES

A. Manufacturing Tolerances: Manufacture GFRC panels so each finished unit complies with following dimensional tolerances.
   1. For dimensional tolerances not listed below, comply with PCI MNL 130.
      a. Overall Height and Width of Units, Measured at Face Adjacent to Mold:
         1) 10 feet or under, plus or minus 1/8 inch.
         2) More than 10 feet, plus or minus 1/8 inch per 10 feet
            a) 1/4 inch maximum.
      b. Edge Return Thickness: Plus 1/2 inch, minus 0 inch.
      c. Architectural Facing Thickness: Plus 1/8 inch, minus 0 inch.
      d. Backing Thickness: Plus 1/4 inch, minus 0 inch.
      e. Panel Depth from Face of Skin to Back of Panel Frame or Integral Rib: 1) Plus 3/8 inch, minus 1/4 inch.
      f. Angular Variation of Plane of Side Mold: Plus or minus 1/32 inch per 3 inches of depth or plus or minus 1/16 inch total, whichever is greater.
g. Variation from Square or Designated Skew (Difference in Length of Two Diagonal Measurements): Plus or minus 1/8 inch per 72 inches or plus or minus 1/4 inch total, whichever is greater.

h. Local Smoothness: 1/4 inch per 10 feet.

i. Bowing: Not to exceed L/240 unless unit meets erection tolerances using connection adjustments.

j. Length and Width of Blockouts and Openings within One Unit: Plus or minus 1/4 inch

k. Location of Window Opening within Panel: Plus or minus 1/4 inch (6 mm).

l. Maximum Permissible Warpage of One Corner out of the Plane of Other Three: 1/16 inch per 12 inches of distance from nearest adjacent corner.

B. Position Tolerances: Measured from datum line locations, as indicated on Shop Drawings.
   1. Panel Frame and Track: Plus or minus 1/4 inch.
   2. Flashing Reglets at Edge of Panel: Plus or minus 1/4 inch.
   3. Inserts: Plus or minus 1/2 inch.
   4. Special Handling Devices: Plus or minus 3 inches.
   5. Location of Bearing Devices: Plus or minus 1/4 inch.

C. Panel Frame Tolerances:
   1. Vertical and Horizontal Alignment: 1/4 inch per 10 feet.
   2. Spacing of Framing Member: Plus or minus 3/8 inch.

2.12 FINISHES

A. Finish exposed face surfaces of GFRC as follows to match approved mockup.
   1. Panel faces shall be free of joint marks, grain, or other obvious defects.

B. Sand or Abrasive Blast Finish: Use abrasive grit, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces to match accepted mockup units.

2.13 PERFORMANCE REQUIREMENTS

A. Structural Performance: GFRC panels, including panel frames, anchors, and connections, shall withstand following design loads, as well as effects of thermal- and moisture-induced volume changes, according to load factors and combinations established in PCI MNL 128.
   1. Design Loads: As indicated.
   2. Deflection Limits: Design panel frames to withstand design loads without lateral deflections greater than 1/240 of wall span.
   3. Thermal Movements: Provide for thermal movements resulting from annual ambient temperature changes of 80 degrees F.
   4. Design panel frames and connections to accommodate deflections and other building movements.
   5. Design panel frames to transfer window loads to building structure.
   6. Fire-Resistance Rating: Select material and minimum thicknesses to provide 1 hour fire rating.
PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine structure and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 ERECTION

A. Install clips, hangers, and other accessories required for connecting GFRC panels to supporting members and backup materials.

B. Setting:
   1. Lift GFRC units at designated points only.
      a. Use caution not to induce stresses in units that would damage them.
   2. Install GFRC panels level, plumb, square, and in alignment.
      a. Provide temporary supports and bracing as required to maintain position, stability, and alignment of panels until permanent connections are completed.
      b. Maintain horizontal and vertical joint alignment and uniform joint width.
      c. Remove projecting hoisting devices.

C. Fastening:
   1. Connect GFRC panels in position by bolting or welding, or both, as indicated on approved Shop Drawings.
      a. Remove temporary shims, wedges, and spacers as soon as possible after connecting is completed.
   2. Field Welding: Comply with applicable AWS D1.1 and AWS D1.3 requirements for welding, appearance, quality of welds, and methods used in correcting welding work.
      a. Perform welding employing qualified welders using equipment and materials compatible with base metal.
      b. Protect GFRC panels from damage by field welding or cutting operations, and provide noncombustible shields as required.

D. Tolerances of erected units: Tolerances for installed GFRC units shall be non cumulative and as listed below. For erection tolerances not listed below, those listed in PCI MNL-117 apply.
   1. Face width of joint:
      a. Panel dimension 10 feet or less: Plus 3/16 inch.
      c. Panel dimension greater than 20 feet: Plus 1/4 inch, minus 5/16 inch.
   2. Warpage: Maximum permissible warpage of one corner out of plane of other 3 shall be 1/16 inch/ft. distance from nearest adjacent corner, or 1/8 inch total after installation.
   3. Bowing: Not over L/360, where L is panel length.
3.03 PATCHING AND REPAIRS

A. Patching or repairs will be permitted only, when in Architect and Structural Engineer’s opinion, structural adequacy of GFRC panel and appearance are not impaired.
   1. Otherwise remove and replace damaged GFRC panels when repairs do not comply with requirements.

B. Mix patching materials and repair GFRC so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces.

C. Prepare and repair accessible damaged galvanized coatings with galvanizing repair paint according to ASTM A780.

3.04 CLEANING AND PROTECTING

A. Perform cleaning procedures, if necessary, according to GFRC manufacturer’s written instructions.
   1. Clean soiled GFRC surfaces with detergent and water, using soft fiber brushes and sponges, and rinse with clean water
   2. Use extreme care to prevent damage to GFRC surfaces and adjacent materials.
   3. Thoroughly rinse soiled surfaces with clean water immediately after using cleaner.

B. Protect installed units by covering with impermeable tarpaulins where they might be stained by subsequent Work performed in close proximity to GFRC.

END OF SECTION 03 4913
SECTION 03 9300
FIBER REINFORCED POLYMER STRENGTHENING SYSTEM

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Defining requirements of reinforced concrete strengthening using externally bonded fiber reinforced polymer (FRP) systems.
      a. Note: Wrapping of building columns with FRP System shall be completed prior to demolition of exterior concrete panels.
   2. Furnishing submittals, materials, tools, equipment, transportation, necessary storage, labor, and supervision required to prepare surface of structural concrete members and to install FRP Reinforcement as indicated.

B. Related Sections:
   1. Section 03 3000: Cast in Place Concrete.
   2. Section 03 3930: Epoxy-Injected Crack Repair.

1.02 REFERENCES


B. ASTM International (ASTM):

C. International Code Council Acceptance Criteria (ICC AC):

D. American Concrete Institute (ACI):
   1. ACI 440.2R-08 – Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures
   2. ACI 440 R-07 – Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures.
   4. ACI 503 R – Pull-off test to determine FRP adhesion to concrete substrate.

1.03 QUALITY ASSURANCE

A. Quality Control Procedures to be Performed by Manufacturer:
   1. Include, but are not limited to following:
a. Nationally recognized program of contractor training, certification and technical support.
b. Minimum ten years experience in FRP Reinforcement confirmed by actual field tests of minimum 100 successful installations.
c. Able to supply testing data to demonstrate system properties and durability of actual FRP Reinforcement to be used.

B. Quality Control Procedures to be Performed by Contractor:
1. Include, but not are limited to following:
   a. Contractor trained by Manufacturer and shall have completed program of instruction in use of FRP Reinforcement.
   b. Minimum of two years experience in FRP Reinforcement confirmed by actual field tests of at least 5 successful installations.
   c. Inspect materials prior to application to assure that they meet specifications and have arrived at Project Site undamaged.
   d. FRP Reinforcement shall be completely inspected by Contractor during and immediately following application of composite materials.
      1) Ensure conformance with design drawings, proper alignment of fibers, and quality workmanship.
      2) Entrapped air shall be released or rolled out before epoxy sets.
      3) Defects shall be noted in Daily Construction Log.
   e. After FRP Reinforcement has cured, Contractor shall inspect Work to check for voids and debonding.
      1) Repairs shall be made per Article 3.04, paragraph D and noted in Daily Construction Log.

1.04 SUBMITTALS

A. Product Data:
1. Including, but not limited to, product standards, physical and chemical characteristics, environmental durability, technical specifications, limitations, installation instructions, and general recommendations regarding each material.

B. Contractor Qualifications: Qualification statement by Contractor listing completed FRP Reinforcement projects, including size, location, owner, engineer/architect, and contact numbers.

C. Product Description: Complete description of FRP Reinforcing system materials, surface preparation, application procedures, application rates, and cure times.

D. Shop Drawings: Complete system details including, but not limited to, FRP Reinforcement, primer, resin, and protective coating.
   1. Indicate limits of FRP Reinforcing.
   2. Details of epoxy-injected crack repair and epoxy resin patching.

E. Contractor’s Daily Construction Logs:
   1. Logs to include following information:
      a. Weather and temperature at application times.
      b. Amount of product used and square footage/linear footage of substrate covered.
      c. Batch numbers of products used.
      d. Names of crew members.
e. Bond-strength tests, noting location, quantity and who performed tests.

F. Test Reports:
   1. Pull-off test results to determine FRP adhesion to concrete substrate.
   2. Independent test report verifying environmental durability of proposed system to be used on Project.
      a. Reports shall include as minimum:
         1) 10,000 hr. resistance to salt water
         2) 10,000 hr. resistance to high temperature (38 degrees C) and high humidity (100 percent)
         3) 10,000 hr. resistance to alkali solution (pH 9.5)
         4) 3,000 hr. resistance to dry heat (60 degrees C)
         5) Resistance to 20 freeze/thaw cycles
         6) Resistance to UV/condensation at 100 cycles
         7) Resistance to diesel fuel (4 hour exposure)

1.05 PROJECT CONDITIONS

A. Do not apply FRP Reinforcement materials if raining, snowing, or dew condensation is expected or existing concrete surface is wet or if the ambient or surface temperature are below 40 degrees F.

B. Ambient temperature and temperature of epoxy components shall be between 50 degrees F and 80 degrees F at time of mixing.
   1. Refer to appropriate technical data sheets for more specific instructions.

C. Take precautions to avoid damage to surfaces near work zone due to mixing and handling of specified material.

D. Contractor is solely responsible for fume control and shall take necessary precautions against injury to installer personnel or adjacent building occupants during application of primer and resin.
   1. Contractor personnel shall use protective equipment and area shall be well vented to outside.
   2. As minimum, installer must take following precautions:
      a. Contractor to locate and protect building air intake during application.
      b. Contractor to follow state, federal, and local safety regulations.
   3. Contractor to follow Manufacturers’ safety requirements as indicated on appropriate MSDS sheets submitted to Contractor.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver primer, saturant and protective coating in original, unopened containers with Manufacturer’s name, labels, product identification, and batch numbers.

B. FRP Reinforcement shall be stored in cool dry area away from direct sunlight, flame, moisture, or other hazards.

C. Store primer, saturant and protective coating under conditions as recommended by Manufacturer in cool dry place out of direct sunlight.
   1. Products that have exceeded their shelf life shall not be used.
D. Contractor is required to confirm that materials used in accordance with this Section conform to local, state, and federal environmental and worker’s safety laws and regulations.

E. During operations Contractor shall maintain barricades.
   1. Comply with requirements of Section 01 5000.

F. Contractor shall properly dispose of empty containers in accordance with local Regulations and requirements of Section 01 7419.

PART 2 – PRODUCTS

2.01 COMPOSITE STRENGTHENING SYSTEM

A. FRP Precured Strip shall be high strength, high modulus, unidirectional carbon fiber reinforced polymer (CFRP).
   1. FRP Precured Strip shall be of type, size, layer and location as indicated.
   2. FRP Precured Strip, shall meet following minimum requirements:
      a. Thickness per layer: 0.08 inch.
      b. Ultimate Tensile Strength: 21 ksi. (in primary fiber direction)
      c. Rupture Strain: 0.017 inch/inch.
      d. Modulus of Elasticity: 11,900 ksi. (in primary fiber direction)
   3. Acceptable Products:
      a. Sika Structural Strengthening System as supplied by Sika Corporation.
      b. TYFO® Fibrwrap® System as supplied by Fyfe Company.
      c. Alternate products must be submitted and accepted by Architect in accordance with requirements for substitutions specified in Sections 01 3300 and 01 1600.

2.02 OTHER MATERIALS

A. Concrete Surface Primer: Surface Primer shall be two component, 100 percent solids, moisture tolerant, high modulus, high strength epoxy.

B. Fabric Saturant: Saturant resin shall be two component, 100 percent solids, moisture tolerant, high strength, high modulus epoxy.

C. Epoxy Repair Mortar: Repair mortar shall be 100 percent solids, non-sag paste epoxy.

D. Protective Coating: Protective coating shall be polymer or acrylic based and shall be UV resistant.

2.03 PERFORMANCE

A. Design composite system to achieve structural performance indicated on Structural Drawings.
   1. Design calculations for composite system shall be submitted for review and acceptance and be stamped by registered civil engineer licensed in State of California.

B. Calculations shall conform to requirements set forth in ICC ES Acceptance Criteria AC125 and be based on design modulus and associated area of composite to be installed.
1. FRP design values must be lower than calculated mean determined from test results received from ASTM D 3039 field test specimens.

PART 3 – EXECUTION

3.01 SURFACE PREPARATION

A. Columns, Beams and Other Concrete Surfaces as indicated:
   1. Prepare surfaces for bonding by means of abrasive blasting or grinding to achieve 1/16 inch minimum amplitude.
   2. Clean contact surfaces by hand or compressed air.
   3. Apply prime coat of manufacturer’s epoxy and allowed to cure for minimum of one hour.
   4. Prior to application of saturated composite fabric, fill uneven surfaces with manufacturer’s thickened epoxy.
   5. Provide anchorage as detailed.

3.02 PROCEDURES FOR APPLICATION

A. Preparation Work for Project: Visit Project Site to ensure that patch work is complete and cured.
   1. Review project specifications in detail.

B. Verify ambient and concrete temperatures.
   1. Work shall not proceed if temperature of concrete surface being repaired is less than 40 degrees F or greater than 100 degrees F.
   2. Temperature of epoxy components shall be between 40 degrees and 100 degrees F at time of mixing or as specified on component labels.
      a. When air temperature is outside prescribed range, other measures must be employed to ensure component temperature is maintained within specified range.

C. Prepare epoxy matrix by combining components at ratio specified by system manufacturer, with allowable tolerance of plus or minus 10 percent.
   1. Components of epoxy resin shall be mixed with mechanical mixer until uniformly mixed, typically 5 minutes at 400-600 rpm.
   2. Components that have exceeded their shelf life, as designated on material Label, shall not be used.

D. Both epoxy resin and fabric shall be measured accurately, combined, and deposited uniformly at rates shown on accepted shop drawings and per manufacturer’s recommendations.
   1. Composite system shall be comprised of fibers completely saturated with epoxy resin per proper ratio.

E. Quality Control Procedures: Record batch numbers for fabric and epoxy used each day, and note locations of installation.
   1. Measure square footage of fabric and volume of epoxy used each day.
   2. Complete report and submit to special inspector and system manufacturer.
   3. Refer to Field Quality Control Article.
F. Fabric Sampling Procedure: On smooth, flat, level surface covered with polyethylene sheeting, or 16 mil plastic film, prime with epoxy saturant, then prepare sample by placing two layers of saturated fabric oriented in same direction and allow to cure.
1. Apply additional topping of epoxy as required to ensure complete saturation.
2. Samples shall be stored in sample box and not moved for minimum 48 hours after casting.
3. Prepared, identified samples shall be given to preapproved testing laboratory.
   a. Refer to Field Quality Control Article for testing procedures and requirements.

G. Installation Procedures:
1. Prepare surface as required, including corner preparation.
2. Remove dust and debris by hand or with compressed air.
3. Clean up and protect area adjacent to element.
4. Using roller or trowel, apply one prime coat of epoxy resin to concrete surface, (2 mil minimum).
   a. Allow primer to become tacky to touch.
5. Fill uneven surfaces or recesses with thickened epoxy.
7. Apply saturated fabric to concrete surface by hand lay-up, using methods that produce uniform, constant tensile force that is distributed across entire width of fabric.
   a. Under certain application conditions, system may be placed entirely by hand methods ensuring uniform, even final appearance.
   b. Gaps between composite bands may not exceed 1/2 inch width in fabric’s transverse joint unless otherwise noted.
   c. Lap length of at least 6 inches is required at necessary overlaps in primary fiber direction of fabric.
8. Apply subsequent layers, continuously or spliced, until designed number of layers as indicated is achieved.
9. Using roller or hand pressure, ensure proper orientation of fibers, release or roll out entrapped air, and ensure that each individual layer is firmly bedded and adhered to preceding layer or substrate.
10. Detail fabric edges, including termination points and edges, with epoxy.
11. Finish: Edges and seams must be feathered.
   a. Use system as directed by manufacturer.
   b. Paint as specified between 24 and 72 hours after final application of epoxy.
   c. When, after 72 hours, epoxy has cured, surface must be roughened by hand sanding or brush blasting.
12. System may incorporate structural fasteners but limitations and detailing must be verified with composite system manufacturer.

3.03 PROCEDURE MODIFICATIONS

A. Installation procedures may be modified to achieve maximum results, subject to approval of Structural Engineer and DSA.
1. Submit proposed procedure modifications to Architect and Structural Engineer.
2. Procedure modifications shall be discussed with Structural Engineer and DSA prior to implementing modifications.
3.04 FIELD QUALITY CONTROL

A. Installers:
1. Record batch numbers for fabric and epoxy used each day, and note locations of installation.
   a. Measure square footage of fabric and volume of epoxy used each day.
   b. Complete report and submit to Structural Engineer, Project Inspector, DSA. and system manufacturer.

B. Inspection:
1. Certified Special Inspector, approved by DSA, shall periodically observe aspects of preparation, mixing, and application of materials, including following:
   a. Material container labels
   b. Surface Preparation
   c. Mixing of epoxy
   d. Application of epoxy to the fiber
   e. Application of composite system
   f. Curing of composite material
   g. Preparation and labeling of test samples
2. Contractor shall monitor mixing of epoxy components for proper ratio and adherence to manufacturer’s recommendations.

C. Laboratory Testing:
1. Record lot number of fabric and resin used, and location of installation.
2. “Sample Batch” shall consist of two 12 inch x 12 inch samples of cured composite.
   a. Minimum of two sample batches shall be made daily.
   b. Two sample batches will be taken at appropriate times during day so as to ensure maximum material deviance in components of composite.
3. Testing laboratory shall pre-condition samples at 140 degrees F for 48 hours before testing.
   a. Samples shall be tested, at random, at owner’s discretion and cost.

D. Tested Samples: Test per ASTM D 3039.
1. 12 inch x 12 inch panel shall have 5 coupons, 3/4 inch x 9 inches, removed and tested for their material properties in longitudinal (primary fiber) direction.
2. Tests shall conform to ASTM procedures and manufacturer’s published testing methods.
3. Only pre-qualified testing laboratories shall be used.

E. Test results shall be made available within 3 weeks of sample submission.
1. testing shall provide average values of following:
   a. Ultimate tensile strength
   b. Tensile modulus
   c. Percent elongation
2. 15 percent of sample batches are suggested to be tested.
   a. Should one 12 inch x 12 inch sample fail (on average), specimens from same sample will be tested.
   b. Should these specimens also fail (on average), other 12 inch x 12 inch from same sample batch will be tested.
   c. In extreme case that this sample also fails, remaining sample batch for that day will be tested and appropriate remedial measures as specified, will be taken to ensure integrity of system from failed sample batch.
d. In addition, 25 percent of remaining sample batches will then be tested using same criteria.

F. Repairs:
1. Defects, including bubbles, delaminations, and fabric tears, spanning more than 5 percent of surface area, or as specified by Architect or Structural Engineer, shall be repaired.
2. Two types of repairs shall be performed:
   a. Small defects (on order of 3 inch diameter) shall be injected or back filled with epoxy.
   b. Large defects shall be repaired as required by Structural Engineer’s specifications and manufacturer’s specifications.
3. Small entrapped air pockets and voids naturally occur in mixed resin systems and do not require repair or treatment.
   a. Defect repair shall be provided by manufacturer and be submitted to Structural Engineer for review and acceptance.

G. Remedial Measures:
1. In event that specified material testing, determines sample batch to possess insufficient material properties, remedial measures shall be taken.
2. When tested composite system has material properties determined to be below minimum specified values, additional layers shall be installed until final composite thickness is increased by same percentage as deficiency of material’s elastic modulus.
3. Required additional material and labor for remedial repairs would not be paid for as extra to contracted Work.

END OF SECTION 03 9300
SECTION 05 0513

SHOP-APPLIED METAL FINISHES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Factory applied high performance metal finishes for following:
      a. Aluminum extrusions for:
         1) Aluminum entrances and curtain wall framing
         2) Aluminum windows
   2. Coil coated steel sheet for metal flashing and trim

B. Related Sections
   1. Section 07 6200: Sheet Metal Flashing and Trim
   2. Section 08 4413: Aluminum Curtain Wall
   3. Section 08 5113: Aluminum Windows
   4. Section 09 9100: Painting; ferrous and galvanized metal
   5. Section 09 9600: High Performance Coatings; on exposed steel
   6. Division 22 through 23 Sections and Division 26 through 28 Sections for
      prefinished plumbing items, mechanical equipment grilles, and prefinished
electrical equipment.

1.02 REFERENCES

A. National Association of Architectural Metal Manufacturers (NAAMM):
   1. NAAMM – Metal Finishes Manual

B. Aluminum Association (AA):
   1. CA-92: Care of Aluminum
   2. DAF-45: Designation System for Aluminum Finishes.

C. American Architectural Manufacturers Association (AAMA):
   1. AAMA 620 -"Voluntary Specifications for High Performance Organic
      Coatings on Coil Coated Architectural Aluminum Substrates"
   2. AAMA 2605 -"Voluntary Specification, Performance Requirements and
      Test Procedures for Superior Performing Organic Coatings on Aluminum
      Extrusions and Panels"

1.03 QUALITY ASSURANCE

A. Applicator Qualifications: Engage experienced applicator who has completed high
   performance coating system applications similar in material and extent to that
   indicated for this Project with record of successful in-service performance.

B. Source Limitations: Obtain primers for each coating system from same manufacturer
   as finish coats.

C. Coating manufacturer shall conduct periodic inspections of surface preparation and
   coating operations as necessary.
D. Coating manufacturer shall notify Architect should Contractor fail to meet one or more portions of specification.

1.04 SUBMITTALS

A. Product Data: For each metal finish system specified; including primers.
      a. Indicate each material and cross-reference specific coating, finish system, and application.
      b. Identify each material by manufacturer’s catalog number and coating material proposed for use.
   2. Manufacturer’s Information: Provide manufacturer’s technical information, including instructions for handling, storing and applying each coating material proposed for use.
   3. Certification by manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOC’s).

B. Samples:
   1. Applied finishes on same metal to be used for Work, for color and finish.
   2. Provide minimum 4 by 8 inch pieces, and 8 inch lengths of larger sizes as required to show finished work.

C. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience.
   1. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.05 WARRANTIES

A. Special Finish Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period.
   1. Warranty does not include normal weathering.
   2. Warranty Period: 10 years from date of Substantial Completion for Type A coating system.
   3. Warranty Period: 20 years from date of Substantial Completion for Type B coating system.

B. Completed high performance metal finishes shall be jointly warranted by respective coating manufacturer and coating applicator to meet weathering tests and performance requirements as specified.
   1. Coating applicator must apply for coating warranty at time of application.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Products: High Performance Metal Finishes are based on following systems as manufactured by PPG Industries, or approved equal by Valspar:
   1. Metal Finish Type A: High Performance Fluoropolymer Coating System for Extruded Aluminum.
      a. Manufacturer’s standard 3 coat system, consisting of primer, color coat, and clear topcoat.
2. Metal Finish Type B: High Performance Fluoropolymer Coating System for
Coil-Coated Steel Sheet.
   a. Manufacturer's standard 2 coat system, consisting of nominal 0.2 mil
corrosion inhibitive primer and 0.75 fluoropolymer color topcoat.

B. Subject to compliance with specified requirements, comparable products may be
submitted by alternate manufacturers in accordance with requirements for product
substitutions specified in Section 01 6000 and following:
   1. Submit items listed in “Submittals” Article and as specified in Section 01 3300,
For evaluation of proposed system.
   2. Tests shall have been made for identical systems within ranges of specified
performance standards and criteria for application to specified substrates.
   3. Acceptance is also subject to availability of acceptable color matching specified
color.
   4. Manufacturer's minimum 10 year finish and material warranty for Type A.
   5. Manufacturer's minimum 20 year finish and material warranty for Type B

2.02 COATING MATERIALS – GENERAL

A. Material Compatibility: Provide primers and finish coat materials that are compatible
with one another and substrates indicated under conditions of service and
application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer’s highest grade of various high performance
coatings specified; of uniform color throughout and color-fast.
   1. Materials not displaying manufacturer’s product identification are not
acceptable.

C. Coating manufacturers and coating applicators shall develop jointly methods and
procedures for surface preparation, priming, and finish coating of materials.

2.03 HIGH-PERFORMANCE COATING SYSTEMS

A. High Performance Metal Finish Type A:
   1. High performance pigmented organic coating, meeting or exceeding
performance and test provisions of AAMA 2605 for ten years minimum and
following requirements:
      a. Minimum 70 percent PVDF (Kynar 500 or Hylar 5000) resin system base
         with pigmentation.
         1) Non-chalking, resistant to ultraviolet deterioration, of uniform color
            throughout, and colorfast.
      b. Prepare, pretreat, and apply coating to exposed metal surfaces following
coating and resin manufacturer's jointly developed methods and
procedures for surface preparation, priming, and application of finish
coating to entrance doors and frames and window materials.
   2. Fluoropolymer Coating System: Manufacturer's standard 3-coat thermo-cured
system, consisting of specially formulated inhibitive primer and fluoropolymer
color topcoat containing not less than 70 percent polyvinylidene fluoride
(PVDF) resin system base by weight complying with AAMA 2605.
   3. Shop apply Coating System Type A to aluminum doors, door frames, curtain
wall and window framing as follows:
      a. Primer Coat: 0.2 to 0.3 mil dry film thickness.
      b. Color Coat: 1.0 mil minimum dry film thickness.
c. Top Coat: Apply clear "XL" topcoat of 0.6 ± 2 mil dry film thickness.

4. Color: Duranar XL as selected by Architect
   a. Doors, Frames, Storefront Framing and Windows: PPG Duranar XL as selected by Architect from manufacturer’s full line.

B. High Performance Metal Finish Type B:
   1. High performance pigmented organic coating, meeting or exceeding performance and test provisions of AAMA 2605 for ten years minimum and following requirements:
      a. Minimum fluoropolymer 70 percent PVDF (Kynar 500 or Hylar 5000) resin system base by weight complying with AAMA 2605.
      b. Provide 1 mil dry film thickness coating one side, 0.3 to 0.4 mil other side, or approved equal.
      c. PPG Duranar Coil Coating System, or approved equal
      d. Color: PPG Duranar coil coating as selected by Architect from manufacturer’s full line, or as scheduled to match adjacent finishes.

2.04 PERFORMANCE REQUIREMENTS

A. Provide factory applied metal finish systems suitable for application to aluminum extrusions and coil coated galvanized steel sheet.

B. Conform to applicable performance standards where referenced in specification:

PART 3 – EXECUTION

3.01 GENERAL REQUIREMENTS

A. Finish visible surfaces of exposed work; defined as surfaces which will be exposed to view from exterior and in interior of completed building.

B. Perform finishing after fabrication, forming, fitting, and welding have been completed.

C. Finishes on exposed work shall be uniform in appearance; members are to match each other exactly throughout installed Work.

D. Specified finishes establish type and quality required.
   1. Finishes are subject to Architect's acceptance.

3.02 CLEANING

A. Comply with Section 01 7423 and following:
   1. Clean in accordance with coating manufacturer’s recommendations.
   2. Do not use materials or methods which may damage finishes or surrounding construction.

3.03 PROTECTION

A. Protect finished surfaces from damage until acceptance by Owner.

END OF SECTION 05 0513
PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
1. Structural steel framing, including structural steel as shown on Structural Drawings.
   a. Standard shapes, plates and rods shown on Architectural, Mechanical, and Electrical Drawings that connect to building structure.
   b. Welded stud connectors for composite construction, concrete engagement, and attachment of building components.
   c. Anchor rods.
   d. Shop painting.
   e. Bent plate deck closures.

B. Related Sections:
1. Section 01 4500: Quality Control
2. Section 03 3000: Cast-in-Place Concrete
3. Section 05 1250: Buckling Restrained Bracing
4. Section 05 5000: Metal Fabrications

1.02 REFERENCES


B. ASTM International (ASTM):
1. ASTM A 6 – Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
2. ASTM A 108 – Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
5. ASTM A 307 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength
7. ASTM A 435 – Standard Specification for Straight-Beam Ultrasonic Examination of Steel Plates
11. ASTM A 898 – Standard Specification for Straight Beam Ultrasonic Examination of Rolled Steel Structural Shapes
13. ASTM F 844 – Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use
14. ASTM F 959 – Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners
15. ASTM F 1554 – Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

C. American Institute of Steel Construction (AISC):
      a. No provision of AISC 303 shall be effective to change duties and responsibilities of Owner, Contractor or Structural Engineer from those set forth in these Contract Documents.
      b. Where discrepancies exist between requirements of Contract Documents and AISC 303, requirements of Contract Documents shall govern.

D. American Welding Society (AWS):
   1. AWS D1.1 – Structural Welding Code -- Steel.
   2. AWS D1.8 – Seismic Welding Supplement.
   3. AWS A2.4 – Standard Symbols for Welding, Brazing and Nondestructive Examination.
   4. AWS A5 – Filler Metal Specifications.
   5. AWS C4.1 – Criteria for Describing Oxygen-Cut Surfaces and Oxygen Cutting Surface Roughness Gauge.
   6. AWS QC1 – Standard for AWS Certification of Welding Inspectors.

E. The American Society of Mechanical Engineers (ASME):

F. The Society of Protective Coatings (SSPC):
   1. SSPC-SP 1 – Solvent Cleaning.
   2. SSPC-SP 2 – Hand Tool Cleaning.
   3. SSPC-SP3 – Power Tool Cleaning.
   c. SSPC-SP6 – Commercial Blast Cleaning.

G. American Society of Non-Destructive Testing (ASNT):
2. ASNT Recommended Practice No. SNT-TC-1A – Personnel Qualification and Certification in Nondestructive Testing.

1.03 QUALITY ASSURANCE

A. Welding Inspector Qualifications:
   1. Welding Inspectors shall be trained and thoroughly experienced in inspecting welding operations, and qualified as Certified Welding Inspectors (CWI) in accordance with AWS D1.1 and AWS QC1.
   2. NDT Personnel Qualifications:
      a. NDT personnel shall be qualified under one of ASNT documents referenced in this Section.
      b. NDT performed by NDT Level I personnel shall be under close, direct supervision of NDT Level II.

B. Demand-Critical Welds: UT may be performed only by UT technicians certified as Level II by their employer, or as ASNT Level III certified by examination by ASNT.
   1. Ultrasonic testing technicians who perform flaw detection or sizing shall be trained in applicable UT procedure and shall demonstrate their competence through testing as prescribed in AWS D1.8, Annex E.

C. Bolting Inspector Qualifications: Competency shall be demonstrated through administration of written examination and through hands-on demonstration by Inspector of methods to be used for bolt installation and inspection.

D. Qualifications:
   1. Steel Fabricator Qualifications: Fabricator shall have had not less than 5 years experience in fabrication of structural steel and be able to furnish evidence of his ability, facilities, proficiency of his personnel, and completed projects.
      a. Fabricator shall be City of Los Angeles Approved Licensed Fabricator.
   2. Steel Erector's Qualifications: Erector shall have had not less than 5 years experience in erection of structural steel and be able to furnish evidence of his ability, facilities, proficiency of his personnel and completed projects.
   3. Welder Qualifications: Welders, welding operators, and tackers shall be qualified in accordance with AWS D1.1.
      a. Welders shall have valid Welding Performance Qualification Record (WPQR) for each welding procedure to be performed.
      b. Welders whose work fails to pass inspection shall be requalified before performing further welding.
      c. Supplemental Welding Personnel Testing: Welders and welding operators performing work on bottom-flange Demand-Critical Welds shall pass Supplemental Welder Qualification Testing, as required by AWS D1.8, Section 5.1.
      d. FCAWS and FCAW-G shall be considered separate processes for welding personnel qualification
      e. Qualification Period: Personnel who have not welded for period of three or more months shall be requalified.
         1) Welding personnel required to be tested using Supplemental Welding Personnel Testing shall be qualified by test within 12 months prior to beginning welding on Project.
      f. Contractor shall pay costs of certifying qualifications and requalifications.
E. Quality Assurance Submittals:
   1. Owner’s Testing Agency will submit following items:
      b. Qualifications of Owner’s Testing Agency management and personnel designated for Project.
      c. Qualification records for Owner’s Testing Agency’s Inspectors and NDT technicians designated for Project.
      d. Owner’s Testing Agency’s Quality Control Plan for monitoring and control of Agency’s operations.
      e. Written Practice for Owner’s Testing Agencies: Owner’s Testing Agency shall maintain Written Practice for selection and administration of inspection personnel, describing training, experience, and examination requirements for qualification and certification of inspection personnel, including those of subcontracting agencies.
         1) Written Practice shall also describe following:
            a) Agency’s procedures for determining acceptability of structure in accordance with applicable codes, standards, and specifications.
            b) Agency’s inspection procedures, including general inspection, material controls, visual welding inspection, and bolting inspection.
      2) Bolting Inspection Procedures: Comply with AISC 348 and Quality Assurance Plan.
      3) Welding Inspection Procedures: Meet requirements of AWS D1.1 and Quality Assurance Plan.
      4) Nondestructive Testing Procedures: Written Practice shall describe responsibility of each level of certification for determining acceptability of material and welds in accordance with applicable codes, standards, specifications and procedures.

1.04 SUBMITTALS

A. Include following in accordance with requirements of Section 01 3300:
   1. Manufacturer’s test reports and literature describing products, including but not limited to following, and excluding those listed in Article 1.06 B:
      a. Manufacturer’s Certifications for electrodes, fluxes and shielding gasses to be used.
         1) Certifications shall satisfy AWS A5 requirements.
         2) Certificate of Compliance from Contractor supplying materials.
         3) Certifications that product meets additional requirements of Project.
      b. Manufacturer’s product data sheets for welding material to be used.
         1) Data sheets shall describe product, limitations of use, recommended welding parameters, and storage and exposure requirements, including baking and rebaking.
      2. Plans of levels showing dimensioned location of edge of slab, deck, and openings.
         a. Submit prior to shop and erection drawings.
      3. Shop and Erection Drawings: Submit detailed shop and erection drawings for structural steel prior to start of fabrication and erection, showing:
         a. Size and location of structural members and connection material.
b. Type, size and location of bolts and welds.
c. Identification of high-strength bolted joints as snug-tight, pretensioned or slip-critical, as required by Contract Documents.
d. Locations where Construction Documents require backing bars to be removed.
e. Locations where Construction Documents require supplemental fillet welds where backing is permitted to remain.

B. Do not fabricate material prior to obtaining final review of submittals.

1.05 DEFINITIONS

A. Demand-Critical Welds: Demand-Critical Welds are designated on Structural Drawings.
   1. Demand-Critical Welds are part of Seismic-Load-Resisting System.

B. Extra Smooth: Surfaces noted as “Extra Smooth” require finish with surface variation of 500 micro-inches or less (AWS C4.1-77, Sample No. 4).

C. Gouge: Depression deeper than overall surface roughness.

D. Heavy Sections: Rolled and built-up sections as defined below.
   1. ASTM A 6 shapes with flanges thicker than 1-1/2 inches.
   2. Welded built-up members with plates exceeding 2 inches in thickness.
   3. Column base plates exceeding 2” in thickness.

E. Nondestructive Testing: Nondestructive testing (NDT) includes magnetic particle testing (MT), penetrant testing (PT), radiographic testing (RT), and ultrasonic testing (UT).
   1. Terms nondestructive examination (NDE) and nondestructive testing (NDT) are synonymous.

F. Protected Zone: Protected Zone is defined as structural members, or portions thereof, to which connections of structural and non-structural elements are limited.
   1. Protected Zone is designated on Structural Drawings.

G. Quality Assurance Plan: Quality Assurance Plan is set of written requirements containing set of procedures that are to be followed by Owner’s Testing Agency to confirm compliance with these requirements.

H. Seismic-Load-Resisting System (SLRS): Seismic-Load-Resisting System (SLRS) is defined as items designated “SLRS” on Structural Drawings, including columns, beams, and braces, and their connections along grid lines denoted “SLRS” on framing plans.

1.06 STRUCTURAL STEEL PRE-CONSTRUCTION CONFERENCE

A. When requested by Structural Engineer, hold Pre-construction Conference prior to performing fabrication or erection work, to review following:
   1. Submittal requirements
   2. Welding and bolting procedures
   3. Fabrication and erection issues
   4. Inspection requirements for structural steel operations.
B. Attendees to include:
   1. Owner’s Representative/Project Inspector
   2. Architect
   3. Structural Engineer
   4. Owner’s Testing Agency
   5. Steel fabricator and steel erector personnel supervising shop, field, and Quality Control Work.

1.07 PROJECT CONDITIONS

A. Provide Owner’s Testing Agency with free access to places on and off Project Site where materials are stored or fabricated, to places where equipment is stored or serviced, and to Project Site.

B. Sequencing and Scheduling:
   1. Notify Architect and Owner’s Testing Agency in sufficient time prior to shop or field fabrication and erection to permit testing and inspection without delaying Work.
   2. Ensure timely delivery of items to be embedded in Work of other sections; furnish setting drawings and directions for installation
   3. Provide templates for setting of anchor rods, one per location.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle packaged materials in original containers with seals unbroken and labels intact until time of use.

B. Structural steel shall be stored and handled in a manner that prevents damage or distortion.
   1. Discharge materials carefully; do not dump onto ground.

C. Do not store materials on structure in manner that might cause distortion or damage to members of supporting structure.

D. Store structural steel members, whether on or off site, above ground on platforms, skids, or other support; store other materials in weather-tight, dry place until use.

E. Store materials to permit easy access for inspection and identification.

F. Electrode Requirements:
   1. Packaging of weld filler metals shall conform to requirements of AWS D.1.1.
      a. FCAW electrodes shall be received in undamaged moisture-resistant containers.
      b. They shall be protected against contamination and injury during shipment and storage.
      c. When removed from protective packaging and installed on machines, care shall be taken to protect electrodes and coatings from deterioration or damage.
   2. Modification or lubrication of electrode after manufacture is not permitted, except that drying shall be permitted when recommended by manufacturer.
3. Electrode Storage and Exposure Limits for Demand-Critical Welds:
   a. Exposure time limit for electrodes shall be in conformance with AWS D1.8 Section 6.4.

G. Fasteners shall be stored in protected place.
   1. Except for ASTM F 1852 “twist-off” type assemblies, clean and relubricate bolts, nuts and washers that become dry or rusty before use.
   2. ASTM F 1852 fastener components may be relubricated following manufacturer’s written instructions, and must be retested after relubrication and prior to use to verify suitability for installation.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Structural steel shall be domestically manufactured and fabricated in United States of America (USA).

B. Steel Shapes, Plates, Tube, Pipe, and Other Sections: As noted on Drawings.
   1. HSS shapes shall be manufactured (rolled and seam welded) in USA.
   2. Alternatively, HSS shapes from outside USA shall have seam welds tested by ultrasonic examination.
   3. Costs of tests and repairs, shall be borne by Contractor.

C. Heavy Sections:
   1. Heavy Sections in Seismic-Load-Resisting System shall be supplied with Charpy V-notch (CVN) testing in accordance with AISC 341 requirements.
   2. Plates and Flanges in Heavy Sections shall be free of laminations within 3 inches of areas to be welded with complete-joint-penetration welds.

D. Standard Threaded Fasteners:

E. High Strength Bolts:
   1. ASTM A325, snug-tight, unless otherwise noted.
   2. Bolted joints in the Seismic-Load-Resisting System shall be Slip-Critical, with pretensioned high-strength bolts and a Class A faying surface or better.
   3. Twist-off-Type Tension-Control Bolt Assemblies: ASTM F1852.
   4. Direct Tension Indicators: Load Indicator Washers: ASTM F959

F. Welding materials:
   1. Comply with AWS D1.1 with a nominal 70 ksi tensile strength.
   2. Supplemental Requirements for the Seismic-Load-Resisting System:
      a. Welds shall meet the requirements of AWS D1.8, Section 6.

G. Welded Stud Connectors:
   1. Headed Shear Studs: AWS D1.1 “Type B” automatic end-welded headed studs made from ASTM A108, Grade 1015 or 1020.
H. Anchor Rods and Nuts: ASTM F1554; Grade as noted on Drawings.
   1. Grade 55 shall be weldable per supplement S1.
   2. Grades 55 shall have minimum CVN toughness of 15 ft-lbs at 40 degrees F per supplement S4.
   3. Grade 105 shall have minimum CVN toughness of 15 ft-lbs at -20 degrees F per supplement S5.

I. Threaded Rods: As noted on Drawings.

J. Clevises and Turnbuckles: A1S1 C 1035
   1. Clevises and turnbuckles shall have design strengths corresponding to AISC Steel Construction Manual with ultimate capacities at least 200 percent of tabulated LRFD values.

K. Shop Primer:
   2. Coordinate selection of primer with finish paint requirements in Section 09 9100 and 09 9600, as applicable.
      a. Primer and finish coat materials for exposed steel are required to be complete system by one manufacturer
   3. Prime painting with specified shop primer is required of structural steel, exposed or concealed, except where indicated otherwise.

L. Galvanizing: Provide zinc coating for those items shown or specified to be galvanized, as follows:
   1. ASTM A 123 for galvanizing rolled, pressed and forged steel shapes, plates, bars and strip 1/8 inch thick and heavier.
   2. ASTM A 386 for galvanizing assembled steel products.
      a. Perform galvanizing after fabrication with Work assembled in as large sections as can be handled.
   3. ASTM A 153 for galvanizing iron and steel hardware.
   4. Remove projections, barbs, and icicles after galvanizing.

M. Galvanizing Repair Paint: Zinc-rich coatings meeting requirements of ASTM A780 or SSPC Paint-20, with dry film containing not less than 94 percent zinc dust by weight.

N. Dry-Pack Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean, uniformly graded, natural sand (ASTM C 404, Size No.2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum water required for placement and hydration.

O. Nonshrink Nonmetallic Grout: Factory premixed, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.
   1. Provide one of following or grout specifically recommended by manufacturer for types of applications indicated:
      a. Masterflow 713 Plus; BASF Building Systems
      b. Sealight 588 Grout; W.R. Meadows
      c. Five Star Grout; Five Star Products, Inc.
      d. SikaGrout 212; Sika Corporation.
2.02 SOURCE QUALITY CONTROL

A. Owner’s Testing Agency will:
   1. Review ladle analysis and certificates of compliance.
      a. Where certification is questionable, test material to verify compliance.
   2. Inspect shop fabrication.
   3. Provide management, personnel, equipment, and services required to perform quality control functions required below.
   4. Verify that no improper attachments to Protected Zone have been made.
   5. Inspect Heavy Sections:
      a. Heavy Section flanges shall be ultrasonically examined at locations to be groove-welded, for evidence of laminations, inclusions, or other discontinuities, in accordance with ASTM A898.
         1) Examination shall include entire area within 3 inches of such joints.
      b. For plates, ultrasonically examine in accordance with ASTM A435.
         1) Discontinuity causing total loss of back reflection that cannot be contained within circle with diameter of greater of 3 inches or one-half the plate thickness, shall be rejected.
   6. Forward copies of product and procedure certificates, data sheets, and test and inspection reports to Owner, Architect, Structural Engineer, Contractor, and DSA.

B. Welding Inspection:
   1. Welding Inspector shall perform tasks indicated in following list.
   2. List shall not be considered exclusive of additional inspection tasks that may be necessary to meet requirements of AWS D1.1, CBC, and Quality Assurance Plan.
      a. Review and understand applicable portions of specifications, Contract Documents and shop drawings for Project.
      b. Verify that applicable welder qualifications, welding operator qualifications, and tack welder qualifications are available, current, accurate, and in compliance with this Section.
      c. Verify welder identification and qualification.
         1) Verify that required supplemental welder qualification testing, when required for joint, has been executed and that welder has passed.
      d. Verify that each welder has unique identification mark or die stamp to identify welds.
      e. Verify that applicable Welding Procedure Specifications (WPSs), with Procedure Qualification Records (PQRs) as needed, are available, current and accurate, and comply with AWS D1.1 and this Section.
      f. Verify that approved Welding Procedure Specification (WPS) has been provided and that each welder performing weld has reviewed WPS.
         1) Copy of appropriate WPS shall be available for each joint, although need not be present at each joint location.
      g. Review mill test reports for main member and designated connection base material for compliance with Project requirements.
      h. Verify base material identification with Contract Documents.
      i. Verify electrode, flux and shielding gas certifications for compliance with Contract Documents.
      j. Verify welding consumables with approved WPSs.
      k. Verify that electrodes are used only in permitted positions and within welding parameters specified in WPS.
I. Verify that electrodes and fluxes are properly stored, and that exposure limits for welding materials are satisfied.

m. At suitable intervals, observe joint preparation, assembly practice, preheat temperatures, interpass temperatures, welding techniques, welder performance, and post-weld controlled cooling and heat treatment to ensure that requirements of WPS and AWS D1.1 are satisfied.

n. At suitable intervals, verify current and voltage of welding equipment in application of WPS, when needed, by calibrated amp and voltmeter.
   1) Current and voltage shall be measured near arc with this equipment.

o. Inspect Work to ensure compliance with AWS D1.1 and specified weld acceptance criteria.

p. Schedule NDT technicians in timely manner, after visual inspection is complete and assembly has cooled.
   1) Final NDT on specific weld shall be performed at least 24 hours after welding has been completed.

q. Mark welds, parts, and joints that have been inspected, and accepted, with distinguishing mark or die stamp, or maintain records indicating specific welds inspected and accepted by each inspector.

r. Document accepted and rejected items in written report.
   1) Transmit report to designated recipients in timely manner.

C. Nondestructive Testing of Welded Joints:

1. Magnetic Particle Testing:
   a. Magnetic Particle Testing (MT) shall be conducted by Owner’s Testing Agency at frequency designated in Table 2-1. MT shall be performed in accordance with AWS D1.1, and AWS D1.8 Annex F.

2. Ultrasonic Testing:
   a. Ultrasonic testing (UT) shall be conducted by Owner’s Testing Agency for percentage of joints designated in Table 2-1. UT shall be performed in accordance with AWS D1.1.

3. Weld Acceptance Criteria shall be in accordance with AWS D1.1.
   a. Regions of welds that cannot be inspected shall be identified and recorded, and Structural Engineer shall be notified.

4. K-Area Welding Inspection:
   a. After welds of continuity plates and doubler plates have cooled to ambient temperature, test column webs for cracking using liquid penetrant (PT) or magnetic particle testing (MT) over zone 3 inches above and below each weld.

D. Table 2-1. Nondestructive Testing Requirements

<table>
<thead>
<tr>
<th>Weld Category</th>
<th>Nondestructive Testing Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete-Joint-Penetration Welds¹</td>
<td>Partial-Joint-Penetration Welds and Fillet Welds</td>
</tr>
<tr>
<td>Welds not described below</td>
<td>No NDT required unless otherwise noted</td>
</tr>
<tr>
<td>SLRS welds not described below</td>
<td>MT 25 percent of joints, full length²</td>
</tr>
<tr>
<td>Top-flange joints at cantilever beam connections³</td>
<td>MT 100 percent of joints, full length UT 100 percent of joints, full length</td>
</tr>
</tbody>
</table>
Nondestructive Testing Requirements

<table>
<thead>
<tr>
<th>Demand-Critical Welds: Butt joints in column splices</th>
<th>MT 100 percent of joints, full length</th>
<th>UT 25 percent of joints, full length²</th>
</tr>
</thead>
</table>

E. Notes:
1. UT is required only when the weld thickness is 5/16” or greater.
2. Where joint fails testing, test 100 percent of joints until 40 consecutive welds pass.
   a. Testing rate may then be reduced to 25 percent.
3. Test joint on each side of cantilever beam support.
4. Reduce rate of UT to 25 percent, when after 40 welds have been inspected, individual welder’s reject rate is less than 5 percent.

2.03 FABRICATION

A. General Requirements:
1. Fabricate structural steel in accordance with AISC 360 (Chapter M and Section J2), AISC 303, and AWS D1.1 as applicable to Statically Loaded Structures, except as otherwise noted herein.
   a. Assume all thermally cut edges are subject to tension stresses.
   b. Delete paragraphs M4.6 and M5.1 from Chapter M of AISC 360.
2. Fabricate and assemble work in shop to greatest extent possible.
3. Where possible, use procedures that do not require Architect’s approval.
   a. Such approval may not be given in some circumstances.
4. Coordinate as required for attachment of other work to structural steel.
5. Drill or punch holes for passage of reinforcing steel shapes, sections, plates, or bars as indicated on Structural Drawings. Notify Architect of conditions not shown or noted.
6. Allowable Tolerances: Comply with AISC 360, Chapter M, and AISC 303, Section 6.
   a. Where more restrictive tolerances are necessary to properly install other building systems and components then adopt more restrictive tolerances.
7. Holes and attachments to structural steel in areas designated as Protected Zone are not allowed except as explicitly shown or noted on Structural Drawings.

B. Connections:
1. Shop Connections: Bolted or welded as noted.
2. Field Connections: Locate splices only where noted or approved by Architect.
3. Assemble structural steel in shop to maximum extent possible, prior to galvanizing.

C. Bolted Joints:
1. Punch or drill holes 1/16 inch larger than bolt size. Material having thickness in excess of connector diameter plus 1/8 inch shall be drilled rather than punched.
2. Ream unfair holes, but only up to next larger bolt size and install bolt corresponding to new hole size.
   a. Where unfairness exceeds maximum, weld hole in base material solid and drill hole of proper size.
3. Remove burrs that would prohibit solid seating of connected parts.
4. Mark completely tightened bolts with identifying symbol.
5. Provide hardened washers over slotted holes.
6. Draw up tight, check threads with chisel or provide approved lock washers where bolts are not pretensioned.
7. Assembly with Standard Threaded Fasteners:
   a. Provide beveled washers under bolt heads or nuts resting surfaces exceeding five percent slope with respect to head or nut.
8. Assembly of High-Strength Structural Bolted Joints:
   a. Meet requirements of AISC 348.
   b. Seismic-Load Resisting System joints shall be slip-critical (friction-type) as defined in AISC 348 with Class A or better faying surfaces.
   c. Provide hardened washers under provided under the element turned in tightening procedure of high strength bolts.
   d. Direct tension indicator washers, where used, shall be provided under head of slip-critical high strength bolts.

D. Welded Construction: (shop and field)
1. Weld in accordance with AISC 360, AWS D1.1, and CBC Chapter 22.
2. Welding shall be performed in accordance with the WPS for the joint.
3. Welds that will be permanently exposed to view shall have burrs, flux, welding oxide air spots, and discolorations removed.
   a. Surfaces of such welds shall be reasonably smooth and uniform.
4. Exterior welds shall be watertight.
5. Each welder working on Project shall be assigned identification symbol or mark.
   a. Each welder shall mark or stamp this identification symbol at each weld completed.
   b. Stamps, if used, shall be low-stress type.
6. Before testing, welds to be subjected to ultrasonic testing (UT) shall be given visible mark, “for UT,” accurately placed on steel at distance of 4 inches away from root of edge preparation.
7. Groove welds shall be complete-joint-penetration welds, unless specifically designated otherwise.
8. WPSs shall be available to welders and inspectors prior to and during welding process.
   a. Prior to welding, joint fit-up shall be verified by welder for conformance with WPS and AWS D1.1.

E. Supplemental Welding Requirements:
1. Maximum Preheat and Interpass Temperature:
   a. Maximum preheat and maximum interpass temperature permitted is 550 degrees F, measured at distance of 1 inch from point of arc initiation.
   b. This maximum temperature may not be increased by WPS, regardless of qualification testing.
2. Nonfusible Backing:
   a. Use of nonfusible backing materials, including ceramic and copper, is permitted only with satisfactory welder qualification testing performed using type of backing proposed for use and using test plate shown in AWS D1.1, Figure 4.21, except that groove dimensions shall be as provided in WPS and PQR.
b. For nonfusible weld tabs and short segments of nonfusible backing bars used at ends of welds between shear plates and column faces, or at ends of continuity plate welds, special welding personnel and welding procedure qualification testing is not required.

3. Peening, Controlled Cooling, and Post-Weld Heat Treatment (PWHT):
   a. Where peening, controlled cooling, or PWHT are used, they shall be performed in accordance with AWS D1.1 and written procedure for their performance shall be incorporated into appropriate WPS.

4. Where insulating blankets are used to control cooling, written procedure and temperature measurements are not required.

5. Application of heat immediately following completion of joint to maintain nominal temperature at or below 550 degrees F is not considered PWHT.

6. Intermix of Filler Metals:
   a. For Demand-Critical Welds in which different weld filler metals are used, supplemental toughness testing shall be conducted as prescribed in FEMA 353, Part I, Appendix C.

7. Wind Velocity Limits:
   a. In Seismic-Load-Resisting-System, in lieu of wind speed limitations in AWS D1.1, welds using GMAW, FCAW-G, GTAW and EGW methods shall not be performed when wind velocity in immediate vicinity of weld exceeds three miles per hour.
   b. Welding performed within enclosed area, and not subject to drafts may be deemed to satisfy this requirement.
   c. For SMAW, FCAW-S, and SAW processes wind shall not affect appearance of molten weld puddle.

8. Welded joints of Seismic-Load-Resisting-System shall conform to AWS D1.8, Section 6.

F. Welded Joint Details:
   1. Backing bars: Use of backing bars shall be in accordance with AWS D1.1.
   2. Backing bars shall be removed where required by Contract Documents or AWS D1.1.
      a. Heavy Section Splices Requiring Removal of Backing Bars:
         1) Welded splices of Heavy Sections, shall have backing bars removed.
         2) Where fusible backing material is used, root pass area shall be backgouged after backing bar removal, and backwelded until flush or with slight reinforcement.
         3) Surface shall then be ground Extra Smooth.
      b. Beam-Column Connection Joints Requiring Removal of Backing Bars:
         1) Following removal of backing, remove un-sound weld metal at root area and excessive weld discontinuities, and backweld.
         2) Minimize gouging and removal of base metal.
         3) Reinforcing fillet weld with minimum leg size of 5/16 inch or root opening plus 1/16 inch, whichever is larger, shall be provided.
         4) Perform MT on fillet weld and immediately adjacent area.
      c. When groove weld backing is permitted to remain, backing shall not exceed 3/8 inch thickness.
         1) For connections of seismic-load-resisting system in which backing is not removed, backing shall be attached to member or plate that does not have its surface prepared for groove weld.
         2) Attachment shall be by either 1/4 inch fillet or 1/8 inch groove weld along complete bar length on side of the bar opposite groove weld.
3. Weld dams are not allowed.

4. Weld Tabs:
   a. Use of Weld Tabs:
      1) Welds shall be terminated at end of joint in manner that will ensure sound welds.
         a) Whenever necessary, this shall be done by use of weld tabs.
      2) Weld tabs shall extend beyond edge of joint distance equal to minimum of part thickness, but not less than 1 inch.
      3) Weld tabs shall be oriented parallel to joint preparation and to weld direction.
      4) Nonfusible weld tabs may be used in applications and locations where qualified in accordance with AWS D1.1, Section 4.
   b. Welded tension splices in Heavy Sections, shall have weld tabs removed and ground Extra Smooth.

5. Heavy Section Joint Weld Tab Removal and Finish:
   a) Welded tension splices in Heavy Sections, shall have weld tabs removed and ground Extra Smooth.

6. SLRS Beam-Column Connection Weld Tab Removal and Finish:
   a) Weld tabs of SLRS connections shall be removed.
   b) Removal may be performed by air carbon arc cutting (CAC-A), grinding, chipping, or thermal cutting to within 1/8 inch of base metal surface.
   c) For continuity plate weld tabs, removal within 1 inch of plate edge is adequate.
   d) Process shall be controlled to minimize removal of base metal except for that material immediately adjacent to weld.
   e) Edges where weld tabs have been removed shall be finished Extra Smooth.
   f) In SLRS connections, gouges deeper than 1/16 inch at locations of removal of weld tabs shall be repaired by welding according to specified requirements for Deep Gouges.
   g) Weld filler metal requirements for Demand-Critical Welds apply.
   h) Contour of weld at ends shall provide smooth transition, free of gouges and sharp corners.
   i) Minimum radius at corner need not be provided.
   j) Following weld tab removal, finishing, and completion of necessary repairs, exposed ends of weld shall be inspected using magnetic particle testing (MT).

5. Weld Toes:
   a. Weld toes, whether for groove welds or fillet welds, shall provide smooth transition between the weld and base metal.
   b. As-welded profile is adequate provided it satisfies criteria of AWS D1.1, Section 5.24.

6. Weld Access Holes:
   a. Weld access holes shall meet dimensional, surface finish, and testing requirements of AISC 360 Chapter J1.6 and AWS D1.1, except as otherwise required by Contract Documents.
   b. Where height of weld access hole exceeds quantity k-tf+1-1/2 inch, or where length of weld access hole exceeds 4 tf (where k and tf are defined in AISC 360), welded reinforcement is required.
      1) Notify Architect for specific instruction.
   c. At welded flange joints that are part of Seismic Load Resisting System, weld access hole detail shown in Figure 6.2 of AWS D1.8 shall be used unless section is Heavy Section.
d. SLRS access hole shall conform to AWS D1.8, Section 6.9.2.
e. SLRS weld access holes shall be inspected using magnetic particle
testing (MT) or liquid penetrant testing (PT) and shall be free of cracks.
   1) When welded gouge repair has been performed, magnetic particle
testing (MT) shall be performed.
7. Web Weld Details: Minimum clear distance of 1/2 inch shall be provided
between weld access hole and fillet welds connecting shear plate and beam
web.
8. Welding for Moment Connection of Bottom Beam Flange shall be sequenced
so as to minimize residual stresses in joint
9. Weave Passes: Weave passes are not permitted in groove welds in SLRS
Column continuity plate details:
a. Column Continuity Plate Details:
   1) When backing bars are used and remain in place, they shall receive
      reinforcing fillet weld between backing bar and column flange.
   2) No fillet weld should be placed between backing bar and continuity
      plate.
   3) Weld terminations near end of column flange tips may be
      completed using weld tabs.
      a) Weld tabs shall be removed.
      b) Conform to AWS D1.8 Sections 6.10.3 and 6.10.4.
      c) Following finishing, edge shall be inspected using MT.
      d) Fillet weld terminations between continuity plate and column
         web shall be approximately 1/4 inch from each end of joint.
10. Tack Welds in SLRS Protected Zones:
a. Tack welds in SLRS Protected Zones are permitted only where they are
    incorporated into required weld.

G. Heavy Sections:
1. Refer to AISC 360 Chapter A3.1c for materials requirements.
2. Applicability of Provisions: Requirements of AISC 360 for Group 4 and 5
   shapes shall apply to Heavy Sections as defined in this Section.
3. Access Hole Requirements:
a. Access holes shall conform to requirements of AISC 360, Chapter J1.6.
b. Weld access holes must be preheated to minimum of 150 degrees F prior
to thermal cutting and ground to Extra Smooth finish.
c. Inspect holes for cracks using either penetrant testing (PT) or magnetic
   particle testing (MT).
d. Optionally, weld access holes may be made by drilling and saw-cutting
   without grinding, but PT or MT of cut surface is still required.
4. Welding:
a. Minimum preheat and interpass temperature shall be as specified in
   AISC 360, Chapter J2.
b. Weld tabs and backing bars shall be removed, ground to Extra Smooth
   finish, with reinforcement not to exceed 1/8 inch at transition slope not to
   exceed 1:10.
c. Refer to AISC 360 J2 for preheat requirements and J1.5 for weld tab and
   backing bar removal requirements.
5. Splices shall conform to requirements of AISC 360, Chapter J1.5

H. Camber: Provide camber as indicated on Contract Drawings in accordance with
AISC 360 Chapter M2.1.
I. Welded Connectors: Install in accordance with AWS D1.1 and manufacturer’s recommendations.
   1. There shall be no porosity or evidence of lack of fusion between end of stud and steel member.

J. Repair of Discontinuities in Protected Zone of Seismic-Load-Resisting System.
   1. Tack Welds: Tack welds are permitted only if they are incorporated into required weld.
   2. Repair of Discontinuities: When erection aids within Protected Zone cannot be avoided, Structural Engineer’s approval of aid’s placement, use, and repair method is required.
      a. Conform to AWS D1.8 Section 6.15.4.

3. Air Carbon Arc Cutting and Thermal Cutting:
   a. Air carbon arc cutting (CAC-A) and thermal cutting is permitted in Protected Zone with prior approval of Structural Engineer for removal of backing bars and weld tabs, as specified.

4. Gouges in members and connections in Seismic-Load-Resisting System shall be repaired according to requirements of this Section.
   a. Weld filler metal requirements for Seismic-Load-Resisting System apply, unless otherwise noted.

K. Surface Finish
   1. Flush Surfaces:
      a. Welds in butt joints required to be flush shall be finished so as to not reduce thickness of thinner base metal or weld metal by more than 1/16 inch, or 5 percent of material thickness, whichever is less.
      b. Remaining reinforcement shall not exceed 1/32 inch in height.
         1) However, reinforcement shall be removed where weld forms part of faying or contact surface.
         2) Reinforcement shall blend smoothly into plate surfaces with transition areas free from undercut.

   2. Finish Methods and Values:
      a. Chipping and gouging may be used, provided these methods are followed by grinding.
      b. Where surface finishing is required, surface shall be Extra Smooth, unless otherwise noted or specified in this Section.
      c. Measurement of surface finish values by visual appearance or tactile comparison is acceptable.

L. Repair of Gouges: Gouges are not permitted in areas requiring Extra Smooth finish surface, or where specifically prohibited by AWS D1.1 or this Section.
   1. Repair of gouges shall meet following requirements, unless otherwise noted:
      a. Shallow Gouges: Gouges up to 3/16 inch deep shall be removed by grinding as per D1.1, or to a radius of not less than 3/8 inch.
      b. Deep Gouges: Gouges deeper than 3/16 inch shall be repaired by welding.
         a. Prior to welding, gouges shall be ground to provide Extra Smooth contour with radius not less than 3/8 inch.
         b. Repair area shall be preheated to temperature between 400 degrees F and 550 degrees F, measured at point of welding approximately one minute after removal of heating source, or shall be preheated in accordance with AWS D1.1 Annex XI for high restraint.
            1) Written repair WPS for application shall be followed.
2) Following completion of welding, the area shall be ground Extra Smooth, with fairing of the welded surface to adjoining surfaces where applicable, and shall be inspected using magnetic particle testing (MT).

3. The transitional slope after gouge removal shall not exceed 1:5.

M. Weld Acceptance Criteria shall be in accordance with AWS D1.1.
1. Regions of welds that cannot be inspected shall be identified and recorded, and Structural Engineer shall be notified.

2.04 SHOP FINISHES

A. Galvanizing: Provide hot dip galvanize coating in accordance with ASTM A 153 for exterior bolts, fasteners, and hardware as indicated on Drawings.
1. Perform galvanizing after fabrication, including but not limited to, shearing, punching, bending, forming, assembling, and welding in largest units practicable.
2. Remove projections, barbs, and icicles after galvanizing.
3. Repair abraded galvanized surfaces not indicated to be painted as specified in "Execution"
4. Do not galvanize items specified to receive specified shop primer.

B. Shop Prime Painting:
1. Shop paint structural steel, except those members or portions of members to be embedded in concrete or mortar, or indicated to be galvanized.
2. Paint embedded steel which is partially exposed on exposed portions and initial 2 inches of embedded areas only.
   a. Do not paint surfaces which are to be welded
   b. Do not paint galvanized surfaces.
3. Preparation: Clean surfaces of mill scale, grease, dirt and foreign matter by sandblasting or wire brushing with power tool.
   a. Prepare surfaces according to SSPC-SP 2 as minimum.
   b. Prepare surface specified to receive zinc-rich primer according to SSPC-SP 6.
4. Contact Surfaces: Clean immediately prior to assembly and leave unpainted.
   a. Heavily coat machine finished surfaces with tallow or other similar removable viscous coating to prevent corrosion.
5. Priming: Apply one coat primer, minimum 3.0 mils dry film thickness.
   a. Prime steel parts not in contact but inaccessible for priming after erection with two coats of primer, minimum total of 6.0 mils dry film thickness.
   b. Primer shall be thoroughly worked into joints, angles and open spaces.
6. Touch-up of Shop Coat: Clean abraded, burned, and otherwise damaged spots and exposed bolts in accordance with SSPC-SP 2 or SP 3 and apply one coat of specified primer.
7. Rusting: Shop prime coat showing evidence of rusting over 25 percent of surface after erection shall be removed and replaced.

PART 3 – EXECUTION

3.01 INSPECTION

A. Examine units of Work to be placed and verify that anchor rods have been installed properly and have sufficient bolt and thread elevation.
B. Do not begin erection before unsatisfactory conditions have been corrected.

3.02 ERECTION

A. General Requirements:
   1. Erect structural steel in accordance with AISC 360 Chapter M, AISC 303, and AWS D1.1 Structural Steel Welding Code as applicable to Statically Loaded Structures.
   2. Requirements for bolted and welded joints specified in Part 2 of this Section shall also apply to field connections unless otherwise noted.
   3. Erection Tolerances:
      a. Do not exceed erection tolerances specified in AISC 303, Section 7.
      b. Where more restrictive tolerances are necessary to properly install other building systems and components then adopt more restrictive tolerances.
   4. Where erection requires performing work of fabrication on Project Site, conform to applicable standards for fabrication.

B. Field Cutting or Alteration:
   1. There shall be no field cutting, alteration, or repair of structural steel members or of connections without prior review and approval by Structural Engineer.
   2. Structural elements with fabrication errors or that do not satisfy tolerance limits shall be repaired.
      a. Submit drawings showing reasons for, and details of, proposed corrective work.

C. Anchor rods shall be set in conformance with Section 7.5 of AISC 303.

D. Temporary Shoring and Bracing:
   1. Provide shoring and bracing as needed until permanent lateral-support is in place and complete.
   2. Contractor is responsible for identifying need for temporary shoring and bracing.

E. Erection Procedures:
   1. Control erection procedures and sequences to avoid problems caused by temperature differentials and weld shrinkage, and other sources of expansion and contraction.

F. Field Assembly:
   1. Clean bearing surfaces and surfaces to be in permanent contact before assembling members.
   2. Do not fasten splices of columns and other members with bearing joints designated on Drawings before abutting surfaces have been brought completely into contact.
   3. Bolted Construction:
      a. Installation of high-strength bolts shall conform to ASTM A325 for slip-critical or snug-tightened type joints, as applicable, in accordance with AISC 348.
         1) Provide washer under head or nut of high strength bolts.
         2) Washer shall be provided under element being turned during tightening.
         3) Bolts in welded connections shall be tensioned after completion of welding.
b. At bolted joints designated as Slip-Critical or that require Pretension, use Twist-off-Type Tension-Control bolt assemblies or Direct Tension Indicators.

c. Do not use flame cutting to align bolt holes except as permitted by AISC 348 specifications.
   1) Ream holes that must be enlarged to admit bolts.
   2) Do not enlarge holes to diameter greater than 1 inch.
   3) When reaming beyond 1/32 inch, drill or ream to next larger hole size and use next larger size bolt.

4. Mill scale shall be removed from column in area where beam flanges will be welded to column.

G. Gas Cutting:
   1. Use of flame cutting torch will be permitted only with Architect or Structural Engineer prior written approval and only where metal cut will not carry stress during cutting, and cut surfaces will not be visible.
   2. When thermal cutting is permitted, cutting shall be done with mechanically guided torch or torch controlled using guide bar.

H. Field Touch-Up Painting:
   1. After erection, touch-up paint field connections and abrasions resulting from Work of this Section, with same paint used for shop prime painting.

I. Remove and repair galvanized surface as required for field welding in accordance with ASTM-A780, A2; required thickness is 100 micro-inches.
   1. Touch up with specified zinc-rich coating.
   2. Repair material shall extend at least three inches beyond edges of damaged areas.

J. Protected Zone: Attachments to structural steel in Protected Zone, other than spot welding of metal deck to beams and welding of metal studs to braces as shown on Structural Drawings, are not allowed.

3.03 CLEANING

A. After erection, thoroughly clean surfaces of foreign or deleterious matter such as dirt, mud, oil, or grease that would impair bonding of fireproofing, concrete, or other finishes as applicable.

3.04 FIELD QUALITY CONTROL

A. Owner’s Testing Agency shall:
   1. Verify proper anchor rod group location, elevation, and orientation prior to placement of concrete foundations.
   2. Verify proper anchor rod group location, elevation, and orientation subsequent to placement of concrete foundations prior to arrival of structural steel.
   3. Perform field welding inspection and testing in accordance with requirements in Part 2 of this Section for shop fabrication, unless otherwise noted.
   4. Inspect and test high strength bolted joints in accordance with AISC 348.
   5. Sample and test bolt assemblies that include direct tension indicators, on daily basis to verify proper indication of deformation with required bolt tension for each size and lot.
6. Inspect erected structural steel as required to establish conformity of Work with reviewed shop drawings and Contract Drawings.
7. Perform testing and inspection of welded stud connectors in accordance with requirements of AWS D1.1.
   a. After bend test, weld section shall not exhibit tearing or cracking.
8. Inspect structural steel to verify that Protected Zones of members of Seismic-Load-Resisting System are free of damage and attachments not approved by Structural Engineer.
9. Forward copies of test and inspection reports to Owner, Architect, Structural Engineer, Contractor, and DSA.

END OF SECTION 05 1200
SECTION 05 1250
BUCKLING RESTRAINED BRACING

Part 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Furnishing Buckling Restrained Braces (BRB's).
   2. Engineering design of BRB's to meet specified strength and deformation Requirements.
   3. Qualification of BRB's by uniaxial and sub-assemblage cyclic testing.

B. Related Sections:
   1. Section 05 1200: Structural Steel Framing

1.02 REFERENCES

A. American Institute of Steel Construction (AISC):
   1. AISC 360 – Specifications for Structural Steel Buildings.
   2. AISC 303 – Code of Standard Practice for Steel Buildings and Bridges

B. ASTM International (ASTM):
   2. ASTM A 36 - Standard Specification for Carbon Structural Steel
   5. ASTM A 500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

C. American Welding Society (AWS):
   1. AWS D1.1 – Structural Welding Code - Steel
   2. AWS D1.8 – Structural Welding Code – Seismic Supplement

D. Japanese Industrial Standard (JIS):
   1. JIS G 3136, Grade SN400 B – Rolled Steel for Building Structure
   2. JIS G 3466, Grade STKR 400 – Carbon Steel Square and Rectangular Tubes for General Structure.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer shall have manufactured and successfully tested BRBs, and meet project requirements prior to opening of bids.
   1. It is sole responsibility of manufacturer to prove they meet requirements as set forth.
2. Structural Engineer will conduct final review for manufacturer’s conformance to these specifications.
3. Non conformance as determined by Structural Engineer will be cause for rejection.

B. Design Engineer Qualifications: Structural Engineer, registered in State of California that is knowledgeable with results of cyclic testing of BRB’s and requirements of this specification and experienced in design of BRB’s based on engineering analysis shall approve and stamp shop drawings.

C. Quality Assurance Plan: Manufacturer shall have detailed Quality Assurance Plan to ensure BRB’s being manufactured are identical to those tested.
   1. Plan shall include following:
      a. Indicate how product is to be identified so it can be traced back to production quality assurance records.
      b. Include flow chart of process by which product is manufactured, including hold points for QA inspections.
      c. List test for materials, including applicable recognized standard for each test and qualifications of testing agency or personnel.
      d. Identify manufacturing tolerances for each process.
      e. Include internal inspections and in-process quality control, including forms and checklists used to document inspections, hold points, qualifications of personnel performing inspections, and how inspections are reviewed and approved.
      f. Identify quality assurance tolerances and handling for erection of braces.

D. Qualifying Cyclic Testing: Per AISC 341, Section K3 for brace and sub-assemblage connection.
   1. It is anticipated that range of test specimens have already been successfully completed and documented by manufacturer.
   2. Project-specific testing is not required for this project, assuming prototype (production) braces meet criterion listed by AISC 341, Section K3.3c – “Similarity of Brace Test Specimen and Prototype”.

E. Extrapolation of Cyclic Qualification Testing: Deviations from materials, details of fabrication, and quality assurance controls used for fabrication of tested prototype braces shall be identified by manufacturer and reviewed by manufacturer’s design engineer to ensure that prototype (production) braces meet or exceed level of quality used in fabrication of test specimen braces.
   1. Include following items:
      a. Weld filler material, including CVN toughness.
      b. Welding procedures and details, including weld terminations.
      c. Shape and finish of plate edges at transitions.
      d. Finish of plate edges, including roughness and treatment of occasional notches.
      e. Tolerances for flatness and straightness of plates.
      f. Details of isolation between plates and core at transitions, to accommodate lengthening and shortening.
      g. Type and thickness of coating materials.

F. Pre-Erection Conference: Schedule Project conference to review Structural Documents and to review installation of BRB’s.
   1. Procedures for handling, fit-up, fastening, and corrections shall be established.
2. Pertinent parties shall attend, including Contractor, Owner’s Representatives, Project Inspector, BRB Manufacturer, Architect, and Structural Engineer.

3. Meeting minutes shall be prepared and published by Construction Manager.

G. Site Visits: BRB manufacturer shall perform at least one site visit to observe installation of BRB’s and provide written report of observations within five days of site visits.

1.04 SUBMITTALS

A. Cyclic Tests for Qualification of BRB evidencing manufacturer's compliance AISC 341, Section K3.
   1. Additional testing to comply with AISC 341, Section K3 shall be responsibility of manufacturer at no additional cost to Owner.

B. Manufacturer’s Quality Assurance Plan: Conform to requirements of Quality Assurance Article.
   1. Authorized representative of manufacturer shall certify validity of Plan by signing and dating.
   2. Plan must be approved before fabrication can commence.
      a. Allow 30 days for review and approval.

C. Engineering Design Drawings: Refer to Design and Performance Requirements Article for design requirements.
   1. Steel Core Drawings: Show size and configuration of steel core for full length of BRB.
      a. Indicate casing size, thickness and length.
   2. BRB System and Configurations: Construction document drawings shall be used for seismic demands required on braces and sizes for connection to concrete frame, except as noted.
   3. Certification: In accordance with Design and Performance Requirements.
   4. Preliminary Design: At Contractor’s option, make initial submittal of items listed above, based on assumed material properties, prior to delivery of materials to be employed in Work.
   5. Final Design: Final drawings, calculations and certifications that include final dimensions of steel core plates based on results of coupon testing of steel to be employed in Work.
      a. Manufacturer’s Design Engineer shall seal final design drawings, calculations and required certification.
      b. Submittal shall be accompanied by results of coupon testing.

D. Erection Drawings:
   1. Show location and size and of BRB’s.
   2. Give complete information necessary for fabrication of elements of structure to receive braces and fabrication of connection plates.
   3. Show methods of assembly, including type and size of bolts, hole diameter, and preparation and finish of faying surfaces.
   4. Identify tolerances for fabrication and erection.

F. Certified Material Test Reports: To Testing Laboratory for record purposes.
   1. Steel: Tensile tests and chemical analysis.
      a. Include trace elements for steel core plates.
2. Steel Core Plates:
   a. Coupon test results for each lot of steel used in fabrication showing initial yield, ultimate tensile stress, and ultimate elongation.
   b. Charpy V-Notch (CVN) testing for plates 2 inches and thicker.
3. Welding Electrodes: Include tensile, elongation, and CVN toughness tests.
   a. Identify diffusible hydrogen.

G. Quality Assurance Test and Inspection Reports: To Testing Laboratory for record purposes prior to shipping of braces.

1.05 DEFINITIONS

A. Buckling Restrained Brace (BRB): Specialty structural brace element consisting axial force resisting steel core encased by system that prevents buckling of steel core.

B. Prototype: Per Glossary of AISC 341, BRB to be installed in building structure.
   1. May also be referred to in this specification as "production brace" or "building brace"

C. Design Story Drift: Per Glossary of AISC 341, design story drift \( c_d \delta_{se} \) includes effect of expected inelastic action due to design level earthquake forces.
   1. Refer to ASCE 7-10 equation (12.12-1); \( I_e = 1.5 \).

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer’s which have successfully completed qualification testing of braces meeting requirements for Project, will be considered acceptable manufacturers, subject to compliance verification with Contract Documents, including limitations on maximum brace dimensions and strains.
   1. Following manufacturers have reported to have passed certain performance criteria in accordance with Design and Performance Requirements Article.
      a. Nippon Steel Corporation; Tokyo, Japan.
      b. STAR Seismic; Park City, UT.
      c. Core-Brace, LLC; West Jordan, UT.
   2. This does not indicate these manufacturers have met requirements of this Project.
   3. It is sole responsibility of manufacturer to prove they meet requirements as set forth.
   4. Structural Engineer will conduct final review of brace provided by manufacturer for conformance to specifications.

2.02 MATERIALS

A. Steel Core Areas: ASTM A 36 or JIS G 3136 SN400 B; except initial yield stress shall be within tolerances shown on Contract Documents, as evidenced by coupon testing of plates to be incorporated in Work.
   1. Plates 2 inches and thicker shall be supplied with Charpy V-Notch testing in accordance with ASTM A 6 Supplementary Requirement S5, or approved equal.
2. Impact test shall meet minimum average value of 20 ft-lbs absorbed energy at Plus 70 degrees F and shall be conducted in accordance with AISC Specification, or approved equal.

B. Casing: ASTM A 500 or JIS G3466 STKR 400.

C. Welding Filler Material: Meet or exceed CVN toughness and elongation of material used for fabrication of tested assemblies.
   1. H16 (diffusible hydrogen), AWS A4.3.

D. Shop Primer: Manufacturer’s standard zinc-rich rust preventative primer; containing less than 0.002 percent lead.
   1. Where faying surfaces of slip-critical bolted connections are painted, primer shall meet requirements of RCSC (Research Council on Structural Connections) for Class A coating.
   2. Refer to Section 09 9600 for compatibility of shop primer with specified finish coatings.

E. Debonding Agent: Manufacturer’s standard; demonstrated suitable to maintain separation of steel core and grout encasement when subjected to minimum of 30 cycles of inelastic yielding at 2.0 percent strain.
   1. Resistant to aging effects for life cycle of 50 years.
   2. Provide manufacturer’s certificate of compliance.

F. Fill Material: Manufacturer’s standard cementitious grout
   1. Demonstrated suitable for function as confining in-fill material by sub-assemblage qualification testing.

2.03 FABRICATION

A. Fabricate steel in accordance with Section 05 1200.
   1. Cut core plates to profile shown on Design Drawings.
      a. Conform to tolerances of Quality Assurance Manual, except tolerance on plate width shall not exceed plus or minus 0.2 inches.
   2. Splices in steel core are not acceptable.
   3. Roughness: After cutting, edges of core plates shall have roughness less than 1000 micro-inches.
   4. Gouges and Notches: Occasional gouges and notches less than 0.2 inches deep in edges of core plates may be repaired by grinding to smooth transition.
      a. Length of transition shall be minimum of 10 times depth of gouge.
      b. Area shall be inspected by Magnetic Particle Testing (MT) after grinding to ensure entire depth of gouge has been removed.
      c. Deeper gouges shall be cause for rejection of piece.

B. Maximum dimensions of casing of buckling restrained brace shall be as indicated.

C. Bolted Connections: Holes for bolted connections shall be drilled and burrs removed.
   1. Bolted connections shall be slip critical.

D. Holes for connections shall be drilled or machined 1/32 inch larger than bolt diameter.
E. Welding: Continuously weld joints, using procedures intended to minimize distortion.
   1. Where cruciform plates are terminated in core, pay particular attention to
detailing and finishing of weld termination; meet or exceed qualification tested
assembly as minimum standard.

F. Assembly: Assemble components of the Buckling Restrained Brace in a manner to
ensure proper performance of brace.
   1. Examine steel core areas for straightness prior to coating with de-bonding
agent.
   2. Provide end-confining plates to ensure confinement of fill material while
allowing for non-restricting movement of steel core.

G. Prepare and shop prime unprotected metal surfaces as follows:
   1. Commercial Blast (SSPC-3) clean as minimum surface preparation.
   2. Apply paint primer at minimum dry film thickness of 1 mil.
   3. Braces will receive spray-on fireproofing, similar to the existing condition.
      a. Metal surface and fireproofing shall be compatible.

2.04 SOURCE QUALITY CONTROL

A. Testing Laboratory will:
   1. Review Manufacturer's Quality Assurance Plan, mill certificates and results of
coupon testing.
   2. Review Manufacturer's quality assurance test and inspection reports.
   3. Observe fabrication and assembly as requested by Owner's Representative.

B. Contractor shall:
   1. Notify Owner's Representative no less than 30 days before start of fabrication
of buckling restrained braces, to allow Owner's Project Inspector and Special
Inspector to observe fabrication and assembly process.
   2. Perform testing and inspection in accordance with approved Quality Assurance
Plan and requirements of Contract Documents.

2.05 DESIGN AND PERFORMANCE REQUIREMENTS

A. Design Requirements:
   1. Confirmation that configuration of connection is within configuration dimensions
of connections noted, subject to acceptance of Architect and Structural
Engineer.
   2. List of five previous installations in United States using BRB's.
   3. Testing protocol for review by Structural Engineer to assess seismic
performance and characteristics of braces.
   4. Engage Structural or Civil Engineer, licensed in State of California, to design
braces to achieve specified Performance Criteria.
      a. Design shall be based on detailed examination and understanding of
results of qualifying cyclic tests and interpolation of results to project
conditions.
      b. End connections used in Project must be similar to those used in testing.
   5. Interpolation of test results for different member sizes shall be justified by
rational analysis that demonstrates stress distributions and magnitudes of
internal strains that are consistent with or less severe than tested assemblies
and that considers adverse effects of larger material and variations in material
properties.
6. Consider effect of imposed end rotations.

B. Performance Criteria:
1. Initial "BRB" yield force shall be as indicated to within plus 10 percent or minus 5 percent.
2. Braces shall provide for stable cyclic displacement (lengthening and shortening) corresponding to two percent of story height or two times design story drift, per AISC 341, Section F4.2, neglecting contributions to drift from elements beyond ends of braces.
   a. For this Project, two percent of story height criteria controls.
   b. Assume brace end rotations, equal to inter-story drift, occur in combination with lengthening and shortening.
      1) Hysteretic behavior in non-linear range shall show no sign of degradation or loss of strength.
      2) Graphs of test results shall show no signs of pinched hysteretic behavior.
3. Portion of steel core that projects beyond casing shall provide for stable cyclic loading at 160 percent of initial yield force of "BRB", or actual tensile strength of BRB (whichever is greater), without initiation of fracture.
4. Tension and compression shall be resisted entirely by steel core.
   a. Buckling restraining system shall prevent brace buckling and control plate buckling without restraining steel core from transverse expansion and longitudinal shortening for deformations corresponding to AISC 341, Section F4.2.
5. End connections and method of connecting used for Project must be same as used in testing.

C. Coupon Tests: Perform coupon test results for each lot of steel used in fabrication of steel core areas showing initial yield, ultimate tensile stress, and ultimate elongation.
1. Coupons shall be taken from plates at point of brace manufacture and shall be used as basis for brace design.

PART 3 – EXECUTION

3.01 ERECTION

A. Erection of braces is under Section 05 1200
   1. Erector shall use positive measures to prevent damage to BRB's.
   2. BRB shall only be repaired or have alterations performed by manufacturer.

B. Comply with erection sequence limitations defined by Structural Drawings.
   1. To avoid temporarily compromising existing lateral load resisting system provided by existing TS (tube steel) braces, do not remove more than one TS brace at a time in each structure.
      a. Complete BRB installation prior to removing next existing TS brace.
   2. BRB work occurs in two existing structures, which are separated by expansion joint where indicated.
   3. BRB work may proceed concurrently in each structure.

C. Prior to erection, clean faying surfaces of brace to be in contact with bolted connections to remove temporary coatings applied for transport and surface contaminants.
D. Buckling restrained braces shall not be field cut or altered.
   1. Alterations to structural steel components to receive BRB’s shall be as permitted by Section 05 1200.

E. After BRB installation is completed, no further field welding to BRB members is permitted, including attachment of nonstructural components.

F. Do not attach finishes and their supporting framing direct to BRB.
   1. Maintain minimum 2 inch wide gap between BRB and adjacent materials.

G. In event of damage to BRB, manufacturer shall be contacted and written procedure describing damage, proposed repair and when corrections will take place shall be submitted to Structural Engineer, manufacturer, Owner’s Project Inspector, and Owner’s Testing Agency.
   1. Repairs shall be performed in strict accordance with approved repair procedures.

END OF SECTION 05 1250
SECTION 05 3000
METAL DECKING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Metal decking as indicated.

B. Related Sections:
   1. Section 01 4500: Quality Control.
   2. Section 05 1200: Structural Steel Framing
   3. Section 07 5419: Polyvinyl Chloride Roofing; roofing and roof insulation
   4. Section 07 6200: Sheet Metal Flashing and Trim.

1.02 REFERENCES


B. ASTM International (ASTM):
   1. ASTM A 36 – Standard Specification for Carbon Structural Steel
   2. ASTM A 108 – Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
   3. ASTM A 653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
   5. ASTM D 746 – Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

C. American Welding Society (AWS):
   1. AWS D1.1 – Structural Welding Code-Steel
   2. AWS D1.3 – Structural Welding Code-Sheet Steel

D. American Iron and Steel Institute (AISI):
   1. AISI Specification for Design of Cold-Formed Steel Structural Members.

E. Steel Deck Institute (SDI):
   1. SDI Design Manual for Floor Decks and Roof Decks.


1.03 QUALITY ASSURANCE

A. General: Metal decking steel shall conform to requirements of strengths and properties of standards specified.
B. Testing: Perform testing and inspection in accordance with requirements specified in Section 05 1200.

C. Codes and Standards: Comply with provisions of referenced codes and standards.

D. Qualification of Field Welding: Qualify welding processes and welding operators in accordance with "Welder Qualification" procedures of AWS D1.1 and D1.3

E. Identification of metal decking steel shall conform to standards specified in Section 01 4500.
   1. Fabricator shall furnish sufficient evidence to Architect attesting compliance with specified requirements.
   2. Unclassified or unidentified decking is not permitted.
      a. Furnish deck manufacturer's certified mill analyses and test reports for each heat covering decking having $F_y$ of 33 Ksi or less.
      b. For decking having $F_y$ greater than 33 Ksi, testing laboratory shall perform one tension and elongation test and one bend or flattening test for each gage.

F. Unidentifiable Steel: Steel which is not readily identifiable as to grade from markings and test records is not permitted.

1.04 SUBMITTALS

A. Product Data: Manufacturer's specifications and installation instructions for each product specified.
   1. Include manufacturer's certification as may be required to show compliance with these specifications.
   2. Furnish ICC ES Reports for each metal deck type.

B. Shop Drawings: Detailed drawings showing layout and types of deck panels, anchorage details and every condition requiring closure panels, supplementary framing, special jointing or other accessories.
   1. Indicate manufacturer's name, metal gage, and deck section properties.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Epic Metals Corp

B. Verco Manufacturing Co.

C. ASC Profiles, Inc.

D. Members of Steel Deck Institute (SDI), or approved equal.

2.02 MATERIALS

A. Structural steel shall be domestically manufactured and fabricated in United States of America (USA).

B. Metal Decking: Roll-formed sheets conforming to ASTM A 653, with G90 zinc coating.
1. Section properties shall conform to applicable provisions of latest edition of AISI - Specification for the Design of Cold-Formed Steel Structural Members.

C. Miscellaneous Steel Shapes: Conforming to ASTM A 36 for steel shapes not covered in Section 05 1200.

D. Flexible Closure Strips for Deck: Vulcanized, closed-cell, expanded chloroprene elastomer, complying with ASTM D 1056, Grade SCE No. 41.

E. Sheet Metal Accessories: Sheet steel, minimum yield strength of 33,000 psi, not less than 0.0359 inch thickness, of same material and finish as deck, profile indicated or required for application.
   1. Furnish with ASTM A 653, G90 zinc coating.

F. Metal Closure Strips: Fabricate metal closure strips of galvanized sheet steel of same quality as deck units; not less than nominal 0.0359 inch (20 gage) thick before coating.
   1. Form to configuration required to provide tight-fitting closures at open ends and sides of decking.

G. Joint Sealing Material: Non-skinning, gun-grade, bulk compound as recommended by deck manufacturer.
   1. Comply with requirements of Section 07 9200.

H. Flexible Closure Strips: Manufacturer's standard vulcanized, closed-cell, synthetic rubber.

2.03 FABRICATION

A. Form deck units of sections designed to support required live load between supporting members
   1. Provide decking in lengths to span over three or more supports with flush, interlocking side laps, 2-1/2 inches minimum end bearing, and 1-1/2 inches minimum side bearing, unless otherwise indicated.

B. Roof Deck Units: Provide G90 galvanized non-vented deck configurations complying with SDI – Roof and Floor Deck Specifications, of metal thickness, depth and width as shown.

C. Welding: Provide materials and methods in accordance with recommendations of steel decking manufacturer.
   1. Hold decking tight to supporting elements with screws or other means for proper welding or crimping of decking edges.
   2. Conform to AWS D1.3, and to patterns and weld types indicated, with welds free from sharp edges and protrusions.
   3. Field coat welds and abraded surfaces at completion with anodic type galvanizing repair paint.

2.04 PERFORMANCE REQUIREMENTS:

A. Calculate properties of deck sections on basis of effective design width as limited by provisions of AISI specifications.
1. Provide deck section properties not less than those specified, including section modulus and moment of inertia per foot of width.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install metal deck units and accessories in accordance with manufacturer's recommendations, final shop drawings, and as specified.

B. Do not start placement of deck units before supporting members are installed.
   1. Place deck units on supporting steel framework and adjust to final position with ends accurately aligned and bearing on supporting members before being permanently fastened.
   2. Lap ends not less than what is specified in this Section.
   3. Do not stretch or contract side-lap interlocks.

C. Fastening Deck Units: Permanently fasten deck units to steel supporting members as noted on Structural Drawings.

D. Fasten side laps between supports as indicated on Drawings.

E. Cutting and Fitting: Cut and fit deck units and accessories around other work projecting through or adjacent to decking.
   1. Provide neat, square and trim cuts.

F. Closure Strips: Provide metal closure strips at open uncovered ends and edges of roof decking, and in voids between decking and other construction.
   1. Weld into position to provide complete decking installation.
   2. Provide flexible closure strips instead of metal closures, at Contractor's option, wherever their use will ensure complete closure.
      a. Install with adhesive in accordance with manufacturer's instructions.

G. Touch-Up Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint according to ASTM A 780.

3.02 CLEANING

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

3.03 FIELD QUALITY CONTROL

A. Install steel decking under continuous inspection according to 2013 CBC Chapter 22A.

3.04 PROTECTION

A. Protect Work until Substantial Completion.

END OF SECTION 05 3000
SECTION 05 5000

METAL FABRICATIONS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Section Includes:
   1. Miscellaneous metal fabrications as shown.
      a. Includes items fabricated from iron and steel shapes, plates, and bars
         which are not part of structural steel or other metal systems specified
         elsewhere.
      b. Miscellaneous sheet metal includes items custom-fabricated from metal
         sheets which are not specified in other sections of specifications.
   2. Work includes, but is not limited to:
      a. Anchor bolts, not specified elsewhere.
      b. Metal stairs.
      c. Steel railing and guardrails.
      d. Stainless steel tubing handrails.
      e. Ladders
      f. Backing and mounting plates for cabinets and equipment items.
      g. Miscellaneous framing and supports
      h. Miscellaneous steel trim
   3. Furnishing inserts and anchoring devices which must be set in concrete for
      installation of miscellaneous metal work.
      a. Provide setting drawings, templates, instructions, and directions for
         installation of anchorage devices.
      b. Coordinate delivery with other Work to avoid delay.

B. Related Sections:
   1. Section 03 3000: Cast-in-Place Concrete; reinforcing mesh and concrete
      fill for metal pan stairs.
   2. Section 05 1200: Structural Steel Framing
   3. Section 07 6200: Sheet Metal Flashing and Trim
   4. Section 09 9100: Painting: shop priming and field painting of interior and
      exterior exposed metal work not indicated to receive
      high performance coatings.
   4. Section 09 9600: High Performance Coatings; shop priming and field
      painting of exterior exposed metal work.

1.02 REFERENCES

   (CBC), Part 2, Volumes 1 and 2.

B. ASTM International (ASTM):
   1. ASTM A36 - Standard Specification for Carbon Structural Steel
   2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings
      on Iron and Steel Products
   3. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and
      Steel Hardware
4. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
5. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
6. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes
7. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength
8. ASTM A480 - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
9. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
10. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
11. ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

C. American Welding Society (AWS):
   1. AWS D1.1 – Structural Welding Code – Steel.
   2. AWS D1.3 – Structural Welding Code – Sheet Steel.
   3. AWS D1.8 – Structural Welding Code – Seismic Supplement

D. American Institute of Steel Construction (AISC):

E. American Iron and Steel Institute (AISI):
   1. AISI S100 – North American Specification for the Design of Cold-Formed Steel Structural Members.

F. American Galvanizers Association, Inc. (AGA):
   1. AGA - Inspection of Hot-Dip Galvanized Steel Products

G. The Society for Protective Coatings (SSPC):
   1. SSPC-SP 1 – Solvent Cleaning.
   2. SSPC-SP 2 – Hand Tool Cleaning.
   3. SSPC-SP 3 – Power Tool Cleaning.
   4. SSPC-SP 6 – Commercial Blast Cleaning.
   5. SSPC-SP 7 – Brush-Off Blast Cleaning.

1.03 QUALITY ASSURANCE

A. Design Criteria:
   1. Design Work to support normally imposed loads and conform to AISC and AISI requirements.

B. Standards:
   1. Conform to applicable provisions and performance referenced standards where indicated.
C. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, where possible.  
   1. Do not delay job progress; allow for trimming and fitting wherever taking field measurements before fabrication might delay Work.

D. Qualifications:  
   1. Fabricator Qualifications:  
      a. Successfully engaged for minimum of 5 years in manufacture of metal fabrications work, similar to that specified and indicated for this Project.  
      b. Fabricator qualifications are subject to Owner and Project Inspector's review and approval before subcontract is awarded.  
   2. Qualifications for Welding Work:  
      a. Qualify welding procedures and welding operators in compliance with AWS Qualification requirements of AWS D1.1.  
      b. Verify that welders to be employed in Work have satisfactorily passed AWS qualification tests.  
      c. When recertification of welders is required, retesting will be Contractor's responsibility.

E. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly.  
   1. Disassemble units only as necessary for shipping and handling limitations.  
   2. Clearly mark units for reassembly and coordinated installation.

F. Mockups:  
   1. Erect at Project Site, unless otherwise acceptable to Owner.  
      a. Mockup railings for Architect and Owner review and acceptance.  
   2. Construct mockup complete with accessories and features required for final assembly on building.  
   3. Mockup sizes and features will be selected by Architect and Owner, and will be not less than 18 inches long.  
   4. Make modifications as necessary to achieve mockup satisfactory to Architect and Owner, or remove and construct additional mockups as required.  
   5. Accepted mockup will serve as standard of quality for Work on building.  
   6. Remove mockup only after completion and acceptance of final Work unless incorporation into Work is authorized by Owner.  
   7. Protect mockup until its removal.

1.04 SUBMITTALS  

A. Product Data: Manufacturer's specifications, anchor details, and installation instructions for products to be used in fabrication of miscellaneous metal, including paint products.  
   1. Product data for specified shop primer system:  
      a. Material List: Provide inclusive list of required coating materials  
         1) Identify material by manufacturer's catalog number and general classification.  
      b. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying coating material proposed for use.
B. Shop Drawings: For fabrication and erection of miscellaneous metal assemblies.
   1. Include plans and elevations at not less than 1/2 inch to 1 foot scale.
   2. Show large scale construction of various parts, methods of joining, thickness of metals, profiles of surfaces, reinforcing, anchorage, and structural supports.
      a. Include information regarding concealed and exposed joints, welds, and fastenings.
      b. Include drawing showing locations of backing and mounting plates.
      c. Include details of sections and connections at not less than 3 inch to 1 foot scale.
      d. Show anchorage and accessory items.
      e. Provide templates for anchor and bolt installation by others.

C. Samples: As requested by Architect.

1.05 PROJECT CONDITIONS

A. Scheduling and Sequencing:
   1. Ensure timely fabrication of items to be embedded or enclosed by other work.
   2. Furnish information and assistance required for locating embedded items and be responsible for proper locations.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle packaged materials in original containers with seals unbroken and labels intact until time of use.

B. Discharge materials carefully and store on clean concrete surface or raised platform in safe, dry area.

PART 2 – PRODUCTS

2.01 MATERIALS AND COMPONENTS

A. Metal Surfaces – General:
   1. For fabrication of miscellaneous metal work which will be exposed to view, only use materials which are smooth and free of surface blemishes
      a. Including pitting, seam marks, roller marks, oil-canning, stains, discolorations and other imperfections, rolled trade names and roughness.

B. Steel Plates, Shapes and Bars: ASTM A 36.

C. Steel Sheets: ASTM A 1011, Grade C.

D. Steel Tubing: Hot-formed, welded or seamless, ASTM A 501 or cold-formed, ASTM A 500.

E. Structural Steel Sheet: Hot-rolled, ASTM A 570; or cold-rolled ASTM A 611, Class 1; of grade required for design loading.

F. Steel Plates:
   1. For cold forming or bending: ASTM A 283, Grade C.
G. Stainless steel, conforming to following:
   1. Type 304
      a. 11 gage, unless otherwise indicated.

H. Welding Electrodes and Filler Metal:
   1. Stainless Steel: Tungsten inert gas (TIG), using rods made from alloyed
      Type 308 stainless steel, as required for color match, strength and compatibility
      in fabricated items.
   2. Carbon Steel: Use electrodes recommended by AWS.

I. Fasteners:
   1. Use fasteners made of same basic metal as fastened metal, unless otherwise
      indicated.
      a. Do not use metals which are corrosive or incompatible with materials
         joined.
      b. Do not use exposed fasteners except where unavoidable.
         1) Match finish of metal surrounding fastener.
   2. Provide Phillips flat-head machine screws for exposed fasteners, unless
      otherwise indicated.
   3. Provide zinc-coated fasteners for exterior use or where built into exterior
      walls, unless otherwise indicated.
   4. Select fasteners for type, grade and class required.
   5. Steel Bolts and Nuts: Regular hexagon head type, ASTM A 307, Grade A; with
      hex nuts.
   6. Lag Bolts: Square head type, ASME B 18.2.1 Machine Screws: Cadmium
      plated steel, ASME B 18.6.3
   7. Wood Screws: Flat head carbon steel, ASME B 18.6.1
   10. Expansion Bolts:
       a. Concrete Anchorage: Hilti Kwik Bolt TZ; ICC ESR-1917
       b. Masonry Anchorage: Hilti Kwik Botl 3; ICC ESR-1385

J. Anchors and Inserts:
   1. Furnish inserts for setting in concrete and provide other anchoring devices as
      required for installation of fabricated metal items.

K. Nonshrink Nonmetallic Grout: Factory premixed, nonstaining, noncorrosive,
   nongaseous grout complying with ASTM C 1107.
   1. Provide one of following or grout specifically recommended by manufacturer
      for types of applications indicated:
      a. Masterflow 713 Plus; BASF Building Systems
      b. Sealtight 588 Grout; W.R. Meadows
      c. Five Star Grout; Five Star Products, Inc.
      d. SikaGrout 212; Sika Corporation.

L. Shop Primer for Ferrous Metal: Carbozinc 859 VOC Organic Zinc-Rich Epoxy
   Primer by Carboline Company, Hydro-Zinc 94-H20 by Tnemec Company, or
   approved equal; VOC compliant.
1. Coordinate selection of primer with finish paint requirements in Section 09 9100 and 09 9600 as applicable.
   a. Primer and finish coat materials for exposed steel are required to be complete system by one manufacturer
2. Prime painting with specified shop primer is required of structural steel, exposed or concealed, except where indicated otherwise.

M. Galvanizing: Provide zinc coating for those items shown or specified to be galvanized, as follows:
1. ASTM A 123:
   a. For galvanizing rolled, pressed and forged steel shapes, plates, bars and strip 1/8 inch thick and heavier.
   b. For galvanizing assembled steel products.
   c. Perform galvanizing after fabrication with Work assembled in as large sections as can be handled.
2. ASTM A 153 for galvanizing iron and steel hardware.
3. Hot dip galvanize exterior metal work after fabrication unless otherwise indicated.
4. Remove projections, barbs, and icicles shall after galvanizing.
5. Do not galvanize exterior metal work specified to receive high performance coatings as specified in Section 09 9600.

N. Isolation Between Dissimilar Materials:
1. Provide single-component, inert-type non-corrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities; VOC compliant.
2. Elasto-Deck BT as manufactured by Pacific Polymers, div. ITW Polymers Sealants North America, or equivalent product acceptable to Architect.

O. Joint Sealant: Comply with requirements of Section 07 9200 and following.
1. Nonsag, nonstaining, silicone sealant complying with ASTM C 920; of type and grade required to seal joints in formed metal; as recommended in writing by formed metal manufacturer or fabricator.

2.02 FABRICATION – GENERAL

A. Fabricate items to comply with requirements indicated, including those for quality, thickness and finish of material as well as those indicating dimensions and details.
1. Use heavier metal gages, stiffeners or metal backing as required to produce surface flatness, free of "oil-canning", and to impart sufficient strength for use indicated.
2. When not otherwise indicated, provide following minimum thickness of metal and comply with SMACNA recommendations for fabrication and installation details:
   a. Sheet Steel: 16 gage.
   b. Galvanized Sheet Steel: 16 gage.
3. Work to dimensions shown or accepted on shop drawings, using proven details of fabrication and support.
4. Use type of materials shown or specified for various components of Work.

B. Use hot-rolled steel bars for work fabricated from bar stock, unless shown or specified to be fabricated from cold-finished or cold-rolled stock.
C. Supply as part of this Section, miscellaneous small parts of material thinner than 10 gage, or items specifically called out, when such supply is normal and accepted part of Work.

D. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
   1. Ease exposed edges to radius of approximately 1/32 inch, unless otherwise shown.

E. Form sheet metal items in maximum lengths and keep joints to minimum.
   1. Do not exposed cut edges of sheet metal except as indicated.
   2. Fold back exposed ends of unsupported sheet metal to form 1/2 inch wide hem on concealed side, or ease exposed edges with backing to radius of approximately 1/32 inch.
   3. Form items with flat, flush surfaces, true to line and level, and without cracking and grain separation at bends.

F. Continuously weld joints and seams except where other methods of joining are indicated.
   1. Grind welds smooth and flush on exposed surfaces.
   2. Comply with AWS and other metal authorities.
   3. Use filler metals and welding procedures which will blend with and match color of sheet metal being joined and will avoid discoloration at welds.

G. Provide type of anchorage shown.
   1. Coordinate with supporting structure.
   2. Fabricate and space anchoring devices as shown and as required to provide adequate support for intended use.

H. Cut, reinforce, drill and tap miscellaneous metal work as required to receive finish hardware and similar items.

I. Fabricate joints which will be exposed to weather in manner to exclude water or provide weep holes where water may accumulate.

J. Galvanizing: Provide zinc coating for those items shown or specified to be galvanized, as follows:
   1. ASTM A 123 for galvanizing rolled, pressed and forged steel shapes, plates, bars and strip 1/8 inch thick and heavier.
   2. ASTM A 386 for galvanizing assembled steel products.
      a. Perform galvanizing after fabrication with Work assembled in as large sections as can be handled.
   3. ASTM A 153 for galvanizing iron and steel hardware.
   4. Hot dip galvanize exterior metal work after fabrication unless otherwise indicated.
   5. Remove projections, barbs, and icicles shall after galvanizing.
   6. Do not galvanize exterior metal work specified to receive high performance coatings as specified in Section 099600.
2.03 MISCELLANEOUS METAL FABRICATIONS

A. Manufacture or fabricate items to sizes, shapes and dimensions required.
   1. Furnish malleable iron washers for heads and nuts which bear on wood structural connections; elsewhere, furnish steel washers.

B. Miscellaneous Framing and Supports: Provide miscellaneous steel framing and supports which are not part of structural steel framework, as required to complete Work.
   1. Fabricate miscellaneous units to sizes, shapes and profiles shown or, where not shown, of required dimensions to receive adjacent other work to be retained by framing.
   2. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection.
   3. Cut, drill and tap units to receive hardware and similar items.
   4. Equip units with integrally welded anchor straps for casting into poured concrete or building into masonry wherever required.
   5. Except as otherwise shown, space anchors 24 inches on center and provide minimum anchor units of 1-1/4 by 1/4 by 8 inch steel straps.

C. Miscellaneous Steel Trim: Provide shapes and sizes as required for profiles shown.
   1. Except as otherwise noted, fabricate units from structural steel shapes and plates and steel bars, with continuously welded joints and smooth exposed edges.
   2. Provide cutouts, fittings and anchorages as required for coordination of assembly and installation of other work.
   3. Galvanize miscellaneous steel trim where indicated.

D. Metal Ladders: Fabricate ladders for locations shown, with dimensions, spacing, details and anchorages indicated.
   1. Comply with requirements of ANSI A 14.3, except as otherwise indicated.
   2. Unless otherwise shown, provide 1/2 by 2-1/2 inch continuous structural steel flat bar side rails with eased edges, spaced 18 inches apart.
   4. Fit rungs in centerline of side rails, plug weld and grind smooth on outer rail faces.
   5. Support each ladder at top and bottom and at intermediate points spaced not more than 5 feet on center.
   6. Use welded or bolted steel brackets, designed for adequate support and anchorage, and to hold ladder clear of wall surface with minimum 7 inch clearance from wall to centerline of rungs.
   7. Return top of rails to wall or structure as indicated.
   8. Hot-dip galvanize ladders, brackets, and fasteners, unless indicated to be painted.

2.04 METAL STAIR FABRICATION

A. Form steel stairs from materials of size, thickness, and shapes indicated, but not less than that needed to comply with performance requirements indicated.
   1. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support.
B. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
   1. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing Work.

C. Shear and punch metals cleanly and accurately.

D. Remove sharp or rough areas on exposed surfaces.
   1. Ease exposed edges to radius of approximately 1/32 inch, unless otherwise indicated.

E. Weld corners and seams continuously to comply with following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing, and welded surface matches contours of adjoining surfaces.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible.
   1. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts.
   2. Locate joints where least conspicuous.

G. Shop Assembly: Preassemble in shop to greatest extent possible to minimize field splicing and assembly.
   1. Use connections that maintain structural value of joined pieces.
   2. Clearly mark units for field assembly and coordinated installation.

H. Fabricate joints that will be exposed to weather in manner to exclude water, or provide weep holes where water may accumulate.

I. Construct stairs to conform to sizes and arrangements shown; join pieces together by welding unless otherwise indicated.
   1. Provide complete stair assemblies including metal framing, hangers, columns, struts, clips, brackets, bearing plates and other components necessary for support of stairs and platforms and as required to anchor and contain stairs on supporting structure.

J. Stair Framing: Fabricate stringers of structural steel channels, or plates, or combination thereof.
   1. Provide closures for exposed ends of stringers.
   2. Construct platforms of structural steel channel headers and miscellaneous framing members.
   3. Bolt or weld headers to strings and framing members to strings and headers, fabricate and join so that bolts, if used, do not appear on finish or surfaces.

K. Metal Pan Risers, Subtreads, and Subplatforms: Shape metal pans for risers and subtreads to conform to configuration shown.
   1. Provide thicknesses of structural steel sheet for metal pans indicated but not less than that required to support total design loading.
2. Form metal pans of uncoated cold-rolled steel sheet or hot-rolled or cold-rolled carbon steel sheet.

3. Directly weld risers and subtreads to stringers; locate welds on side of metal pans to be concealed by concrete fill.

4. Attach extruded abrasive nosings to pan risers.
   a. Make nosings full width of tread flush with tread surfaces.

5. Directly weld risers and subtreads to stringers; locate welds on side of metal pans to be concealed by concrete fill.

6. Attach extruded abrasive nosings to pan risers.
   a. Make nosings full width of tread flush with tread surfaces.

7. Attach risers and subtreads to stringers by means of brackets made of steel angles or bars.
   a. Weld brackets to strings and attach metal pans to brackets by welding, riveting or bolting.

L. Provide subplatforms of configuration and construction indicated, of same metal as risers and subtreads and in thicknesses required to support design loading.
   1. Weld subplatform to platform framing members.

M. Stair Tread Nosing: Fabricate units with extruded aluminum base, sizes, and configurations indicated with abrasive filler material bonded and locked into channels in base.
   1. Provide abrasive grit of aluminum oxide, silicone carbide, or combination of both.
   2. Color as selected by Architect.
   3. Manufacturers: Subject to compliance with specified requirements, provide products by one of following:
      a. Ampstep Products, LLC.
      b. American Safety Tread Co., Inc.
      c. Safe-T-Metal Company, Inc.
      d. Wooster Products Inc.
   4. Provide types for use on concrete filled steel stairs.
      a. Provide nosing full length of step for concrete filled steel pan stairs.
   5. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

2.05 HANDRAIL AND RAILING SYSTEM FABRICATION

A. General: Fabricate handrails and railing systems to dimensions and details shown, with smooth bends and welded joints ground smooth and flush.
   1. Comply with requirements indicated for design, finish, member sizes, including wall thickness of tubing, post spacings, and anchorage, but not less than that required to support structural loads.
   2. Use 1-1/2 inch O.D. seamless stainless steel mechanical tubing with wall thickness of 0.065 inch.
   3. Interconnect railing and handrail members by butt-welding or welding with internal connectors, at fabricator’s option, unless otherwise indicated.
      a. At tee and cross intersections, cope ends of intersecting members to fit contour of tubing to which end is joined, and weld all around.
      b. Form changes in direction of handrails and rails by welding in prefabricated flush elbow fittings.
c. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of tubing throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of tubing.

B. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnections of pipe and attachment of handrails and railing systems to other work.
   1. Furnish inserts and other anchorage devices for connecting handrails and railing systems to concrete work.
   2. Close exposed ends of pipe by welding 3/16 inch thick steel plate in place or with prefabricated fittings, except where clearance of end of pipe and adjoining wall surface is 1/4 inch or less.

C. Fittings for Handrails and Railing Systems: Provide non-galvanized ferrous metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in concrete construction.
   1. Provide stainless steel fittings for use with stainless steel railings.

2.06 FINISHES

A. Comply with NAAMM Metal Finishes Manual for recommendations relative to application and designations of finishes, as applicable.
   1. Protect mechanical finishes on exposed surfaces by application of strippable, temporary protective covering prior to shipment.
   2. Variations in appearance of abutting or adjacent pieces are not acceptable when they are within 1/2 of range of approved samples.
      a. Noticeable variations in same piece are not acceptable.
      b. Variations in appearance of other components are acceptable when they are within range of approved samples and are assembled or installed to minimize contrast.
   3. Apply heavy coat of specified isolation material to metal surfaces in contact with concrete or dissimilar materials.
      a. Do not apply on exposed surfaces.

B. Preparations of Surfaces:
   1. Thoroughly clean mill scale, rust, dirt, grease, and other foreign matter from ferrous metal prior to galvanizing.
   2. Where hand cleaning methods are not adequate, clean in accordance with SSPC SP 1, SSPC SP 2, SSPC SP 3, or SSPC SP 7, as required.
   3. Metal work specified to receive high performance coating:
      a. Conform to requirements for high performance coating systems specified in Section 09 9600
      b. Clean in accordance with SSPC-SP 6.
   4. Completely eliminate burrs, rough spots and pitting from normally exposed ferrous metal items.

C. Shop Painting: Apply specified shop primer to uncoated surfaces of miscellaneous metal work, except members or portions of members to be embedded in concrete surfaces and edges to be field welded, and galvanized surfaces, unless otherwise specified.
1. Immediately after surface preparation, brush or spray on primer in accordance with manufacturer's instructions, and at rate to provide uniform dry film thickness of 2.0 mils for each coat.
   a. Use painting methods which will result in full coverage of joints, corners, edges and exposed surfaces.
2. Apply one shop coat to fabricated metal items, except apply 2 coats of paint to surfaces inaccessible after assembly or erection.

D. Stainless Steel Finish:
1. Remove tool and die marks and stretch lines or blend into finish.
2. Unless otherwise indicated, grind and polish surfaces to produce uniform finish, free of cross scratches.
3. Finish with grain with long dimension of each piece.
4. Exposed Surfaces: NAAMM No.4 Finish.

E. Galvanized Finish:
1. Where specified, galvanize items after fabrication.
2. Conform to requirements for galvanizing as specified in "Materials and Components" Article.
3. Where galvanizing is removed by assembly procedures, touch up abraded areas with zinc-rich paint.

2.07 STRUCTURAL PERFORMANCE REQUIREMENTS

A. Fabricate and install miscellaneous metal assemblies to withstand structural loads without exceeding allowable design working stress of materials involved, including anchors and connections.
1. Apply each load to produce maximum stress in each of respective components of each metal fabrication.

B. Stair Framing: Capable of withstanding stresses resulting from loads specified as well as stresses resulting from railing system loads.
1. Steel Stairs and Treads: Capable of withstanding concentrated load of 300 lbf applied at center of tread span.
2. Steel Stair Platforms: Capable of withstanding uniform load of 100 lbf per square foot of projected plan area.

C. Steel Handrails and Railing Systems:
1. Apply each load to produce maximum stress in each of respective components of each metal fabrication.
   a. Comply with ASCE 7-10, Section 4.5.1.
2. Designed to resist concentrated load of 200 lbf applied vertically downward and horizontally in perpendicular direction at any point on top rail.
3. Uniform load of 50 lbf per linear foot applied in any direction.
4. Concentrated and uniform loads above shall not be assumed to act concurrently.
PART 3 – EXECUTION

3.01 PREPARATION

A. Examine areas to receive Work and verify that setting conditions and dimensions are correct to receive items.
   1. Do not start installation until unsatisfactory conditions have been corrected.

B. Field Measurements: Perform sheet metal work in cooperation with other trades.
   1. Where possible, verify size, location and placement of miscellaneous sheet metal work prior to fabrication.
   2. Coordinate field measurements and shop drawings with fabrication and shop assembly.

C. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete construction.
   1. Coordinate delivery of such items to Project Site.

3.02 INSTALLATION

A. Cutting and Fitting: Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications.
   1. Fit exposed connections accurately together to form tight hairline joints.
   2. Weld connections which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations.
   3. Grind joints smooth and touch-up shop paint coat.
   4. Do not weld, cut or abrade surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.

B. Placement: Set Work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels.
   1. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry or similar construction.
   2. Galvanize exposed fasteners to secure to in-place construction.
   3. Fasten work tightly to prevent rattle or vibration.
   4. Do not tighten fasteners through finish alone without spacer washers.
   5. Use nonshrink grout mixed in accordance with manufacturer's direction for setting frames, plates, sills, bolts and similar items.
   6. Locate and place sheet metal items plumb, level and in alignment with adjacent Work.
   7. Tolerances:
      a. Offset from true horizontal, vertical and design location shall not exceed 1/16 inch in 10 feet of length for any component, non-cumulative.
      b. Maximum offset from true alignment between abutting components shall not exceed 1/32 inch.

C. Use concealed anchorages where possible.
   1. Provide brass or lead washers fitted to screws where required to protect sheet metal surfaces.
2. Provide concealed gaskets, flashing, sealants and fillers and install as Work progresses to make installations weathertight or sealed.

D. Form tight joints with exposed connections accurately fitted together.
   1. Provide reveals and openings for sealants and joint fillers, as indicated.

E. Protect non-ferrous metal surfaces from corrosion or galvanic action by application of heavy coating of specified isolation coating material on concealed contact surfaces of dissimilar materials, before assembly and installation, where there is possibility of corrosive or electrolytic action.

F. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.

3.03 FIELD PAINTING

A. Touch-up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting.
   1. Apply by brush or spray to provide minimum dry film thickness of 2.0 mils.

C. Repair of Galvanized Surfaces: Repair areas damaged by welding, cutting or during handling, transport or erection in accordance with ASTM A 780 by application of multiple coats of galvanizing repair paint, to dry film thickness of 8 mils.

D. Repair of Finished Surfaces: Repair finishes damaged by cutting, welding, soldering and grinding operations required for shop fitting and jointing.
   1. Restore finishes so that there is no evidence of corrective work.
   2. Return items which cannot be refinished in field to shop, make required alterations, and refinish entire unit or provide new units, at fabricator’s option.

3.04 CLEANING

A. Remove protective devices only when items will be safe from other construction operations or removal is required to permit related Work.

3.05 PROTECTION

A. Protect metal work from damage to surface, profile, and shape.

END OF SECTION 05 5000
SECTION 06 1013

MISCELLANEOUS CARPENTRY

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Rough carpentry work not specified elsewhere and generally intended for support of other work.
   2. Wood furring.
   3. Miscellaneous blocking, grounds, nailers, and panels.

B. Related Sections:
   1. Section 03 3000: Cast-in-Place Concrete; wood formwork
   2. Section 06 4000: Architectural Woodwork
   3. Section 07 0150: Roof Repairs
   4. Section 08 1400: Wood Doors

1.02 REFERENCES


B. American Plywood Association (APA):
   1. Guide to Plywood Grades

C. Underwriters' Laboratories, Inc. (UL)
   1. Fire Hazard Classification – FR-S

D. West Coast Lumber Inspection Bureau (WCLIB):

E. Western Wood Products Association (WWPA):
   1. Standard Grading Rules for Western Lumber.

F. American Wood Preservers Association Standards (AWPA)

1.03 QUALITY ASSURANCE

A. Wood Product Quality Standards:
   1. Lumber Standards: Comply with West Coast Lumber Inspection Bureau (WCLIB).
   3. Factory-mark each piece of lumber and plywood with type, grade, mill and grading agency, except omit marking from surfaces to be exposed with transparent finish or without finish.
“L” TOWER BUILDING  
SEISMIC AND CODE UPGRADES  
RIO HONDO COLLEGE

B. Single-Source Responsibility for Fire Retardant Treated Wood:  
   1. Obtain each type of fire-retardant-treated wood product from one source and by single producer.

1.04 SUBMITTALS

A. Wood treatment data from chemical treatment manufacturer.
   1. Include chemical treatment manufacturer's instructions for handling, storing, installing, and finishing treated material:
      a. Preservative Treatment: Include certification by treatment plant stating type of solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.
      b. Waterborne Preservative Treatment: Include certification that moisture content of treated wood was reduced to levels specified prior to shipment to Project Site.
      c. Fire-Retardant Treatment: Include certification by treating plant that treated wood complies with specified requirements.
      d. Include warranty of chemical treatment manufacturer for each type of treatment.

1.05 DELIVERY, STORAGE AND HANDLING

A. Delivery and Storage: Keep materials under cover and dry.
   1. Protect against exposure to weather and contact with damp or wet surfaces.
   2. Stack material above ground level on uniformly spaced supports to prevent deformation.
   3. For material pressure treated with waterborne chemicals, place spacers between each bundle for air circulation.

PART 2 – PRODUCTS

2.01 LUMBER, GENERAL

A. Standards: Furnish lumber manufactured to comply with PS 20 - American Softwood Lumber Standard, with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.

B. Grade Stamps: Furnish lumber with each piece factory marked with grade stamp of inspection agency that indicates grading agency, grade, species, moisture content at time of surfacing, and mill.

C. Sizes: Provide nominal sizes indicated, complying with PS 20, except where actual sizes are specifically noted as being required.

D. Surfacing: Dressed lumber, S4S, unless otherwise indicated.

2.02 DIMENSION LUMBER FOR CONCEALED CONDITIONS

A. Species: Wood species listed by PS 20.

B. Moisture Content: S-DRY, KD 19 or MC 19 (19 percent maximum moisture content).

C. Grade: No.2, or standard grade.
D. Grade: No.3, or utility grade.

2.03 CONSTRUCTION PANELS

   1. Trademark: Furnish construction panels that are each factory marked with APA trademark for grade specified.

B. Electrical/Telephone Backing Panels: C-D Plugged, Exposure 1 plywood panels, fire-retardant treated, thickness as indicated, but not less than 1/2 inch nominal.

2.04 FASTENERS

A. Where miscellaneous carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating per ASTM A 153 or of AISI Type 316/316L stainless steel.


C. Bolts: ASTM A 307, Grade A; with ASTM A 563 hex nuts and flat washers.

2.05 PRESERVATIVE WOOD TREATMENT BY PRESSURE PROCESS

   1. Mark each treated item with AWPB or SPIB Quality Mark Requirements.
   2. Coat surfaces cut after treatment to comply with AWPA M4.

B. Above-Ground Wood Treatment: Pressure treat with waterborne preservatives to minimum retention of 0.25 pcf.
   1. Kiln-dry interior dimension lumber after treatment to 19 percent maximum moisture content.
   2. Treat wood items indicated and in following circumstances:
      a. In contact with roofing, flashing, or waterproofing.
      b. In contact with masonry or concrete.
      c. Within 18 inches of grade.

C. Ground Contact Wood Treatment: Pressure treat with waterborne preservatives to minimum retention of 0.40 pcf.

2.06 FIRE-RETARDANT TREATMENT BY PRESSURE PROCESS

A. Identify treated wood with appropriate classification marking of Underwriters Laboratories, Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.

B. Dimension Lumber: Comply with AWPA C20.
   1. Treatment Types: Interior Type A for protected wood and Exterior Type for wood exposed to weather.

C. Plywood: Comply with AWPA C27.
   1. Treatment Types: Interior Type A for protected wood and Exterior Type for wood exposed to weather.
D. Inspect each piece after drying and discard damaged or defective pieces.

PART 3 – EXECUTION

3.01 INSTALLATION – GENERAL

A. Discard units of material with defects that impair quality of miscellaneous carpentry and in sizes that would require excessive number or poor arrangement of joints.

B. Cut and fit miscellaneous carpentry accurately.
   1. Install members plumb and true to line and level.

C. Coat cut edges of preservative-treated wood to comply with AWPA M4.

D. Securely fasten miscellaneous carpentry as indicated and according to applicable codes and recognized standards.

E. Countersink nail heads on exposed carpentry work and fill holes.

F. Use fasteners of appropriate type and length.
   1. Predrill members when necessary to avoid splitting wood.

3.02 WOOD GROUNDS, NAILERS, AND BLOCKING

A. Install where shown and where required for screeding or attachment of other work.
   1. Cut and shape to required size.
   2. Coordinate location with other work involved.

B. Attach to substrates as required to support applied loading.
   1. Countersink bolts and nuts flush with surfaces, unless otherwise indicated.

3.03 WOOD FURRING

A. Install at spacing indicated, with closure strips at edges and openings.
   1. Shim with wood as required for tolerance of finished Work.

B. Furring to Receive Plywood Paneling: Install 1 by 3 inch furring at 2 feet on center, horizontally and vertically.
   1. Select furring strips for freedom from knots that could cause bent-over nails and damage to paneling.

C. Furring to Receive Gypsum Board: Install 1 by 2 inch furring at 16 inches on center, vertically.

3.04 CONSTRUCTION PANELS


END OF SECTION 06 1013
SECTION 06 4000
ARCHITECTURAL WOODWORK

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Decorative Laminate Casework; including countertops and backsplashes.
   2. Casework hardware and accessories.

B. Related Sections:
   1. Section 05 5000: Metal Fabrications; metal backing plates and fabricated steel supports for countertops.
   2. Section 06 1000: Rough Carpentry; miscellaneous wood blocking.
   3. Section 07 9200: Joint Sealants; mildew-resistant sealant for damp or wet areas.
   4. Section 08 1400: Wood Doors
   5. Section 09 9100: Painting; paintable caulk at dry areas.

1.02 REFERENCES


B. Woodwork Institute (WI):

C. ASTM International (ASTM):

D. The American Society of Mechanical Engineers (ASME):
   1. ASME B18.6.1 – Wood Screws (Inch Series)

1.03 QUALITY ASSURANCE

A. Single-Source Responsibility for Fabrication and Installation: Engage qualified casework firm to assume undivided responsibility for fabricating, finishing, and installing Work specified in this Section, including providing countertops and backsplashes.

B. Quality Standards: Except as otherwise shown or specified, comply with specified provisions of Woodwork Institute (WI), Architectural Woodwork Standards (AWS), Edition 2.
C. Apply WI Certified Compliance Label to each casework and countertop unit.
   1. Do not remove WI Certified Compliance labels until casework has been accepted by Architect.

D. Inspection: When millwork shop is not WI Certified shop, provide for inspections by authorized WI Inspectors complying with following schedule:
   1. Inspection at Manufacturer's Shop: Prior to initial delivery of casework components to Project Site.
   2. Site Conditions: Prior to delivery of casework components to Project Site, inspect Project Site for compliance with requirements of Section 2 of AWS, paragraph 1.2.3
   3. On-Site Inspections:
      a. Immediately after installation of first casework components.
      b. Immediately after complete installation of casework components.
   4. Provide additional site inspections as required by Architect and Owner, at no cost to Owner, when certified WI inspection reports indicate noncompliance with specified requirements.

E. Comply with requirements of CBC for casework attachment and seismic restraint.

F. Formaldehyde Emissions:
   1. Provide composite wood products/materials containing no added formaldehyde-based resins complying with regulations of California Air Resources Board (CARB) as tested in accordance with ASTM E 1333.

1.04 SUBMITTALS

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

B. Shop Drawings: Showing location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
   1. Furnish WI Certified Compliance Label on first page of shop drawings.
   2. Comply with AWS Section 1, Submittals; indicate AWS grades.
   3. Show plans, elevations, ends, cross-sections.
   4. Show details and location of anchorages and fitting to floors, walls, and base.
      a. Include layout of units with relation to surrounding walls, doors, windows, and other building components.
   5. Coordinate shop drawings with other work involved.

C. Certified Compliance Certificate: Before delivery of casework to Project Site, WI Certified Compliance Certificate certifying that products fully meet requirements of WI Grade specified.

D. WI Certified Compliance Certificate for Installation: Upon completion of installation.

E. Samples:
   1. Decorative Laminate: Four 5 inch by 8 inch samples each of plastic laminate surfacing and cabinet liner required in Work.
   2. Edge Banding: Four 6 inch long samples of edge banding for selection of color, design and finish.
   3. Exposed cabinet hardware; one unit of each type and finish.
1.05 PROJECT CONDITIONS

A. Environmental Conditions: Obtain and comply with woodwork manufacturer's and installer's coordinated advice for optimum temperature and humidity conditions for woodwork during its storage and installation.
   1. Do not install woodwork until these conditions have been attained and stabilized so that woodwork is within plus or minus 1.0 percent of optimum moisture content from date of installation through remainder of construction period.

B. Field Measurements: Before proceeding with fabrication of casework required to be fitted to other construction, obtain accurate field measurements and verify dimensions and shop drawing details as required for accurate fit.
   1. Show recorded measurements on final shop drawings.
   2. When possible, coordinate manufacturing schedule with construction progress to avoid delay of Work.
      a. Where sequence of measuring substrates before fabrication would delay Project, proceed with fabrication (without field measurements) and provide ample borders and edges to allow for subsequent scribing and trimming for accurate fit.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver casework as factory-assembled units.

B. Protect casework during transit, delivery, storage and handling to prevent damage, soiling and deterioration.

C. Deliver casework when Project construction is ready for installation.
   1. Provide clean storage area as required by WI AWS, Section 2 – Care and Storage.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Provide materials complying with requirements of Architectural Woodwork Standards and AWS quality grade indicated, unless otherwise indicated.
   1. High pressure decorative laminate, complying with NEMA LD 3.

B. High Pressure Decorative Laminate Manufacturers:
   1. Subject to compliance with specified requirements, provide high pressure decorative laminates by one of following:
      a. Formica Corp.
      b. Laminart.
      c. Nevamar Corp.
      d. Wilsonart International
   2. Colors and Patterns: As scheduled.

C. Core Material for High Pressure Decorative Laminate:
   1. Medium Density Fiberboard (MDF) complying with ANSI A208.2, made with binder containing no urea formaldehyde.
3. Product and Manufacturer: Medite FR and Medite II by Sierra Pine Composite Solutions, or approved equal.
   a. Provide Medite FR where panels are required to be fire retardant.
   b. Provide Medite II where panels are not required to be fire retardant.

D. Semi-Exposed Surfaces:
   1. Low Pressure Decorative Melamine Overlay.

E. Edge Banding: provide as follows:
   1. High pressure decorative laminate (HPDL): Same thickness as countertop surface.
      a. For self-edge countertops and tops
      b. Top and front edges of splashes.
   2. Polylvinylchloride (PVC) Edging: chip proof, flame resistant and impervious to moisture.
      a. Door Edges and Drawer Front Edges: Minimum 3 mm thickness
      b. Exposed Edges of Boxes: Minimum 0.08 mm thickness
   3. Colors: As scheduled or selected by Architect.

F. Adhesive: Type 1 adhesive, fully waterproof.
   1. Use for adhesive bonded materials.

G. Solid Hardwood Trim:
   1. For Painted Finish:
      a. AWS Premium Grade, Natural Yellow Birch or Yellow Poplar, plain sawn.

2.02 CASEWORK HARDWARE

A. Provide hardware required for complete casework installation.
   1. Hinges:
      a. Heavy duty wrap-around, 2-1/4 inch minimum width, offset for overlay door installation
         1) Tight pin butts of 0.083 inch thick steel,
         2) Installed with minimum of five No. 8 full thread screws to jamb and four No. 8 full thread screws to door.
         3) Provide 3 hinges for doors over 48 inches in height.
         4) Rockford Process Control 851 or 852, Stanley HT1592 or approved equal.
      b. Concealed Hinges: Heavy duty concealed offset for overlay door installation
         1) Installed with minimum of two full thread screws to jamb and two full thread screws to door.
         2) Blum Modul hinge system or Hafele Duomatic hinges 300 Series, or approved equal.
   2. Catches: Two on doors over 36 inches in height, one on doors under 36 inches in height.
      a. Provide elbow catches on companion doors where locks are specified.
      a. Size: 5/16 inch diameter; 4 inch centers.
      b. Engineered Products Company (EPCO) No. MC402-SS 4"; or approved equal.
      c. Provide specified wire pulls on doors and drawers.
4. Door and Drawer Locks: Surface mounted, pin tumbler type.
   a. 3/4 inch bolt throw, brass construction,
   b. BHMA 626 finish, complete with strike.
   c. Door Locks: National C8173
   d. Drawer Locks: National C1878
   e. Provide locks on doors and drawers, unless indicated otherwise.
5. Keying: Verify keying requirements with Owner prior to start of Work.
   a. For estimate use grandmaster key system.
   b. Number keys and provide 2 keys per lock.
   c. Key locks alike.
6. Chain Stops: Provide for doors with limited swing.
7. Drawer Guides for Drawers 24 inches wide or less: 100 pound load-rated, full extension, ball bearing; Accuride 3832.
8. Drawer Guides for File, Paper Storage, and Heavy-Duty Drawers 42 inches wide or less: 150 pound load-rated, over travel extension, ball bearing; Accuride 4034.
9. Heavy-Duty Adjustable Shelf Bracket Assemblies: Provide following as manufactured by Knape & Vogt Manufacturing Company, or approved equal.
   a. Pilaster: No. 255 AL
   b. Supports: No. 256 AL
   c. Finish: As Scheduled
11. Exposed Hardware Finish: Except where not available, provide exposed hardware with satin stainless steel finish (ANSI/BHMA 630)
   a. Where not available, provide satin chrome (626) or satin aluminum (628) finish.

**2.03 ACCESSORIES**

A. Grommet: Doug Mockett and Company, round plastic grommet and cap, in sizes indicated.
   1. Color as scheduled, or when not scheduled, as selected by Architect.

**2.04 FABRICATION**

A. Quality Standards: For following types of casework comply with indicated standards as applicable:
   1. Decorative Laminate Casework: AWS Section 10-Casework, grades as follows:
      a. Open Cabinets: Premium grade.
      b. Others: Custom grade.
   2. Countertops and Splashes:
         1) Typical Edge: Provide 1-1/2 inch "Premium" Grade self edge at leading edge, unless detailed or noted otherwise; extend top laminate over edge laminate.

B. Design and Construction Features: Comply with details shown for profile and construction of casework and where not otherwise shown, comply with applicable Quality Standards.
   1. Obtain approval of Architect in writing, for proposed deviations.
3. Construction Type: Type 1.
4. Door and Drawer Front Style: Flush overlay.
5. Provide dust panels between lockable drawers.
6. Recess clip-type shelf standards within open type casework.
7. Provide 1/2 inch by 6 inch vent slots at 2'-0" on center in bottom, over toe paces in sink units.
8. Apply resilient base to exposed side of exposed ends of fixed base cabinets.

C. Pre-Cut Openings: Fabricate work with pre-cut openings, wherever possible, to receive hardware, appliances, plumbing fixtures, electrical work and similar items.
   1. Locate openings accurately and use templates or roughing-in diagrams for proper size and shape.
   2. Smooth edges of cutouts and where located in countertops and similar exposures, seal edges of cutouts with water-resistant coating.

D. Edge Banding:
   1. Self-Edge: High pressure decorative laminate of same color and pattern as face surface.
      a. Trim and buff corners and edges to eliminate sharp edges.
   3. Shelves supported on wall-mounted standards and brackets; edge band edges.

E. High pressure decorative laminate faced doors to be 3/4 inch thick.

F. Shelving:
   1. Load Capacity, shelving: 50 lbs. per square foot.
   2. Maximum load capacity: 200 lbs. per shelf.

G. Tall Cabinet Stiffener (Over 18 inches Deep and 36 inches Wide): 1-1/8 inch square hardwood top stiffener finished to match adjacent surface and secured to top with 1-3/4 inch No. 9 FHWS, 12 inches on center.

H. File Drawers: Sides of file drawer shall be 5/8 inch net thickness; bottoms shall be 3/4 inch hardwood plywood, routed for file follower.
   1. Fasten drawer front to drawer with four concealed wood screws.

I. Filler Panels: For spaces of 3 inches or more, use flush type filler panels, with surfaces and edging to match cabinets.

J. Complete fabrication, including assembly, finishing, and hardware application, before shipment to Project Site to maximum extent possible.
   1. Disassemble components only as necessary for shipment and installation.
   2. Where necessary for fitting at Project Site, provide ample allowance for scribing, trimming, and fitting.

2.05 FASTENERS AND ANCHORS

A. Screws: Select material, type, size, and finish required for each use.
   1. Comply with ASME B8.6.1 for applicable requirements.
2. For metal framing supports, provide screws as recommended by metal framing manufacturer.

B. Nails: Select material, type, size, and finish required for each use.
   1. Comply with ASTM F 1667 for applicable requirements.

C. Anchors: Select material, type, size, and finish required by each substrate for secure anchorage.
   1. Provide nonferrous metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance.
   2. Provide toothed steel or lead expansion bolt devices for drilled-in-place anchors.

**PART 3 – EXECUTION**

**3.01 PREPARATION**

A. Condition woodwork to average prevailing humidity conditions in installation areas before installing.

B. Before installing architectural woodwork, examine shop-fabricated Work for completion and complete Work as required, including back priming and removal of packing.

**3.02 INSTALLATION – GENERAL**

A. Installation Compliance:
   1. AWS Section 10-Casework, and installation requirements in AWS Appendix B.
   2. WI Certified Seismic Installation Program (CSIP) for DSA-approved casework anchorage.

B. Install Work plumb, level, true and straight with no distortions.
   1. Shim as required using concealed shims.
   2. Install to tolerance of 1/8 inch in 8'-0" for plumb and level and with 1/16 inch maximum offset in flush adjoining surfaces, 1/8 inch maximum offsets in revealed adjoining surfaces.

C. Scribe and cut Work to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.

D. Install casework without distortion so that doors and drawers will fit openings properly and be accurately aligned.
   1. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation.
   2. Complete installation of hardware and accessory items as indicated.

E. At gypsum board construction, anchor through wall surface to steel backing plates or wood blocking placed in wall as work of other sections.
   1. Anchorage through gypsum board panels only is not acceptable.

F. Furnish fillers, closures, trim and like as required for complete installation.
   1. Scribe in place wherever required.
3.03 INSTALLATION OF COUNTERTOPS

A. Anchor securely to base units and other support systems as indicated.
   1. Fasten joints in tops with draw-bolt type fasteners let into underside of top.

B. Install countertops with ends flush with exposed ends of base cabinets unless otherwise indicated.

C. Verify opening requirements and make cutouts for sinks, fittings and equipment.

D. Completely fill joints between splash and walls with sealant.

E. Field Jointing: Where practicable, make in same manner as factory jointing using dowels, splines, adhesives, and fasteners recommended by manufacturer.
   1. Locate field joints as shown on accepted shop drawings, factory prepared so there is no Project Site processing of top and edge surfaces.

F. Workmanship: Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.
   1. Provide flush hairline joints in top units using clamping devices.
   2. Use manufacturer’s recommended adhesive and holding devices to provide joint widths not more than 1/16 inch wide at each location, completely filled and flush with abutting edges.
   3. Penetration of tops with fasteners is not permitted.
   4. After installation, carefully dress joints smooth, remove surface scratches, clean and polish entire surface.
   5. Provide holes and cutouts as required for built-in equipment and mechanical and electrical service fixtures.
      a. Verify size of openings with actual size of equipment to be used, prior to making openings.
      b. Form inside corners to radius of not less than $\frac{1}{8}$ inch.
      c. After sawing, rout and file cut-outs to ensure smooth, crack-free edges.

G. Provide scribe moldings for closures at junctures of top, curb and splash with walls as recommended by manufacturer for materials involved.
   1. Use paintable caulk specified in Section 09900, unless indicated or directed otherwise.
   2. Use mildew resistant one part silicone rubber sealant or chemical resistant, permanently elastic sealing compound where indicated, directed, or recommended by manufacturer.

3.04 INSTALLATION OF ACCESSORIES

A. Install in precise manner following manufacturer’s directions.
   1. Turn screws to flat seat; do not drive.
   2. Adjust moving parts to operate freely without excessive bind.

3.05 REPAIR, ADJUSTMENT, AND CLEANING

A. Repair damaged and defective casework wherever possible to eliminate defects functionally and visually; where not possible to repair properly, replace casework.
   1. Adjust joinery for uniform appearance.
B. Clean hardware, lubricate and make final adjustments for proper operation.

C. Clean casework on exposed and semi-exposed surfaces.
   1. Touch-up shop applied finishes to restore damaged or soiled areas.

3.06 PROTECTION

A. Provide protection and maintain conditions, in manner acceptable to manufacturer and installer, that ensures woodwork is without damage or deterioration at time of Substantial Completion.

END OF SECTION 06 4000
SECTION 07 0150
ROOF REPAIRS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Two-ply, modified bituminous membrane roofing, including base sheet and cap sheet.
   2. Roofing insulation and substrate board.
   3. Roof membrane coating material to meet cool roof requirements.
   4. Walkway pads.

B. Related Sections:
   1. Section 01 7329: Cutting and Patching
   2. Section 02 4119: Selective Demolition
   3. Section 06 1013: Miscellaneous Carpentry; wood blocking, curbs, cants, and nailers.
   4. Section 07 6200: Sheet Metal Flashing and Trim
   5. Section 07 9200: Joint Sealants
   6. Section 07 9513: Expansion Joint Cover Assemblies; roof expansion joints

1.02 REFERENCES


B. ASTM International (ASTM):
   2. ASTM C728 – Standard Specification for Perlite Thermal Insulation Board
   5. ASTM D41 – Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
   7. ASTM D 1668 - Standard Specification for Glass Fabrics (Woven and Treated) for Roofing and Waterproofing

C. UL, LLC (UL):

D. National Roofing Contractors Association (NRCA):
1. NRCA Roofing and Waterproofing Manual

E. Asphalt Roofing Manufacturers Association (ARMA):
   1. NRCA/ARMA – Quality Control Recommendations for Polymer Modified Bitumen Roofing.

F. FM Global (FM):
   1. FMG 4450 – Approval Standard for Class 1 Insulated Steel Deck Roofs.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer to perform Work of this Section who has specialized in installing roofing similar to that required for this Project; who is approved, authorized, or licensed by the roofing system manufacturer to install manufacturer's product; and who is eligible to receive the standard roofing manufacturer's warranty.
   1. Installer to maintain a full-time Supervisor/Foreman on job site during all phases of bituminous sheet roofing work and at any time roofing work is in progress, proper supervision of workmen shall be maintained.
   2. In addition, a minimum three-hour fire watch is required on each day that torch applied membranes are installed.

B. Fire-Test-Response Characteristics: Provide roofing materials with the fire-test-Response characteristics indicated as determined by testing identical products per test method indicated below by UL, FM, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
   1. Exterior Fire-Test Exposure: Class A; complying with UL 790, for application and slopes indicated.

C. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project Site. Meet with the same participants and review the same items listed for the preinstallation conference. In addition, review status of submittals and coordination of work related to roof construction. Notify participants at least 5 working days before conference.

D. Preinstallation Conference: Before installing roofing system, conduct conference at Project Site to comply with requirements of Section 01 3119. Notify participants at least 5 working days before conference.
   1. Meet with Owner; Architect; Owner's insurer, where applicable; testing and Inspecting agency representative; roofing Installer; roofing system manufacturer's representative; deck Installer; and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
   2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
   3. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and attachment to structural members.
   4. Review loading limitations of deck during and after roofing.
5. Review flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing.
6. Review governing regulations and requirements for insurance, certifications, and inspection and testing, where applicable.
7. Review temporary protection requirements for roofing system during and after installation.
8. Review roof observation and repair procedures after roofing installation.
9. Document proceedings, including corrective measures or actions required, and furnish copy of record to each participant.

1.04 SUBMITTALS

A. Product Data: For each type of roofing product specified. Include data substantiating that materials comply with requirements.

B. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install specified roofing system and is eligible to receive the standard roofing manufacturer's warranty.

C. Manufacturer Certificates: Signed by roofing system manufacturer certifying that the roofing system complies with requirements specified in the "Performance Requirements" Article.
   1. Upon request, submit evidence of complying with requirements.

D. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roof installation.

E. Closeout Submittals: Per Sections 01 7700 and 01 7839.
   1. Maintenance Data: For roofing system to include in the maintenance manuals.
   2. Warranty: Sample copy of standard roofing manufacturer's warranty stating obligations, remedies, limitations, and exclusions of warranty.

1.05 DEFINITIONS

A. Roofing Terminology: Refer to ASTM D 1079 for definitions of terms related to roofing work not otherwise defined in this Section.

1.06 PROJECT CONDITIONS

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

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store roofing materials in a dry, well-ventilated, weathertight location to ensure no significant moisture pickup and maintain at a temperature exceeding roofing system manufacturer's written instructions.
   1. Store rolls of felt and other sheet materials on end on pallets or other raised surfaces.
      a. Do not double-stack rolls.
   2. Handle and store roofing materials and place equipment in a manner to avoid significant or permanent damage to deck or structural supporting members.
B. Do not leave unused felts and other sheet materials on the roof overnight or when roofing work is not in progress unless protected from weather and moisture and unless maintained at a temperature exceeding 50 degrees F.

C. Deliver and store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.

D. Comply with requirements of authorities having jurisdiction for identification and labeling of roofing materials.

E. Protect roofing insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources.
   1. Store in a dry location.
   2. Comply with insulation manufacturer’s written instructions for handling, storing, and protecting during installation.

1.08 WARRANTY

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

B. Standard Roofing Manufacturer’s Warranty: Submit a written warranty, without monetary limitation, signed by roofing system manufacturer agreeing to promptly repair leaks in the roof membrane and base flashings resulting from defects in materials or workmanship for the following warranty period:
   1. Warranty Period: 30 years.
   2. Contractor will submit a minimum of a 5-year warranty to the membrane manufacturer with a copy directly to Owner.
   3. Membrane manufacturer shall provide an annual inspection for the life of the warranty.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with specified requirements, manufacturers offering products that may be incorporated into the Work, include the following, or approved equal:
   1. SBS-Modified Bituminous Membrane Roofing:
      a. The Garland Co., Inc.
   2. Polyisocyanurate Board Insulation:
      a. The Celotex Corp.
      b. GAF Building Materials Corp.
   3. Glass-Fiber-Board Insulation:
   4. Perlite Board Insulation:
      b. GAF Building Materials Corp.
2.02 SBS-MODIFIED BITUMINOUS SHEET

A. Roofing Membrane Sheet: The Garland Co., Inc's SBS Torch Grade Base Sheet, ASTM D 6164, Grade S, Type I or II, polyester-reinforced or ASTM D 6163, Grade S, Type I or II, glass-fiber-reinforced, SBS-modified asphalt sheet; smooth surfaced; suitable for application method specified.
   1. Use: Base ply of 2-ply, modified bituminous membrane roofing system.

B. Roofing Membrane Cap Sheet: The Garland Co., Inc's Stress ply IV EUV Mineral Cap Sheet, ASTM D 6164, Grade G, Type I or II, polyester-reinforced or ASTM D 6163, Grade G, Type I or II, glass-fiber-reinforced, SBS-modified asphalt sheet; granular surfaced; suitable for application method specified, and as follows:
   1. Use: Finish ply of 2-ply, modified bituminous membrane roofing system.
   2. Granule Color: As selected by Architect.

2.03 AUXILIARY ROOFING MEMBRANE MATERIALS

A. General: Furnish auxiliary materials recommended by roofing system manufacturer for intended use and compatible with SBS-modified bituminous roofing.
   1. Furnish liquid-type auxiliary materials that meet VOC limits of authorities having jurisdiction.

B. Asphalt Primer: ASTM D 41.

C. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required by roofing system manufacturer for application.

D. Mastic Sealant: Polyisobutylene, plain or modified bituminous, nonhardening, nonmigrating, nonskinning, and nondrying.

E. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion resistance provisions in FMG 4470, designed for fastening roofing membrane components to substrate, tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.

F. Metal Flashing Sheet: Metal flashing sheet is specified in Section 07 6200.

G. Wood Nailer Strips: Furnish wood nailer strips complying with requirements of Section 06 1013.

H. Roofing Granules: Ceramic-coated roofing granules, No. 11 screen size with 100 percent passing No.8 sieve and 98 percent of mass retained on No. 40 sieve, color to match roofing membrane.

I. Glass-Fiber Fabric: Woven glass cloth, treated with asphalt; complying with ASTM D 1668, Type 1.

J. Miscellaneous Accessories: Provide miscellaneous accessories recommended by roofing system manufacturer for intended use.
2.04 SUBSTRATE BOARDS

A. Substrate Board: ASTM C 1177, glass-mat, water-resistant gypsum substrate, 1/4 inch thick.
   1. Product: Subject to compliance with specified requirements, provide Dens-Deck Prime by Georgia-Pacific Corporation.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion resistance provisions in FMG 4470, designed for fastening substrate panel to roof deck.

2.05 ROOF INSULATION

A. General: Provide preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated. Provide either, at Contractor's option, extruded-polystyrene board Insulation or polyisocyanurate board Insulation with a top layer of 1/2 inch perlite board Insulation.

B. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, 1.6-lb/cu. ft. minimum density, square edged.
   1. Manufacturers:
      a. Dow Chemical Company.
      b. Owens Corning.
      c. Approved equal.

C. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, felt or glass-fiber mat facer on both major surfaces.
   1. Manufacturers:
      a. Apache Products Company.
      c. Celotex Corporation.
      d. GAF Materials Corporation.
      e. Johns Manville International, Inc.

D. Perlite Board Insulation: ASTM C 728; composed of expanded perlite, cellulosic fibers, binders, and waterproofing agents with top surface seal-coated.
   1. Manufacturers:
      b. GAF Materials Corporation.

E. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches, unless otherwise indicated.

F. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.06 INSULATION ACCESSORIES

A. General: Furnish roofing insulation accessories recommended by insulation manufacturer for intended use and compatible with sheet roofing material.
B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions of FM 4470, designed for fastening roofing insulation to substrate, tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.

C. Tapered Edge Strips: Rigid, perlite insulation board, complying with ASTM C 728.

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

2.07 ROOF WALKWAYS

A. Walkway Pads: Mineral-granule-surfaced, reinforced asphaltic composition, slip-resisting pads, manufactured as a traffic pad for foot traffic and acceptable to roofing system manufacturer, 3/8 inch thick, minimum.
   1. Pad Size: 36 inches by 36 inches

2.08 PERFORMANCE REQUIREMENTS

A. General: Install a watertight, modified bituminous membrane roofing and base flashing system with compatible components that will not permit the passage of liquid water and will withstand wind loads, thermally induced movement, and exposure to weather without failure.

B. FM Listing: Provide modified bituminous membrane, base flashings, and component materials that meet requirements of FM 4450 and FM 4470 as part of a roofing system and that are listed in FM Approval Guides for Class 1 or noncombustible construction, as applicable. Identify materials with FM markings.
   1. Roofing system shall comply with the following:
      a. Fire/Windstorm Classification: Class 1A-90.

C. Solar Reflectance for Roofs with Slopes of 2:12 or Less:
   1. Initial solar reflectance (P) of not less than 0.70 when tested according to CRRC-1.
   2. Initial thermal emittance (e) of not less than 0.75 when tested according to CRRC-1.
   3. Roof coating shall be certified and labeled by the Cool Roof Rating Council (CRRC) or another supervisory entity approved by the California Energy Commission.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions under which roofing will be applied, with installer and roofing system manufacturer's technical representative present, for compliance with requirements.

B. Verify that roof openings and penetrations are in place and set and braced and that roof drains are properly clamped into position.

C. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at roof penetrations and terminations and match the thicknesses of insulation required.
1. Verify that wood nailer strips are located perpendicular to roof slope and are spaced according to requirements of roofing system manufacturer.

D. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units in excess of 1/16 inch out of plane.

E. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean substrate of dust, debris, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

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

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install modified bituminous membrane roofing system according to roofing system manufacturer's written instructions, requirements of authorities having jurisdiction, and applicable recommendations of NRCA/ARMA.

1. Install roofing system according to applicable specification plates of NRCA Roofing and Waterproofing Manual

B. Start installation of modified bituminous membrane roofing in presence of roofing system manufacturer's technical personnel.

C. Shingling Plies: Install modified bituminous membrane roofing system with ply sheets shingled uniformly to achieve required number of membrane plies throughout. Shingle in direction to shed water.

1. Where roof slope exceeds 1/2 inch per 12 inches, run sheets of modified bituminous membrane roofing parallel with slope. Backnail top ends of sheets to nailer strips.

D. Cant Strips: Install and secure preformed 45-degree cant strips at junctures of modified bituminous membrane roofing system with vertical surfaces or angle changes greater than 45 degrees.

E. Cooperate with inspecting and testing agencies engaged or required to perform services for installing modified bituminous membrane roofing system.

F. Coordinate installing roofing system components so insulation and roofing plies are not exposed to precipitation or left exposed at the end of the workday or when rain is forecast.

1. Provide cutoffs at end of each day's work to cover exposed ply sheets and insulation with a course of coated felt with joints and edges sealed.

2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.

3. Remove and discard temporary seals before beginning work on adjoining roofing.
3.04 INSULATION INSTALLATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system manufacturer's written instructions for installing roofing insulation.

C. Install tapered insulation under area of roofing to conform to slopes indicated and to Shop Drawings.

D. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.

E. Install one or more layers of insulation under area of roofing to achieve required thickness.
   1. Where overall insulation thickness is 2 inches or greater, install required thickness in 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.

F. Trim surface of insulation where necessary at roof drains so completed surface is flush with ring of drain.

G. Nailer Strips: Where roof slopes are greater than 1/2 inch per 12 inches (1 :24), mechanically fasten to deck 4-inch nominal-wide, wood nailer strips of same thickness as insulation, spaced not more than 20 to 21 feet apart. Run nailers perpendicular to slope of roof.

H. Install insulation with long joints of insulation in continuous straight lines with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.
   1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

I. Attached Insulation: Prime surface of concrete deck with asphalt primer at a rate of 3/4 gal./100 sq. ft., unless a greater weight is required by roofing system manufacturer, and allow primer to dry. Set each layer of insulation in a solid mopping of hot roofing asphalt.

3.05 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
   1. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturer's written instructions.

3.06 UNDERLAYMENT INSTALLATION

A. Install One layer of SBS Torch Base Sheet to a properly prepared substrate. Shingle in proper direction to shed water on each area of roofing.
B. Using a roofing torch, heat the surface of the coiled portion until the burn-off backer melts away. At this point, the material is hot enough to lay into the substrate. Progressively unroll the sheet while heating and press down with your foot to insure a proper bond.

C. After the major portion of the roll is bonded, re-roll the first six feet and bond it in a similar fashion.

D. Repeat this operation with subsequent rolls with side laps of four inches and end laps of eight inches.

E. Give each lap a finishing touch by passing the torch along the joint and spreading the melted bitumen evenly with a rounded trowel to insure a smooth, tight seal.

F. Extend underlayment two inches beyond top edges of cants at wall and projection bases.

G. Install base flashing ply to all perimeter and projections details

3.07 FLASHING MEMBRANE INSTALLATION – GENERAL

A. Curb, wall and parapet flashings shall be sealed on a daily basis. No condition should exist that will permit moisture entering behind, around or under the roof or flashing membrane.

B. Prepare walls, penetrations and expansion joints to be flashed with asphalt primer at the rate of 100 square feet per gallon. Allow primer to dry tack free.

C. Flashing plies will be adhered with a roofer’s torch. The modified membrane will be used as the flashing and will be nailed off 8” O.C. at all vertical surfaces.

D. The entire sheet of flashing membrane must be solidly adhered to the substrate.

E. Seal vertical laps of flashing membrane with a three-course application of Flashing Bond and fiberglass mesh.

F. Counter flashing, cap flashings, expansion joints, and similar work to be coordinated with modified bitumen roofing work are specified in other sections.

G. Roof accessories, miscellaneous sheet metal accessory items, including piping vents and other devices to be coordinated with the roofing system work are in other sections.

H. Metal Edge Detail:
   1. Inspect the nailer to assure proper attachment and configuration.
   2. Run underlayment over the edge. Assure coverage of all wood nailers. Fasten underlayment with ring shank nails 8 inches on center.
   3. Install continuous cleat, fasten 6 inches on center.
   4. Install new metal edge hooked to continuous cleat and set in bed of roof cement.
      a. Fasten flange to wood nailer every 3 inches on center, staggered.
   5. Prime metal edge at a rate of 100 square feet per gallon and allow to dry.
6. Strip in flange with base flashing ply covering entire flange with 6 inches on to the field of roof. Assure ply laps do not coincide with metal laps.

7. The second ply shall be a modified flashing ply installed over the base-flashing ply, 9 inches on to the field of roof.

I. Coping Cap (Lower Sections of wall where applicable):

1. Minimum flashing height is 8". Maximum flashing height is 24". Prime vertical wall at a rate of 100 square feet per gallon and allow to dry.

2. Set cant in Flashing Bond Mastic. Run all field plies over cant a minimum of 2".

3. Attach tapered board to top of wall.

4. Install base flashing ply covering entire wall and wrapped over top of wall and down face with 6 inches on to field of roof. Nail membrane 8 inches on center.

5. The second ply shall be a modified flashing ply installed over the base flashing ply 9 inches on to field of roof. All vertical seams will receive a three-course application of mastic and mesh allowed to cure and aluminize.

6. Install continuous cleat, fasten 6 inches on center to outside wall.

7. Install new metal coping cap hooked to continuous cleat.

8. Fasten inside cap 24 inches on center with approved fasteners with neoprene washers.

J. Equipment Support:

1. Minimum curb height is 8 inches. Prime vertical at a rate of 100 square feet per gallon and allow to dry.

2. Set cant in Flashing Bond Mastic. Run all field plies over cant a minimum of 2 inches.

3. Install base flashing ply covering curb with 6 inches on to field of roof.

4. The second ply shall be a modified flashing ply installed over the base flashing ply 9 inches on to field of roof. Attach top of membrane to top of curb and nail 8 inches on center. Vertical seams will receive a three-course application of mastic and mesh allowed to cure and aluminize.

5. Install premanufactured cover. Fasten sides 24 inches on center with fasteners and neoprene washers. Joint cover laps will have butyl tape in between metal covers.

6. Set equipment on neoprene pad and fasten as required by equipment manufacturer.

K. Curb Detail/Air Handling Station:

1. Minimum curb height is 8". Prime vertical at a rate of 100 square feet per gallon and allow to dry.

2. Set cant in Flashing Bond Mastic. Run all field plies over cant a minimum of 2 inches.

3. Install base flashing ply covering curb with 6 inches on to field of roof.

4. The second ply shall be a modified flashing ply installed over the base flashing ply 9 inches on to field of roof. Attach top of membrane to top of three-course application of mastic and mesh allowed to cure and aluminize.

5. Install premanufactured counterflashing with fasteners and neoprene washers or per manufacturer's recommendations.

6. Set equipment on neoprene pad and fasten as required by equipment manufacturer.

L. Manufactured Curb for Equipment Support:

1. Minimum curb height is 8 inches. Prime vertical at a rate of 100 square feet per gallon and allow to dry.
2. Run all field plies over cant of the premanufactured equipment support a minimum of 2 inches.

3. Install base flashing ply covering premanufactured curb with 6 inches on to field of roof.

4. The second ply shall be a modified flashing ply installed over the base flashing ply 9 inches on to field of roof. Attach top of membrane to top of wood curb and nail 8 inches on center. Vertical seams will receive a three-course application of mastic and mesh allowed to cure and aluminize.

5. Install premanufacturered cover. Fasten sides 24 inches on center with fasteners and neoprene washers. All joint cover laps will have butyl tape between metal covers.

6. Set equipment on neoprene pad and fasten as required by equipment manufacturer.

M. Roof Drain:
1. Plug drain to prevent debris from entering plumbing.
2. Taper insulation to drain minimum of 24 inches from center of drain.
3. Run roof system plies over drain. Cut out plies inside drain bowl.
4. Set lead/copper flashing (30 inches square minimum) in 1/4 inch bed of mastic.
   a. Run lead/copper into drain a minimum of 2 inches.
   b. Prime lead/copper at a rate of 100 square feet per gallon and allow to dry.
5. Install base flashing ply (40 inches square minimum).
6. Install modified membrane (48 inches square minimum).
7. Install clamping ring and assure all plies are under the clamping ring.
8. Remove drain plug and install strainer.

N. Plumbing Stack:
1. Minimum stack height is 12 inches.
2. Run roof system over the roof. Seal the base of the stack with elastomeric sealant.
4. Install base flashing ply by torch.
5. Install modified membrane by torch.
6. Caulk the intersection of the membrane with elastomeric sealant.
7. Turn sleeve a minimum of 1" down inside of stack.

O. Heat Stack:
1. Minimum stack height is 12".
2. Run roof system over the roof. Seal the base of the stack with elastomeric sealant.
4. Install base flashing ply by torch.
5. Install modified membrane by torch.
6. Caulk the intersection of the membrane with elastomeric sealant.
7. Install new collar over cape. Weld collar or install stainless steel draw brand.
3.08 FIELD QUALITY CONTROL

A. Manufacturer's Field Service:
   1. Arrange for a qualified technical representative of the roofing materials manufacturer to be present during initial application of roofing materials to ensure materials are applied in accordance with the manufacturer's requirements. Do not commence built-up roof system application when manufacturer's representative is not present to observe the work.
   2. Arrange additional visits by manufacturer's representative during application as necessary to ensure compliance with manufacturer's requirements.

B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.
   1. Notify Architect and Owner 48 hours in advance of the date and time of inspection.

3.09 PROTECTING AND CLEANING

A. Protect modified bituminous membrane roofing from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove modified bituminous roofing that does not comply with requirements, repair substrates, reinstall roofing, and repair base flashings to a condition free of damage and deterioration at the time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07 0150
PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Cold fluid-applied waterproofing system, including, but not limited to, following:
      a. Fluid-applied waterproofing membrane.
      b. Prefabricated drainage composite/protection course.

B. Related Sections:
   1. Section 03 3000: Cast-in-Place Concrete; finishes for waterproofing.
   2. Section 07 9200: Joint Sealants

1.02 REFERENCES


B. ASTM International (ASTM):
   1. ASTM C836 - Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course
   4. ASTM D751 - Standard Test Methods for Coated Fabrics
   5. ASTM D903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds
   7. ASTM D2369 - Standard Test Method for Volatile Content of Coatings
   8. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating
   9. ASTM D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
   10. ASTM D5295 - Standard Guide for Preparation of Concrete Surfaces for Adhered (Bonded) Membrane Waterproofing Systems

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Qualified installer with at least 3 years experience in Work of type required and approved by manufacturer to install manufacturer's products.
B. Fluid Applied Waterproofing Material: Liquid applied, single component, moisture cured polyurethane, designed to form seamless, flexible rubber membrane impervious to moisture.
   1. For each type of material required for Work, provide primary materials which are products of one manufacturer.

1.04 SUBMITTALS

A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.

1.05 PROJECT CONDITIONS

A. Environmental Limitations: Apply waterproofing within range of ambient and substrate temperatures recommended by waterproofing manufacturer.
   1. Do not apply waterproofing to damp or wet substrate, when relative humidity exceeds 85 percent, or when temperatures are less than 5 degrees F above dew point.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials and products in labeled packages.
   1. Store and handle liquid materials in their original undamaged containers in clean, dry, protected location, and within temperature range in strict compliance with manufacturer's instructions and recommendations.
   2. Protect from damage from sunlight, weather, excessive temperatures and construction operations.
      a. In cool temperatures, store the material for several hours at room temperature to facilitate mixing and application.
   3. Remove damaged material from Project Site and dispose of in accordance with applicable regulations.
   4. Remove and replace liquid materials that cannot be applied within their stated shelf life.

1.07 WARRANTY

A. Special Warranty: Manufacturer's standard form, signed by manufacturer and installer, and agreeing to repair or replace waterproofing that does not comply with requirements or that does not remain watertight for period of five years after date of Substantial Completion.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design: Design for cold fluid-applied waterproofing system is based on Elasto-Deck B.T., as manufactured by Pacific Polymers, division of ITW Polymers Sealants North America.

B. Products: Subject to compliance with specified requirements, provide named product
or one of following:
2. BASF Building Systems: Sonoshield HLM 5000
3. Carlisle Corporation, Carlisle Coatings & Waterproofing Div.: Carlisle CCW-525
4. Colloid Environmental Technologies Company (CETCO): LDC 60
5. United Coatings: Elastall 1000

2.02 WATERPROOFING MATERIALS

A. Fluid Applied Waterproofing Membranes:
1. Liquid applied, single component, moisture cured polyurethane, designed to form seamless, flexible rubber membrane impervious to moisture that meet or exceed performance requirements of ASTM C 836 and other ASTM standards as shown in following table.
2. Provide material for spray application, unless indicated otherwise
   a. Provide Trowel Grade for detailing
3. Type I for horizontal surfaces
4. Type II for vertical surfaces
5. Color: Black

B. Physical Properties of Membrane:
1. Hydrostatic Pressure Resistance, ASTM D 751: 94 psi, Type II only
2. Water Vapor Transmission, ASTM E 96, (Procedure B) water method: 0.72 grains/hr/q. ft.
3. Moisture vapor transmission, after decay test: 1.563 grains/hr/q. ft., Type II only
4. Adhesion to Concrete, ASTM D 903:
   a. Type I: 14.9 lb/in.
   b. Type II: 19 lb/in
   c. No peel/film break
5. Elongation, ASTM D 412: 700 percent, ±10 percent
6. Tensile Strength, ASTM D 412:
   a. Type I: 300 psi ±10 percent
   b. Type II: 436 psi
7. Hardness, ASTM D 12240 (Shore A):
   a. Type I: 40 ±5
   b. Type II: 35 ±5
8. Tackfree Time, at 7rF and 55% RH: 12 to 16 hours
9. Recoat Time, at 77°F and 55% RH: 16 to 24 hours
10. Percent Solids, ASTM D 2369:
    a. Type I:
       1) By Weight: 86 ±2
       2) By Volume: 78 ±2
    b. Type II:
       1) By Weight: 82 ±2
       2) By Volume: 77 ±2
11. Recovery, ASTM D 412:
    a. Type I: 98 percent
    b. Type II: 96 percent

C. Prefabricated Drainage Composite: Sitedrain 180 Series Drainage Composite by American Wick Drain or approved equal, for vertical surfaces.
1. Designed to promote positive drainage while serving as protection course.

D. Miscellaneous Materials: Tape and other accessories specified or acceptable to manufacturer of fluid applied waterproofing membrane.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine conditions of substrates and other conditions under which Work is to be performed and notify Contractor, in writing, of circumstances detrimental to proper completion of Work.
1. Do not proceed with Work until unsatisfactory conditions are corrected.

3.02 SURFACE PREPARATION

A. Conform to requirements of ASTM D 5295 and following:
1. Clean and prepare substrate according to manufacturer's written recommendations.
   a. Provide clean, dust-free, and dry substrate for waterproofing application.
2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.

B. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

C. Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids.
1. Fill form tie rod holes with concrete and finish flush with surrounding surface.
2. Repair holes greater than 1/2 inch in depth and 1/4 inch in diameter deep and finish flush with surrounding surface.
3. Remove scaling to sound, unaffected concrete and repair exposed area.

D. Prepare vertical and horizontal surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, and sleeves according to ASTM C 898 and manufacturer's written instructions.
1. Apply double thickness of waterproofing and embed a joint reinforcing strip in preparation coat when recommended by waterproofing manufacturer.
2. Fill form tie rod holes with concrete and finish flush with surrounding surface.

E. Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 898 and waterproofing manufacturer's written instructions.
1. Grind irregular construction joints to suitable flush surface.
2. Remove dust and dirt from joints and cracks complying with ASTM 04258 before coating surfaces.

3.03 WATERPROOFING APPLICATION
A. Apply waterproofing according to ASTM C 898 and manufacturer's written instructions.

B. Apply one or more coats of waterproofing to obtain seamless membrane free of entrapped gases, with average dry film thickness of 60 mils and minimum dry film thickness of 50 mils.

C. Install protection course with butted joints over nominally cured membrane before starting subsequent construction operations and backfilling.

3.04 CURING, PROTECTING, AND CLEANING

A. Cure waterproofing according to manufacturer's written recommendations, taking care to prevent contamination and damage during application stages and curing.

B. Protect waterproofing from damage and wear during remainder of construction period.

C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07 1400
SECTION 07 1616
CRYSSTALINE WATERPROOFING

PART 1 – GENERAL

1.01 SUMMARY

A. Crystalline waterproofing at elevator pit walls and pit slab.

B. Related Sections:
   1. Section 03 3000: Cast-in-Place Concrete; for formwork, waterstops, and
      finishing concrete walls and slabs to receive waterproofing.
   2. Section 079200: Joint Sealants; for elastomeric and preformed sealants
      in concrete walls and floors.

1.02 REFERENCES

A. California Code of Regulations (CCR), Title 24, Part 2, California Building Code

B. ASTM International (ASTM):
   1. ASTM C33 - Standard Specification for Concrete Aggregates
      Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)
   3. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar
   5. ASTM C321 - Standard Test Method for Bond Strength of Chemical-Resistant
      Mortars
      Mortars
   7. ASTM C596 - Standard Test Method for Drying Shrinkage of Mortar Containing
      Hydraulic Cement

C. US Army Corps of Engineers (USACE):
   1. CE CRD-C 48 - Standard Test Method for Water Permeability of Concrete

1.03 QUALITY ASSURANCE

A. Applicator Qualifications: Experienced applicator who has completed crystalline
   waterproofing similar in material, design, and extent to that indicated for this Project,
   whose work has resulted in application with record of successful in-service
   performance.

1.04 SUBMITTALS

A. Product Data: For each type of product specified.
1.05 PROJECT CONDITIONS

A. Proceed with waterproofing work only after pipe sleeves, vents, curbs, inserts, drains, and other projections through substrate to be waterproofed have been completed.
   1. Proceed only after concrete and masonry substrate defects, including honeycombs, voids, and cracks, have been repaired to provide sound substrate free of forming materials, including reveal inserts.

B. Ambient Conditions: Proceed with waterproofing work only if temperature is maintained at 40 degrees F or above during Work and cure period and space is well ventilated and kept free of water.

1.06 WARRANTY

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

B. Special Warranty: Written warranty, signed by applicator and countersigned by Contractor, agreeing to repair or replace waterproofing that does not comply with requirements or that fails to perform as required, and to maintain watertight conditions within specified warranty period.
   1. Warranty includes responsibility for removing and replacing other work that conceals crystalline waterproofing.
   2. During warranty period, repairs and replacements required because of unusual weather phenomena and other events beyond Contractor's or applicator's control shall be completed by Contractor or applicator and paid for by Owner at prevailing rates.
   3. Revise warranty to period required and verify availability.
      a. Period below is maximum included with manufacturer's published data.
   4. Warranty Period: Five years from date of Substantial Completion.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design: Design for crystalline waterproofing system is based on Xypex as manufactured by Xypex Chemical Corporation.

B. Products: Subject to compliance with specified requirements, provide named product or one of following:
   1. Anti-Hydro International, Inc.: Hydro Cap
   3. BASF Building Systems: Tegraproof
   4. Conproco Corporation: Conpro Seal
   5. The Euclid Chemical Company: Hey'Di K-11
   6. Koster-American Corporation: Koster NB-1

2.02 MATERIALS

A. Portland Cement: ASTM C 150, Type I.
B. Slurry-Coat Aggregate: ASTM C 144, sand.

C. Trowel-Coat Aggregate: ASTM C 33, fine aggregate.

D. Water: Potable.

E. Crystalline Waterproofing: Blend of Portland cement, specially treated sand, and active chemicals formulated to penetrate by capillary action into concrete and to chemically react with free lime in presence of water to develop crystalline growth within concrete capillaries, producing impervious, dense, waterproof concrete with properties meeting or exceeding following criteria:
   1. Permeability: 30 feet when tested according to CE CRD-C 48.
   2. Compressive Strength: 9,000 psi at 28 days when tested according to ASTM C 109.
   3. Flexural Strength: 6,000 psi at 28 days when tested according to ASTM C 348.
   4. Bond Strength: 690 psi at 14 days when tested according to ASTM C 321.

F. Patching Compound: Ready-mixed cementitious waterproofing and repair mortar for filling and patching tie holes, honeycombs, reveals, and other imperfections with properties meeting or exceeding following:
   1. Compressive Strength: 7,600 psi at 28 days when tested according to ASTM C 109.
   2. Flexural Strength: 710 psi at 28 days when tested according to ASTM C 348.
   3. Shrinkage: Minus 0.093 percent at 28 days and plus 0.073 percent at 90 days when tested according to ASTM C 596.

G. Plugging Compound: Cementitious, ready-mixed, efflorescence-free, surface waterproofing compound with hydrophobic properties that requires only addition of water, and is resistant to water and moisture but is vapor permeable for standard applications (vertical, overhead and horizontal surfaces not exposed to vehicular traffic); with properties meeting or exceeding following criteria:
   1. Permeability: 30 feet when tested according to CE CROC 48.
   2. Compressive Strength: 6,000 psi at 28 days when tested according to ASTM C 109.
   3. Flexural Strength: 1,000 psi at 28 days when tested according to ASTM C 348.
   4. Bond Strength: 300 psi at 14 days when tested according to ASTM C 321.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine walls, floors, and other surfaces where waterproofing is to be applied with applicator present, for compliance with requirements for surface preparation, cleaning, and other conditions affecting waterproofing performance.
   1. Proceed with application only after unsatisfactory conditions have been corrected.
   2. Begin waterproofing application only after unsatisfactory conditions have been corrected.
   3. Application of waterproofing indicates acceptance of surfaces and conditions.

CRISTALLINE WATERPROOFING
07 1616-3
3.02 PREPARATION

A. Protect other work from dripping or splatter from crystalline waterproofing during application.
   1. Provide temporary enclosure to confine operation, to prevent polluting air, and to ensure adequate ambient temperatures and ventilation conditions for application.

B. Stop active water leaks with plugging and patching compounds according to waterproofing manufacturer's written instructions.

C. Schedule cleaning and surface preparation so dust and other contaminants from cleaning and preparation process will not fall on wet, newly coated surfaces.

D. Surface Preparation of Concrete: Comply with waterproofing manufacturer's written instructions and requirements indicated below to ensure that waterproofing bonds to concrete surfaces.
   1. Clean concrete surfaces according to ASTM 0 4258 by using one or combination of procedures as needed to effectively remove efflorescence, chalk, dust, dirt, mortar spatter, grease, oils, curing compounds, and form release agents.
   2. Prepare scratch and float finished concrete by etching with 10% muriatic (hydrochloric) acid solution according to ASTM 04260.
   3. Prepare smooth-formed and trowel-finished concrete by mechanical abrading or abrasive-blast cleaning according to ASTM 04259.
   4. Concrete Joints: Clean reveals according to waterproofing manufacturer's written instructions.

E. Mask-off surfaces adjoining areas to receive waterproofing treatment where surface damage or discoloration might result from application of waterproofing.
   1. Do not allow crystalline waterproofing or crystalline compound to migrate into reveals or annular spaces intended for resilient sealants or gaskets, such as joint spaces between pipes and pipe sleeves, unless indicated to be filled with sealant.

F. At cracks in concrete, remove loosened chips and cut square reveal approximately 1 inch deep.

3.03 APPLICATION

A. Comply with waterproofing manufacturer's written instructions, unless more stringent requirements are indicated.

B. Mix waterproofing components according to waterproofing manufacturer's written instructions.

C. Protect adjacent surfaces.
   1. Dampen wall surface with water before applying waterproofing.

D. Apply waterproofing coating evenly and fill voids and pores of substrate with waterproofing slurry.
   1. Keep tools clean and free from build-up.
E. Apply number of coats at rates recommended by manufacturer for each coat.
   1. After allowing previous coat to cure, dampen wall before applying additional coats.

F. Mist-cure waterproofing for two to three days immediately after application as recommended by manufacturer.

G. Waterproofing Treatment Extensions: Apply treatment to columns that are integral with walls to be treated, and extend treatment onto interior, nontreated walls that intersect exterior, treated walls, for a distance of 24 inches for cast-in-place concrete.
   1. Where floors (but not walls) are treated, extend treatment 12 inches high onto exterior walls and onto both exterior and interior columns.
   2. Unless otherwise indicated, extend treatment to every surface of substrate in area indicated for treatment, including pipe trenches, pipe chases, pits, sumps, and similar offsets and features.

3.04 PROTECTION

A. Protect applied crystalline waterproofing from rapid drying, severe weather exposure, and water accumulation.
   1. Maintain completed Work in moist condition for not less than seven days by covering with impervious sheeting or by other curing procedures recommended by waterproofing manufacturer.

END OF SECTION 07 1616
SECTION 07 2100
BUILDING INSULATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Thermal batt insulation.
   2. Sound attenuation batt insulation in interior partitions

B. Related Sections:
   1. Section 06 1013: Miscellaneous Carpentry
   2. Section 09 2900: Gypsum Board

1.02 REFERENCES

A. California Code of Regulations (CCR), Title 24:

B. ASTM International (ASTM):
   1. ASTM C 423 - Test Method for Sound Absorption Coefficient by the Reverberation Room Method.
   5. ASTM E 136 – Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C.

1.03 QUALITY ASSURANCE

A. Standard: Provide products complying CBC Chapter 7, Section 707 and Part 12, Chapter 12-13, Standards for Insulating Materials.

1.04 SUBMITTALS

A. Product Data:
   1. Manufacturer's product literature and installation instructions for each type of insulation required.

B. Certified Test Reports: Include with product data, copies of certified test reports showing compliance with specified performance values, including R-values, characteristics, and perm ratings.

C. Quality Certification: Manufacturer's certification stating insulating materials comply with Standards for Insulating Material.
1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to Project Site and store in safe, dry place, with labels intact and legible at time of installation.

B. Protect insulation from physical damage and from becoming wet or soiled.
   1. Comply with manufacturer’s recommendations for handling, storage and protection during installation.
   2. Do not install insulation that has become wet or soiled.
      a. Remove wet or soiled materials from Project Site.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Mineral wool or fiberglass formed into uniform mat of definite dimension and controlled density as manufactured by one of following:
   1. CertainTeed Corporation
   2. Knauf Insulation
   3. Johns Manville
   4. Owens Corning

2.02 THERMAL INSULATION

A. Inorganic mineral or glass fibers formed into flexible resilient blankets (batts) or semi-rigid resilient sheets complying with ASTM C 665, Type I
   1. Blankets without membrane facing in manufacturer’s standard lengths and widths as required, conforming to following:
      a. Surface Burning Characteristics, ASTM E 84:
         1) Flame spread index of 25 or less
         2) Smoke developed index of 50 or less.

B. Provide thermal insulation with material only “R” value as follows:
   1. Underside of roof deck, roof rafter spaces:
   2. Nominal 6 inch thickness: R-30

C. Sag Wires: 18 gage steel wires.

2.03 SOUND ATTENUATION INSULATION

A. Wall Cavity: Unfaced glass fiber insulation batts, complying with ASTM C 665, Type I.
   1. Blankets without membrane facing in manufacturer’s standard lengths and widths as required, conforming to following:
      a. Surface Burning Characteristics, ASTM E 84:
         1) Flame spread index of 10 or less
         2) Smoke developed index of 10 or less.

B. Provide sound insulation in interior partitions conforming to following:
   1. Minimum 3-1/2 inches thick, friction fit.
   2. NRC Rating of 1.0 on E-405 mounting.
2.04 ACCESSORIES

A. Provide accessory materials, not specifically described but required for complete and proper installation, as selected by Contractor, subject to approval of Architect.
   1. Provide metal clips, impaling pins and washers, hardware, zinc-coated wires, furring channels, and other items for anchoring insulation to substrates as required and recommended by insulation manufacturer.

PART 3 – EXECUTION

3.01 INSPECTION AND PREPARATION

A. Inspect substrate and conditions under which insulation work is to be performed.

B. Clean substrates of substances harmful to insulations, including removal of projections which might interfere with installation.

C. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Comply with manufacturer's instructions for particular conditions of installation in each case.
   1. Where printed instructions are not available or do not apply to project conditions, consult manufacturer's technical representative for specific recommendations before proceeding with Work.

B. Extend insulation full thickness as shown over entire surface to be insulated.
   1. Cut and fit batt insulation tightly around pipes, conduits and penetrations.
   2. Remove projections which interfere with placement.

C. Apply single layer of insulation of required thickness, unless otherwise shown or required to make up total thickness.
   1. Maintain total insulation integrity over entire area to be insulated, including areas between closely spaced members.

D. Apply insulation units to substrate by method indicated, complying with manufacturer's recommendations.
   1. Where specific method is not indicated, use mechanical anchorage to provide permanent placement and support of units.
   2. Prevent batt insulation from sagging during and after installation by installing adequate sag wires.

E. Make insulation continuous at corners and overlaps.
   1. Fit tightly against adjoining insulation and frames.
   2. Extend insulation from floor to ceiling or above as indicated.
   3. Avoid gaps, bulges or extreme compression.
      a. Do not compress batt insulation in excess of 10 percent
3.03 PROTECTION

A. Protect installed insulation from harmful weather exposures and from possible physical abuse, by temporary covering or enclosure, where installation of concealing work is delayed.
   1. Installer shall advise Contractor of exposure hazards, including possible sources of deterioration and fire hazards.

3.04 CLEANUP

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

END OF SECTION 07 2100
SECTION 07 4213
ALUMINUM PLATE PANEL SYSTEM

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes aluminum plate panels used as exterior cladding.

1.02 PERFORMANCE REQUIREMENTS

A. Structural performance: provide exterior/interior wall cladding assemblies capable of withstanding the effects of load and stresses from dead loads, wind loads, snow loads and normal thermal movement without evidence of permanent defects of assemblies or components.
   1. Dead load: As required by applicable building code.
   2. Live Load: As required by applicable building code.
   3. Wind Load: Uniform pressure (velocity pressure) of (Insert Design Criteria) lb/sq ft. (Insert Design Criteria), acting inward or outward.
   4. Thermal Movements: Provide assemblies that allow for thermal movements resulting from the following maximum changes (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components and other detrimental effects:
      a. Temperature Change (range): 120 degrees F, ambient; 180 degrees F, material surfaces.

B. Sealed joints shall allow free and silent movement of panels during expansion and contraction while preventing uncontrolled penetration of moisture.

C. Manufacturing, installation, and sealing shall prevent deformation of exposed surfaces.

D. Design panel system to accommodate substructure tolerance of +0 to -1/8 inch.

E. Not Permitted: Vibration harmonics; wind whistles; noises caused by thermal movement; thermal movement transmitted to other building elements; loosening, weakening or fracturing of attachments or components of system.

F. Preformed metal panel system to withstand code imposed design loads. Maximum allowable deflection of span: L/180.

G. Air Infiltration: Panel system shall not have air infiltration rate more than 0.12 cfm per sq. ft. of fixed wall area when tested in accordance with ASTM E 283 at static air pressure differential of 1.57 psf.
H. Static Water Penetration: Panel system shall have no water penetration as defined by test method when tested in accordance with ASTM E 331 at inward static pressure differential of not less than 6.24 psf positive static air pressure difference for a 15 minute duration, with a water application rate of 5 gal/ft²/hr.

I. Dynamic Water Penetration: Panel system shall have been tested in accordance with AAMA 501 and shall have passed with no uncontrolled water leakage at 15.0 psf dynamic pressure differential for a 15 minute duration, with water application rate of 5 gal/ft²/hr.

J. Cyclic Static Air Pressure Differential: Provide a panel system capable of pressure cycle testing in accordance with ASTM E 1233. Testing shall consist of 100 cycles from 5 psf to 25 psf and system must pressure equalize in less than 0.08 seconds when tested as part of AAMA 508-7 test protocol.

K. Pressure Equalized Rain Screen Performance: Provide a panel system designed to have no streaming water or droplets/mist on more than 5% of the cavity moisture barrier, when tested to AAMA 508-07 which includes static and dynamic testing with imperfect air barriers.

1.03 SUBMITTALS

A. Product Data: Manufacturer’s product literature for the panel specified.

B. Shop Drawings: For exterior/interior wall panel assemblies and accessories. Include plans; elevations; sections and details.

C. Structural Calculations: Submit a comprehensive analysis of design loads, including dead loads, live loads, wind loads and thermal movement.

D. Quality Assurance Submittals:
   1. Certificates: Product certificates signed by manufacturer certifying materials comply with the specified performance characteristics and criteria, and physical requirements.

E. Samples for initial selections: Manufacturer’s color charts showing the full range of colors available for units with factory-applied color finishes.

F. Samples for verification: Provide color samples of selected color. Samples shall involve normal color and texture variations, include sample sets showing the full range of variations expected.

G. Affidavit certifying that the material meets the requirements specified.

1.04 QUALITY ASSURANCE

A. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where the project is located and who is experienced in providing engineering services of kind indicated.

B. Manufacturer Qualifications: Minimum of 5 years experience in manufacturing exterior wall panels similar to those specified.
C. Installer Qualifications: Acceptable to manufacturer.

1.06 DELIVERY, STORAGE & HANDLING

A. General: Comply with Division 1 Product Requirements Sections.

B. Ordering: Comply with manufacturer's ordering instructions, and lead-time requirements to avoid construction delays.

C. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
   1. Store materials in accordance with manufacturer's recommendations.
   2. Handle materials carefully to avoid damage to materials and finishes.

1.06 PROJECT CONDITIONS

A. Field Measurements: Verify actual supporting and adjoining construction by field measurements before fabrication, and indicate recorded measurements on final shop drawings. Coordinate construction to ensure that wall panel assemblies fit properly to supporting and adjoining construction and coordinate schedule with construction progress to avoid delaying the work.
   1. Established dimensions: where field measurements can not be made without delaying the work, guarantee dimensions and proceed with fabrication of wall panel assemblies corresponding to the established dimensions.

1.07 WARRANTY

A. Project warranty refers to Conditions of the Contract for project warranty provisions. Manufacturer's warranty: submit, for Owner's acceptance, manufacturer's standard warranty documents executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights owner may have under Contract Documents.

B. The Contractor shall warrant the materials to be free of faults and defects in accordance with the General Conditions, except that the warranty shall be extended by paint manufacturer's standard multi-year warranty. The warranty shall be in writing and shall be signed by the manufacturer.

C. Materials Manufacturers: Repair or replace defective materials for a period of two (2) years.

D. Panel System Manufacturer: Repair or replace fabricated products which fail due to faulty workmanship for a period of five (5) years.

E. Panel System Installer: Repair or replace products or components which fail due to faulty workmanship for a period of two (2) years.

F. Painted Finish: Coatings Manufacturer and applicator to warrant paint for period of twenty years after date of Substantial Completion.
   1. Factory applied finish applied by applicator will not:
      a. Chip, crack or peel (lose adhesion) but does not include minute fracturing which may occur in proper fabrication of building parts.
b. Chalk in excess of ASTM D 4214 number eight rating, determined by procedure outlined in ASTM D 4214 specification test.

c. Change color more than five Delta-E Hunter units (square root of the sum of square Delta L, Delta a, and Delta b) as determined by ASTM D 2244.

2. It is acknowledged that fading or color changes may not be uniform when surfaces are not equally exposed to the sun and elements.

1.08 DEFERRED APPROVAL

A. Work of This Section Is Deferred Approval Item.
   1. Comply With Section 01 3300 for Deferred Approval submittal requirements.

B. Do not start fabrication and installation of Deferred Approval item until detailed drawings, specifications, and engineering calculations have been approved by Architect and Division of the State Architect.

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Manufacturers: Subject to compliance with specified requirements, provide products manufactured by one of following:
   3. Quality Metalcrafts, LLC

2.02 MATERIALS

A. Aluminum Extrusions: ASTM B221, alloy 6063-T6 or 6061-T6

   1. Thickness: 0.125 inch

2.03 FABRICATION, GENERAL

A. Tolerances
   1. Reinforce panels with stiffeners where applicable to meet design criteria.
   2. Panel lines, breaks, and angles shall be sharp and true, and surfaces shall be free from warp or buckle.

B. Panel surfaces shall be free of scratches or marks caused during fabrication.

C. If a metallic color is selected ensure that panel grain is maintained. Under no circumstances are panel blank sizes to be rotated even if material waste in increased.

D. Condensation: Fabricate panels for control of condensation, including vapor inclusion of seals and provisions for breathing, venting, weeping and draining.
2.04 ACCESSORIES

A. Exposed rivets/fasteners shall be stainless steel.

B. Hidden fasteners shall be Climaseal coated or stainless steel.

C. Flashing: Aluminum, same finish as for aluminum panel where exposed; secured with concealed fastening method.

D. Panel System Subgrits: Provide G90 galvanized steel of gauge and spacing required for panel system structural requirements, as recommended by panel manufacture and in accordance with approved shop drawings. To avoid galvanic reaction, separate dissimilar metals.

E. Proprietary extrusions supplied by fabricator. System is to be Dry Set with exposed stainless steel rivets located in the return flange.

F. No exposed sealant to be used at panel-to-panel connections.

2.05 FINISHES - GENERAL

A. Comply with NAAMM Metal Finishes Manual for architectural metal products for recommendations for applying and designating finishes.

2.06 ALUMINUM FINISHES

A. Panel Finishes:
   1. Refer to Section 05 0513 for specified finish.

PART 3 – EXECUTION

3.01 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation. Panel substructure shall be level and plumb. Panel substructure shall be structurally sound as determined by that subcontractor’s engineer. Panel substructure shall be free of defects detrimental to work and erected in accordance with established building tolerances. Coordinate delivery of such items to Project Site.

3.02 INSTALLATION

A. Erect panels level and plumb, in proper alignment in relation to substructure framing and established lines.

B. Panels shall be erected in accordance with approved shop drawings.

C. Panel anchorage shall be structurally sound and per engineering recommendations.

D. Where aluminum materials come in contact with dissimilar materials, an isolation shim or tape shall be installed at fastening locations.
E. Locate and place wall panels’ level, plumb, and at indicated alignment with adjacent work.

3.03 CLEANING AND PROTECTING

A. Clean exposed surfaces of wall panels that are not protected by temporary covering to remove fingerprints and soil during construction period.

B. Clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Protect wall panel assemblies from damage during construction. Use temporary protective coverings where needed as approved by the wall panel manufacturer.

D. Clean and touch up minor abrasions in finished with air-dried coating that matches color and gloss of, and is compatible with, factory–applied finish coating.

END OF SECTION 07 4213
SECTION 07 4243
ALUMINUM COMPOSITE PANEL SYSTEM

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes aluminum composite panels used as exterior cladding.

1.02 PERFORMANCE REQUIREMENTS

A. Structural performance: provide exterior/interior wall cladding assemblies capable of withstanding the effects of load and stresses from dead loads, wind loads, snow loads and normal thermal movement without evidence of permanent defects of assemblies or components.

1. Dead load: As required by applicable building code.

2. Live Load: As required by applicable building code.

3. Wind Load: Uniform pressure (velocity pressure) of (Insert Design Criteria) lb/sq ft. (Insert Design Criteria), acting inward or outward.

4. Thermal Movements: Provide assemblies that allow for thermal movements resulting from the following maximum changes (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components and other detrimental effects:
   a. Temperature Change (range): 120 degrees F, ambient; 180 degrees F, material surfaces.

B. Sealed joints shall allow free and silent movement of panels during expansion and contraction while preventing uncontrolled penetration of moisture.

C. Manufacturing, installation, and sealing shall prevent deformation of exposed surfaces.

D. Design panel system to accommodate substructure tolerance of +0 to -1/8 inch.

E. Not Permitted: Vibration harmonics; wind whistles; noises caused by thermal movement; thermal movement transmitted to other building elements; loosening, weakening or fracturing of attachments or components of system.

F. Structural Performance / Uniform Load Deflection Test: Provide panel system that has been tested in accordance with ASTM E330 at a design pressure of 60 psf without deformation or failures of structural members. Maximum allowable deflection of span: L/60 at panel and L/180 framing.

G. Air Infiltration: Panel system shall not have air infiltration rate more than 0.12 cfm per sq. ft. of fixed wall area when tested in accordance with ASTM E 283 at static air pressure differential of 1.57 psf when tested as part of AAMA 508-7 test protocol.
H. Cyclic Static Air Pressure Differential: Panel system shall be pressure cycled tested in accordance with ASTM E 1233. Testing shall consist of 100 cycles from 5 psf to 25 psf and system must pressure equalize in less than 0.08 seconds when tested as part of AAMA 508-7 test protocol.

I. Static Water Penetration: Panel system shall have no water penetration as defined by test method when tested in accordance with ASTM E 331 at inward static pressure differential of not less than 6.24 psf positive static air pressure difference for 15 minute duration, with water application rate of 5 gal/ft\(^2\)/hr.

J. Dynamic Water Penetration: Panel system shall have been tested in accordance with AAMA 501 and shall have passed with no uncontrolled water leakage at 6.24 psf dynamic pressure differential for a 15 minute duration, with water application rate of 5 gal/ft\(^2\)/hr.

K. Pressure Equalized Rain Screen Performance: No streaming water or droplets/mist on more than 5% of the cavity moisture barrier, tested to AAMA 508-07 which includes static and dynamic testing with imperfect air barriers.

L. Spline joints shall have method for preventing uncontrolled water penetration through four way (and two way) joints. Method shall have been tested as part of system testing per ASTM 283, 331, AAMA 501 and AMMA 508.

1.03 SUBMITTALS

A. Product Data: Manufacturer's product literature for the panel specified.

B. Shop Drawings: For exterior/interior wall panel assemblies and accessories. Include plans; elevations; sections and details.

C. Structural Calculations: Submit a comprehensive analysis of design loads, including dead loads, live loads, wind loads and thermal movement.

D. Quality Assurance Submittals: Submit the following:
   1. Certificates: Product certificates signed by manufacturer certifying materials comply with the specified performance characteristics and criteria, and physical requirements.

   E. Samples for initial selections: Manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.

   F. Samples for verification: Provide color samples of selected color. Samples shall involve normal color and texture variations, include sample sets showing the full range of variations expected.

   G. Affidavit certifying that the material meets the requirements specified.

1.04 QUALITY ASSURANCE

A. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where the project is located and who is experienced in providing engineering services of kind indicated.
B. Manufacturer Qualifications: Minimum of 5 years experience in manufacturing exterior wall panels similar to those specified.

C. Installer Qualifications: Acceptable to manufacturer.

1.05 DELIVERY, STORAGE & HANDLING

A. Ordering: Comply with manufacturer’s ordering instructions, and lead-time requirements to avoid construction delays.

B. Delivery: Deliver materials in manufacturer’s original, unopened, undamaged containers with identification labels intact.
   1. Store materials in accordance with manufacturer’s recommendations.
   2. Handle materials carefully to avoid damage to materials and finishes.

1.06 PROJECT CONDITIONS

A. Field Measurements: Verify actual supporting and adjoining construction by field measurements before fabrication, and indicate recorded measurements on final shop drawings. Coordinate construction to ensure that wall panel assemblies fit properly to supporting and adjoining construction and coordinate schedule with construction progress to avoid delaying the work.
   1. Established dimensions: where field measurements can not be made without delaying the work, guarantee dimensions and proceed with fabrication of wall panel assemblies corresponding to the established dimensions.

1.07 WARRANTY

A. Project warranty refers to Conditions of the Contract for project warranty provisions. Manufacturer’s warranty: submit, for Owner’s acceptance, manufacturer’s standard warranty documents executed by authorized company official. Manufacturer’s warranty is in addition to, and not a limitation of, other rights owner may have under Contract Documents.

B. The Contractor shall warrant the materials to be free of faults and defects in accordance with the General Conditions, except that the warranty shall be extended by paint manufacturer's standard multi-year warranty. The warranty shall be in writing and shall be signed by the manufacturer.

C. Materials Manufacturers: Repair or replace defective materials for a period of two (2) years.

D. Panel System Manufacturer: Repair or replace fabricated products which fail due to faulty workmanship for a period of five years.

E. Panel System Installer: Repair or replace products or components which fail due to faulty workmanship for a period of two years.
F. Painted Finish: Coatings Manufacturer and applicator to warrant paint for a period of twenty years after date of Substantial Completion.
   1. Factory applied finish applied by applicator will not:
      a. Chip, crack or peel (lose adhesion) but does not include minute fracturing which may occur in proper fabrication of building parts.
      b. Chalk in excess of ASTM D 4214 number eight rating, determined by the procedure outlined in ASTM D-4214 specification test.
      c. Change color more than five Delta-E Hunter units (square root of the sum of square Delta L, Delta a, and Delta b) as determined by ASTM D 2244.
      d. It is acknowledged that fading or color changes may not be uniform when surfaces are not equally exposed to sun and elements.

1.08 DEFERRED APPROVAL

A. Work of This Section Is Deferred Approval Item.
   1. Comply with Section 01 3300 for Deferred Approval submittal requirements.

B. Do not start fabrication and installation of Deferred Approval item until detailed drawings, specifications, and engineering calculations have been approved by Architect and Division of the State Architect.

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Manufacturers: Subject to compliance with specified requirements, provide products manufactured by one of following:
   1. Firestone Metal Products - Series 1200 - Aluminum Composite Wall Panel System.
   3. Quality Metalcrafts, LLC

2.02 MATERIALS

A. Aluminum Extrusions: ASTM B221, alloy 6063-T6 and/or 6061-T6

B. Panels shall be 4mm aluminum composite material.

C. Fire Retardant Core (FR): Noncombustible; shall have a Class “A” building material rating when tested in accordance with ASTM E84 (Steiner Tunnel Test). Additionally shall have been tested in accordance with ASTM E108, ASTM E162, ASTM D1929, UL 1715 and ASTM E119 (both one and two hour) testing.

2.03 FABRICATION - GENERAL

A. Composition
   1. Aluminum composite material shall be composed of a thermoplastic core sandwiched between two aluminum sheets formed in a continuous process with no applied glues or adhesives.
   2. Bond integrity per ASTM D1781 and ASTM C481 Cycle B, shall be a minimum of 40 in-lb.in. (Peel Strength)
B. Aluminum face sheets  

C. Tolerances:  
   1. Panel bow shall not exceed 3.8% of panel overall dimension in width or length.  
   2. Panel dimensions shall be such that there will be an allowance for field adjustment and thermal movement.  
   3. Panel lines, breaks and curves shall be sharp, smooth and free from warps or buckles.

D. Panel surfaces shall be free of scratches or marks caused during fabrication.

E. Ensure that entire project is manufactured from single color coil paint run to ensure color uniformity.

F. When metallic color is selected ensure that panel grain is maintained. Under no circumstances are panel blank sizes to be rotated even if material waste is increased.

G. Condensation: Fabricate panels for control of condensation, including vapor inclusion of seals and provisions for breathing, venting, weeping and draining.

2.04 ACCESSORIES

A. Exposed rivets/fasteners shall be stainless steel.

B. Hidden fasteners shall be Climaseal coated or stainless steel.

C. Flashing: Aluminum, same finish as for aluminum panel where exposed; secured with concealed fastening method.

D. Panel System Subgrits: Provide G90 galvanized steel of gauge and spacing required for panel system structural requirements, as recommended by panel manufacture and in accordance with approved shop drawings. To avoid galvanic reaction, separate dissimilar metals.

E. Dry Set System: Proprietary extrusions supplied by fabricator.  
   1. Set with exposed stainless steel rivets located in return flange.

F. Wet Seal System: Install exposed sealant, conforming to requirements of Section 07 9200 at panel-to-panel connections.  
   1. Sealant shall be non-staining type.

2.05 FINISHES, GENERAL

A. Comply with NAAMM Metal Finishes Manual for architectural metal products for recommendations for applying and designating finishes.

2.06 ALUMINUM FINISHES

A. Panel Finishes:  
   1. Refer to Section 05 0513 for specified finish.
PART 3 – EXECUTION

3.01 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation. Panel substructure shall be level and plumb. Panel substructure shall be structurally sound as determined by that subcontractor’s engineer. Panel substructure shall be free of defects detrimental to work and erected in accordance with established building tolerances. Coordinate delivery of such items to project site.

3.02 INSTALLATION

A. Erect panels level and plumb, in proper alignment in relation to substructure framing and established lines.

B. Panels shall be erected in accordance with approved shop drawings.

C. Panel anchorage shall be structurally sound and per engineering recommendations.

D. Where aluminum materials come in contact with dissimilar materials, an isolation shim or tape shall be installed at fastening locations.

E. Locate and place wall panels’ level, plumb, and at indicated alignment with adjacent work.

3.03 CLEANING AND PROTECTING

A. Clean exposed surfaces of wall panels that are not protected by temporary covering to remove fingerprints and soil during construction period.

B. Clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Protect wall panel assemblies from damage during construction. Use temporary protective coverings where needed as approved by the wall panel manufacturer.

D. Clean and touch up minor abrasions in finished with air-dried coating that matches color and gloss, and is compatible with, factory–applied finish coating.

END OF SECTION 07 4243
SECTION 07 6200

SHEET METAL FLASHING AND TRIM

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Sheet metal flashings and trim not part of roof repairs.
   2. Reglet and counter flashing assemblies.
   3. Miscellaneous metal flashing and counter flashing as required, except where provided under Division 23 or Division 26.
   4. Drip flashings.
   5. Other sheet metal items, not necessarily specified herein or in other sections, but required to prevent penetration of water into building.

B. Related Sections:
   1. Section 05 0513: Shop-Applied Coatings for Metal
   2. Section 06 1013: Miscellaneous Carpentry
   3. Section 07 0150: Roof Repairs
   4. Section 07 9200: Joint Sealants.
   5. Section 07 9513: Expansion Joint Cover Assemblies
   6. Section 09 9100: Painting; items specified to be field painted

1.02 REFERENCES

A. ASTM International (ASTM):
   1. ASTM A 653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

B. Sheet Metal & Air Conditioning Contractors’ National Association (SMACNA):

1.03 QUALITY ASSURANCE

A. Standards: Comply with material and installation requirements of Sheet Metal and Air Conditioning Contractor's National Association (SMACNA), Architectural Sheet Metal Manual, unless otherwise indicated or specified.

B. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, or fastener disengagement.

1.04 SUBMITTALS

A. Shop Drawings: Showing fabrication, jointing and securing of metal to form flashings and trim.
1. Show expansion joint details and waterproof connections to adjoining work and at obstructions and penetrations.
2. Identify material, thickness, weight and finish for each item and location in Project.
3. Details for forming sheet metal flashing and trim, including profiles, shapes, seams and dimensions.
4. Details for fastening, joining, supporting and anchoring sheet metal flashing and trim, including fasteners, clips, cleats and attachments to adjoining work.

B. Samples for Verification: For each type of sheet metal flashing and trim indicated with factory-applied color finishes, minimum of four 6 inch square samples.

1.05 SEQUENCING

A. Coordinate metal flashing and trim work with adjacent work, including installation of roofing, waterproofing, drains, piping, blocking, nailers, reglets, framing at openings, curbs and parapets.

B. Coordinate installation with interfacing and adjoining construction to provide leakproof, secure, and non-corrosive installation.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver sheet metal flashing materials and fabrications undamaged.
1. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.

B. Unload, store and install sheet metal flashing materials and fabrications in manner to prevent bending, warping, twisting and surface damage.

C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering.
1. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

PART 2 – PRODUCTS

2.01 SHEET METAL MATERIALS

A. Galvanized Steel: ASTM A 653 with G90 coating, structural quality, minimum 0.0299 inch thickness (22 U.S. standard gage) unless otherwise indicated
1. Prepainted Type: Finish coated with colored 1 mil dry film thickness, fluoropolymer (Kynar resin-based) coating one side, 0.3 to 0.4 mil on other side.
   a. Use in visually exposed locations.
   b. Comply with requirements in Section 05 0513 for Metal Finish Type B
   c. Color: As selected by Architect

2.02 MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Fasteners: Same metal as flashing-sheet metal or other corrosion resistant metal as recommended by sheet manufacturer.
1. Match finish of exposed heads with material being fastened.
B. Reglets: Metal units of type and profile indicated, compatible with flashing indicated, corrosion resistant.
   1. Fry Reglet Co. "Spring Lok" 2-piece style as indicated; 24 gage galvanized steel.
   2. Provide manufacturer's standard prefabricated corner units.
   3. Use stainless steel washers with neoprene facing.
   4. Equivalent products by MM Systems or Lane-Aire may be used subject to acceptance by Architect.

C. Metal Accessories: Provide sheet metal clips, straps, anchoring devices and similar accessory unit as required for installation of Work, matching or compatible with material being installed, corrosion resistant, size and gage required for performance.

D. Zinc Drain Pans and Pipe Flashing: ASTM B 69, 99.995% pure zinc; ZincJak by Commercial Innovations
   1. Thickness: 0.02 inch
   2. Pipe Flashing: Interior coated, exterior preprimed
   3. Drain Pans: Pretreated both sides with factory primer topside coating
   4. Lead Free Solder for Zinc: SN 100C, Aim Solder
   5. Flux for Zinc: No. 17 or No. 70, Superior Flux Mfg. Co.

E. Epoxy Seam Sealer: 2-part noncorrosive metal seam cementing compound, recommended by metal manufacturer for exterior/interior nonmoving joints including riveted joints.

F. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

G. Isolation Between Dissimilar Materials:
   1. Provide single-component, inert-type non-corrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities; VOC compliant.
   2. Elasto-Deck BT as manufactured by Pacific Polymers, div. ITW Polymers Sealants North America, or equivalent product acceptable to Architect.

H. Roofing Cement: ASTM D 4586, asphaltic, compatible with roofing materials.

I. Elastomeric Sealant: Generic type recommended by manufacturer of metal and fabricator of components being sealed; comply with ASTM C 920 and requirements of Section 07 9200.


2.03 FABRICATION

A. Sheet metal work is not necessarily individually described.
   1. Descriptions included are major items or those requiring detail.
   2. Provide other work, as indicated or necessary.

B. Shop fabricate Work to greatest extent possible.
   1. Comply with details shown, applicable requirements of SMACNA Manual, and other recognized industry practices.
2. Fabricate for waterproof and weather-resistant performance; with expansion provisions for running work, sufficient to permanently prevent leakage, damage or deterioration of Work.
3. Form work to fit substrates.
4. Comply with material manufacturer instructions and recommendations for forming material.
5. Form exposed sheet metal work without excessive oil-canning, buckling and tool marks, true to line and levels indicated, with exposed edges folded back to form hems.

C. Seams: Fabricate non-moving seams in sheet metal with flat-lock seams.
   1. For metal other than aluminum, tin edges to be seamed, form seams, and solder.

D. Expansion Provisions: Where lapped or bayonet-type expansion provisions in Work cannot be used, or would not be sufficiently water/weatherproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

E. Separations: Provide for separation of metal from non-compatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with isolation coating or other permanent separation as recommended by manufacturer/fabricator.

F. Counterflashing, reglets, gravel stops, copings and edgings in stock patterns, conforming substantially to details and design as shown, are acceptable.
   1. Manufacturers: Fry Reglet Corp., Lane-Aire Corp., or approved equal.

PART 3 – EXECUTION

3.01 GENERAL

A. Inspect substrates and conditions under which metal flashing and trim will be installed.
   1. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Except as otherwise indicated, comply with manufacturer's installation instructions and recommendations, and with SMACNA Manual.
   1. Anchor units of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated.
   2. Install Work with laps, joints and seams which will be permanently watertight and weatherproof.
   3. Use fasteners, solder, welding rods, protective coatings, separators, sealants and other miscellaneous items as required to complete sheet metal flashing and trim system.
   4. Anchor sheet metal flashings in accordance with Factory Mutual Loss Prevention Data Sheet 1-49.
   5. Drive exposed fasteners through steel/neoprene washers.

C. Bed flanges of Work in thick coat of isolation coating where required for waterproof performance.
D. Install reglets to receive counter flashing in manner and by methods indicated.
   1. Where shown in concrete, furnish reglets to trades of concrete and masonry work for installation as Work of Sections 03 3000 and 04 2000.
   2. Install counterflashing in reglets, either by snap-in seal arrangement, or by wedging in place for anchorage and filling reglet with mastic or elastomeric sealant, as indicated and depending on degree of sealant exposure.

E. Metal Protections: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with isolation coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.

F. Install exposed sheet metal flashing and trim without excessive oil canning, buckling and tool marks.

   1. Space movement joints at maximum of 10 feet with no joints allowed within 24 inches of corner or intersection.
   2. Where lapped or bayonet-type 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 elastomeric sealant concealed within joints.

H. Seal joints with elastomeric or butyl sealant as required for watertight construction.

I. Touch-up abraded areas, where coating has been damaged, with 2 mil coating of paint, specifically recommended by manufacturer for repair of prepainted coatings.

3.02 ROOFING WORK

A. General: Install sheet metal work and accessories under direct supervision, and to complete satisfaction of roofing installer.
   1. Install Work watertight and weathertight throughout.
   2. Provide for expansion and contraction, free from undue stress in any part of completed Work using lap-type expansion joints bedded in flashing compound.

B. For embedment of metal flashing flanges in roofing or composition flashing or stripping, extend flanges for minimum of 4 inch embedment.

C. Pipe and Conduit Penetrations of Roofing:
   1. Flash with zinc flashing.
   2. Flanges stripped in by roofer.
   3. At short vent pipes, flash per SMACNA, Figure 4-158, with top of flashing turned down 2 inches inside vent pipe.
   4. At pipes extending above roof too far to completely cover with zinc, extend zinc flashing up pipe minimum 8 inches and counterflash with storm collar with draw band per SMACNA, Figure 4-15C.
      a. Seal top of storm collar against pipe with elastomeric sealant.
3.03 CLEANING

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

END OF SECTION 07 6200
SECTION 07 8116

CEMENTITIOUS FIREPROOFING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Wet mix spray-applied fire resistive material (SFRM) applied to following, where indicated:
      a. Steel beams
      b. Metal decking.

B. Related Sections:
   1. Section 05 1200: Structural Steel Framing
   2. Section 05 3000: Metal Decking
   3. Section 07 8400: Firestopping

1.02 REFERENCES


B. ASTM International (ASTM):
   1. ASTM D2240 - Standard Test Method for Rubber Property—Durometer Hardness
   4. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C
   5. ASTM E605 - Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members
  11. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

C. Underwriters’ Laboratories, Inc. (UL):
   1. UL Fire Hazard Classifications
   2. UL Building Materials Directory
   3. UL Fire Resistance Directory
D. The Association of the Wall and Ceiling Industry (AWCI):
      Inspection of Field Applied Sprayed Fire-Resistive Materials; an Annotated
      Guide.

E. South Coast Air Quality Management District (SCAQMD):
   1. SCAQMD Rule 1113 – Architectural Coatings

1.03 QUALITY ASSURANCE

A. Installer of Cementitious Fireproofing: Firm licensed or otherwise approved by
   manufacturer of primary fireproofing materials, including qualified factory training
   where recommended by manufacturer.

B. Fire-Endurance Ratings: Provide products which have been tested in accordance
   with ASTM E 119 for fire-resistance, and rated by UL or other industry-recognized
   agency for required resistances.

C. Surface Burning Characteristics: As indicated for sprayed-applied fire-proofing
   product, tested per ASTM E 84 and listed in UL Building Materials Directory.

D. Fire-Resistance Ratings: As indicated by reference to fire-resistant designs listed in
   UL Fire Resistance Directory, or in comparable publication of another testing and
   inspecting agency acceptable to authorities having jurisdiction.
   1. For fire-resistant assemblies where sprayed-applied fireproofing serves as
      direct-applied protection, tested per ASTM E 119.

1.04 SUBMITTALS

A. Product Data: Manufacturer's product specifications and application instructions.

B. Test reports containing following information:
   1. Test results from an independent testing laboratory indicating compliance of
      sprayed-applied fireproofing products with performance requirements
      indicated, including asbestos content where applicable.
   2. Test results of in-place performance as required under Part 3 of this Section
      for field quality control.

C. Certificates:
   1. Manufacturers certification that fireproofing material complies with specified
      product requirements and is suitable for use indicated.
   2. Certification by manufacturers that products supplied comply with local
      regulations controlling use of Volatile Organic Compounds (VOC).
   3. Applicators certification that sprayed fireproofing has been completed as
      specified and meets fire resistance ratings, thickness requirements, and
      application requirements.

D. Qualification data for firms and persons specified in "Quality Assurance" article to
   demonstrate their capabilities and experience.
   1. Include list of completed projects with project names, addresses, names of
      architects and owners and other information specified.
1.05 PROJECT CONDITIONS

A. Environmental Conditions: Do not install sprayed-on fireproofing when ambient or substrate temperatures are 40 degrees F and falling, unless temporary protection and heat is provided to maintain temperatures at or above this level for 24 hours before, during, and for 24 hours after applying sprayed-applied fireproofing.

B. Protection:
   1. Ventilation: Ventilate sprayed-on fireproofing by natural means or, where this is inadequate, forced-air circulation during and after application until fireproofing dries thoroughly.
   2. Provide temporary enclosures to prevent spray from contaminating air.
   3. Protect adjacent surfaces and equipment from damage by overspray fall-out, and dusting off of sprayed fireproofing materials.
   4. Provide fire extinguisher and post caution signs warning against smoking and open flame when working with flammable materials.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original, unopened packages bearing name of manufacturer and product identification, date of manufacture; shelf life, if applicable, and fire resistance ratings applicable to Project.

B. Reject damaged packages found unsuitable for use and remove from Project Site.

C. Store materials inside, under cover, above ground and in manner to keep them dry until ready to use.
   1. Remove from Project Site and discard materials that have been exposed to moisture or have otherwise deteriorated.

1.07 SEQUENCING

A. Sequence and coordinate application of sprayed-applied fireproofing with other, related work specified in other sections to comply with following requirements:
   1. Provide temporary enclosures to prevent deterioration of sprayed-applied fireproofing for interior application due to exposure to unfavorable environmental conditions.
   2. Avoid unnecessary exposure of sprayed-on fireproofing to abrasion and other damage likely to occur during construction operations subsequent to its application.
   3. Do not apply fireproofing to metal roof decking substrates until application of roofing has been completed
   4. Prohibit roof traffic during application and drying of fireproofing.
   5. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
   6. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until fireproofing is installed.
   7. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, tested, and corrections made to any defective fireproofing.
1.08 REGULATORY REQUIREMENTS

A. CBC requirements for fire resistance ratings of areas to receive spray-applied fireproofing materials.

B. Underwriters' Laboratories, Inc.: Fire Hazard Classifications.

C. Provide fireproofing products containing no detectable asbestos as determined according to method specified in 40 CFR Part 763, Subpart F, Appendix A, Section 1, Polarized Light Microscopy.

D. Comply with applicable codes and regulations of governmental agencies having jurisdiction including those having jurisdiction over airborne emissions and industrial waste disposal.
   1. Comply with current applicable regulations of California Air Resources Board (CARB), South Coast Air Quality Management District (SCAQMD), and Environmental Protection Agency (EPA), as applicable.
      a. Where those requirements conflict with Specification, comply with more stringent provisions.
   2. Regulatory changes may affect formulation, availability, or use of specified materials.
      a. Confirm availability of materials to be used prior to Project bid and before start of fireproofing application on Project.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, provide products by one of the following:
   1. The Carboline Company
   3. Isolatek International Corp.

2.02 MATERIALS

A. High Density Fireproofing:
   1. Material Composition: Single component, spray-applied, cementitious fireproofing consisting of factory-blended, fire resistive Portland cement based binders and lightweight mineral or synthetic aggregates mixed with water at Project Site to form slurry or mortar for conveyance and application.
   2. Physical Performance Characteristics:
      a. Fireproofing material meeting following physical performance standards:
         1) Dry Density: Measure field density in accordance with ASTM E 605
            a) Minimum Average Density: 40 pcf, or that required by manufacturer, or as listed in UL Fire Resistance Directory for each rating indicated, or as required by authority having jurisdiction, whichever is greater.
         2) Deflection: No cracking of material or delamination from surface to which it is applied when tested in accordance with ASTM E 759.
         3) Bond Impact: No cracking of material or delamination from surface to which it is applied when subject to impact tests in accordance with ASTM E 760
4) Bond Strength:
   a) Minimum Average Bond Strength: 10,000 psf.
   b) Minimum Individual Bond Strength: 8,000 psf.
   c) When tested in accordance with ASTM E 736
5) Air Erosion: Maximum allowable total weight loss of fireproofing material of 0.00 g/ft² when tested in accordance with ASTM E 859.
6) Compressive Strength: No deformation of fireproofing of more than 10 percent when subjected to compressive forces of 540 psi when tested in accordance with ASTM E 761.
7) Corrosion Resistance: Test fireproofing applied to steel in accordance with ASTM E 937.
   a) Fireproofing does not promote corrosion of steel.
8) Impact Penetration: Fireproofing not to show loss of more than 6 cm³ when subjected to impact penetration tests in accordance with ASTM E 760.
9) Surface Burning Characteristics: Exhibit following surface burning characteristics of material when tested in accordance with ASTM E 84:
   a) Flame Spread Index: 0
   b) Smoke Developed Index: 0
10) Resistance to Mold: Formulate fireproofing material at time of manufacture with mold inhibitor.
   a) Test fireproofing material in accordance with ASTM G 21
   b) Show resistance to mold growth for period of 28 days for general use.
11) Combustibility: Noncombustible when tested in accordance with ASTM E 136
12) Durometer Hardness: Minimum Durometer Hardness of 35 when tested in accordance with ASTM D 2240.

3. Product and Manufacturer:
   a. Monokote Z-146 by Grace Construction Products
   b. Pyrocrete 241 by The Carboline Company
   c. Fendolite M-II by Isolatek International

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates with installer present to determine if they are in satisfactory condition to receive sprayed-applied fireproofing.
   1. Substrate is in satisfactory condition when it complies with following:
      a. Comply with requirements in Sections where substrate and related materials and construction are specified.
      b. Free of oil, grease, rolling compounds, incompatible primers, loose mill scale, dirt or other foreign substances capable of impairing bond of fireproofing with substrate under conditions of normal use or fire exposure.
      c. Objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
      d. Are not obstructed by ducts, piping, equipment, and other suspended construction that will interfere with applying fireproofing.
B. Conduct tests according to sprayed-on fireproofing manufacturer's recommendations to verify that substrates are free of oil, rolling compounds, and other substrates capable of interfering with bond where there is any doubt as to their presence.

C. Do not proceed with installation of fireproofing until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean substrate of substances that could impair bond of fireproofing, including oil, grease, rolling compounds, incompatible, primers, and loose mill scale.

B. Sandblast members to receive sprayed fireproofing to remove incompatible materials which would affect bond when scraping, brushing, or washing will not remove materials.

C. Cover other work which might be damaged by fall-out or over-spray of fireproofing materials during spraying operations.
   1. Provide temporary enclosure as may be required to confine operations, protect environment, and ensure adequate ambient conditions including manufacturer's recommended minimum air and substrate temperatures.

3.03 APPLICATION

A. Comply with fireproofing manufacturer's instructions for mixing materials, for application procedures and for types of equipment used to convey and apply fireproofing materials
   1. As applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

B. Provide thicknesses as indicated or as required for compliance with indicated fire-endurance ratings, whichever is greater in each instance.

C. Extend fireproofing full thickness over entire area of each substrate to be protected.
   1. Unless otherwise recommended by fireproofing manufacturer, install body of fireproof covering in single course.

D. Apply fireproofing materials by sprayed-applied method to maximum extent possible.
   1. Following spraying operation in each area, complete coverage by trowel application or other placement method acceptable to manufacturer.

E. Maintain ambient conditions during installation and for cure period following installation, as recommended by manufacturer.
   1. Provide ventilation and avoid excessive rate of drying.
   2. Protect from exposure to sun.

3.04 FIELD QUALITY CONTROL

A. Testing Laboratory: Owner will employ and pay qualified independent testing laboratory to perform field quality control testing.
C. Extent and Testing Methodology: Arrange for testing of completed fireproofing in successive stages in areas of extent described below
   1. Do not proceed with fireproofing of next area until test results for previously completed work evidence compliance with requirements.
   2. Extent of Each Test Area: Not greater than one area or 100 sq. ft., whichever produces greatest number of test areas.
   3. Within each area, testing agency will randomly select one structural member of each type (primary beam, secondary beam, and steel deck, and test fireproofing as follows:
      a. For cohesion and adhesion per ASTM E 736.
      b. For thickness per ASTM E 605.
      c. Lower flanges and webs of beams, and floor deck for density per ASTM E 605 or Appendix A - Alternate Method for Density Determination of AWCI Technical Manual 12-A.
      d. When testing discovers fireproofing not in compliance with requirements, testing agency will perform additional random testing to determine extent of noncompliance.

D. Testing Laboratory: Report test results promptly and in writing to Contractor and Architect.

E. Repair and replace fireproofing where test results indicate that it does not comply with specified requirements for cohesion and adhesion or for density or both.

F. Apply additional fireproofing per manufacturer's directions where test results indicate that thickness does not comply with specified requirements.

G. Additional Testing: Where fireproofing is removed and replaced or repaired, additional testing will be performed to determine compliance with specified requirements.

3.05 CLEANING, REPAIR, AND PROTECTION

A. Cleaning: Immediately upon completion of spraying operations in each containable area of Project, remove over-spray and fall-out of materials from surfaces of Work and clean surfaces to remove evidence of soiling.

B. Cure exposed cementitious fireproofing materials in compliance with fireproofing manufacturers recommendations to prevent premature drying.

C. Protect fireproofing according to recommendations of fireproofing manufacturer and installer from damage resulting from construction operations or other causes so that fireproofing will be without damage or deterioration at time of Substantial Completion.

D. Coordinate installation of fireproofing with other construction to minimize need for other trades to cut or remove fireproofing.
   1. As installation of other construction proceeds, inspect fireproofing and patch areas where fireproofing was removed or damaged.
E. Repair or replace Work which has not been successfully protected.

END OF SECTION 07 8116
SECTION 07 8400

FIRESTOPPING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Firestopping and smoke seals.
   3. Damming material, clips, and closures.

B. Related Sections:
   1. Section 03 3000: Cast-in-Place Concrete.
   2. Section 07 9200: Joint Sealants
   3. Section 09 2900: Gypsum Board.

1.02 REFERENCES


B. ASTM International (ASTM):
   2. ASTM E 814 - Standard Test Method for Fire Tests of Penetration Firestop Systems

C. Underwriter’s Laboratories, Inc. (UL):
   1. UL 1479 - Standard for Fire Tests of Penetration Firestops

1.03 QUALITY ASSURANCE

A. Performance Criteria:
   1. Provide materials and Work to conform to source quality control criteria as specified and 2013 CBC requirements in fire resistant wall and floor assemblies to prevent passage of fire, smoke, and toxic gases.
   2. Installed firestopping shall be of sufficient thickness, width, and density to provide fire resistance rating at least equal to floor, wall, or partition construction into which it is installed.

B. Comply with 2013 CBC requirements for fire rated construction.

C. Qualifications of Manufacturer: Products furnished for firestopping and smoke seals shall be manufactured by firm which has been continuously and regularly employed in manufacture of these materials for period of at least 5 years; and that can provide evidence of these materials being satisfactorily installed on at least 5 projects of similar size and type within such period.
D. Qualifications of Installer: Work of this section shall be installed by firm which has been in the business of installing similar materials for at least 5 consecutive years; and can provide evidence of satisfactory completion of 5 projects of similar size and scope. Installer shall have applicators trained and certified by manufacturer for performing this Work.

1.04 SUBMITTALS

A. Product Data:
   1. Manufacturer's product data for each type of firestopping and smoke seal material proposed for installation. Indicate product characteristics, typical installations, performance, and limitation criteria and test data.
   2. Manufacturer's printed installation instructions for each type of product, system, and construction required for Work. Indicate fire resistance rating of each installation.
   3. Fire test reports from independent testing agency indicating following:
      a. Fire test report of firestopping material installed to substrate and penetration materials similar to Work of this section. Test to indicate both Flame (F) and Temperature (T) Ratings.
      b. Test reports of products to be installed shall indicate conformance to ASTM E 814, UL rating with UL classified system description, and UL classified system detail.

B. Field Samples: No less than 10 days before commencing Work of this section, provide field installed samples of firestopping materials and systems.
   1. Apply one sample of firestopping material for each different penetration and related fire rating required for the Work.
   2. Sample areas shall comply with thickness, fire resistance ratings, and finished appearance.

C. Manufacturer's Qualifications: Evidence of conformance with qualification requirements specified above.

D. Installer’s Qualifications: Evidence of conformance with qualification requirements specified above.

1.05 SYSTEM DESCRIPTION

A. Provide firestopping and smoke seals to prevent passage of fire, smoke, toxic gasses or water from one floor or area to another.
   1. Seal openings in floors, fire rated walls and permanent partitions penetrated by pipes, ducts, conduits and other items as shown, specified, and as required for type of construction.

B. Mineral fiber insulation shall be installed as firesafing at non-rated penetrations not containing pipes, ducts, conduits, and other items in floor slabs, wall partitions, construction-joint conditions between slabs and adjacent construction, and where indicated or required.

C. Provide damming material, clips, and closures as required for support and containment of dams, and other insulation materials required for tested and rated firestopping systems.
1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to Project Site in manufacturer's original, unopened containers bearing correct UL labeling.

B. Firestopping material shall be stored above grade in area protected from detrimental weather and moisture conditions.

C. Firestopping and seal materials shall be installed before expiration of shelf life.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Unless otherwise noted, products shall be as manufactured by Bio Fireshield Inc. (Bio); 3M Fire Protection Products; General Electric (GE), Hilti., or approved equal.

B. Provide materials and systems of specified manufacturers to suit penetration and substrate as determined by various conditions of installation.

2.02 MATERIALS

A. Firestopping Sealant:
   1. Single component, noncombustible firestopping sealant:
      a. Biotherm "S" gun grade, or Biotherm "T" self leveling silicone by Bio
      b. Pensil 100 by GE Silicone
      c. CP25WB by 3M
      d. Approved equal.

B. Firestopping Putty:
   1. One-part intumescent Type FSP by Nelson
   2. MPS/MPP by 3M
   3. Approved equal.

C. Cementitious Firestopping Mortar:
   1. Novasit K-10 (55 lb. density) by Bio
   2. 3M mortar by 3M
   3. Approved equal.
   4. Cementitious mortar shall be non-shrinking, asbestos free type.

D. Firestop Pillows: Manufactured by Bio Fireshield, Nelson, or approved equal.

E. Firesafing, Mineral Fiber or Ceramic Wool Non-Combustible Insulation:
   1. Mineral Fiber: Density 4 pounds per cubic foot:
      a. USG Thermafiber
      b. Fibrex "FBX Safing Insulation"
      c. Approved equal.
   2. Ceramic Wool: Density 6 pounds per cubic foot:
      a. Johns Manville "Ceramic Fiber Insulation"
      b. Carborundum "Fiberfrax" ceramic fiber
      c. Approved equal.
      d. Provide material in tested thickness for required hour rating:
         1) Flame Spread Index: 0.
2) Smoke developed Index: 0.

3. For mineral fiber, provide 20-gage minimum size metal retainer clips and plates for firesafing support in vertical applications and in compliance with tested rating.

F. Supplemental Material: Provide supplementary materials required for complete, fire rated, installation.

2.03 SOURCE QUALITY CONTROL

A. Firestopping and smoke seal material shall be tested by independent testing agency for conformance to Flame (F) and Temperature (T) requirements of ASTM E-814/UL 1479.

B. Conform to UL Fire Hazard Classification Requirements. Material shall be classified as a fill, void, or cavity material and system for UL Through Penetration Firestop System. Comply with UL 1479.

C. Material shall be tested and classified noncombustible per ASTM E 84.

PART 3 – EXECUTION

3.01 APPLICATION REQUIREMENTS

A. Provide single component, noncombustible, firestopping sealant or putty:
   1. Within penetrations subject to movement including conduit, cable bundles, buss duct, and noncombustible pipe.
   2. As sealant or caulking for smoke barrier construction, fire, and smoke dampers, mechanical/electrical framed elements in masonry and gypsum board partition systems, and other conditions.

B. Provide mineral fiber insulation for firesafing at joints and openings through floor slabs, walls, and partitions not indicated to be grouted, gaskets, sealed or otherwise made sound or air tight in this or other sections.
   1. Firesafing shall be packed and wedged solidly from both sides of walls and partitions, and from both top and bottom sides of slabs with noncombustible mineral fiber insulation.

3.02 PREPARATION

A. Examine areas and conditions where firestopping and smoke seals are to be installed for conditions detrimental to proper completion of Work.
   1. Do not proceed with Work until unsatisfactory conditions have been corrected for rated fire protection.

B. Surface to receive firestopping or smoke seals shall be free of dirt, dust, grease, form release agents, or other matter that would impair bond of firestopping material to substrate or penetrating items.
   1. Substrate shall be frost free and when required, dry.

C. Voids and cracks in substrate shall be filled and unnecessary projections removed before installation of firestopping.
D. Penetrating items shall be permanently installed before firestopping and smoke seal installation.

E. Ensure that pipes, conduit, cable, and other items, which penetrate fire rated construction, have been permanently installed before installation of firestopping.
   1. Schedule and sequence Work to ensure that partitions and other construction, which would conceal penetrations, are not installed before installation of firestopping and smoke seals.

3.03 INSTALLATION

A. Provide installation in accordance with manufacturer’s installation procedures, as required.
   1. Install firestops in accordance with fire test reports, UL fire resistance requirements, and reviewed sample installations.

B. Dam Construction:
   1. Install dams when required to properly contain firestopping materials within openings and as required to achieve fire resistance rating as tested and rated.
   2. Provide in conformance with installation requirements for type of floor, wall, and partition construction, and as recommended by firestopping manufacturer.
   3. Combustible damming material shall be removed after appropriate curing.
      a. Noncombustible damming material may be left as permanent component of firestopping system.
   4. Placement of dams shall not interfere with function, or adversely affect appearance, of adjacent construction.

C. Installation of Single Component Firestopping Sealant:
   1. Provide noncombustible insulation as required to achieve fire resistance rating.
   2. Install with manual or powered caulking gun.
      a. For up to 3 hour rating, install in 1/2 inches total thickness to both sides of wall penetrations, and to one side in floor penetrations.
   3. Surface of gun grade firestopping sealant shall be tooled with clean potable water.
   4. Remove excess materials from adjacent surfaces within 10 minutes with either water or other material compatible with sealant and recommended by sealant manufacturer, leaving Work in neat, clean condition.

D. Installation of Cementitious Firestopping Mortar:
   1. Mixing: Add dry powder to water and mix with mechanical mixer or hand mixing tools.
      a. Ratio and duration of mix shall be as instructed by firestopping mortar manufacturer.
      b. Average wet density of mortar shall be 70 pounds per cubic foot (plus or minus 5).
   2. Wet surfaces before installation of firestopping mortar.
      Mortar may be hand installed or pumped into opening.
   3. When installing around layered or grouped cables, vibrate or move cables slightly to prevent voids from forming between cables.
   4. Exposed surfaces shall be finished with conventional plastering tools before curing.
   5. Allow at least 48 hours for initial cure before form removal.
      a. For full cure allow 27 days.
3.04 PROTECTION

A. Protect Work until Substantial Completion.

3.05 CLEANUP

A. Remove and legally dispose of rubbish, debris, and waste materials off Project Site.
SECTION 07 9200

JOINT SEALANTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Joint sealants required to seal exterior and interior joints to make buildings weather and water tight.

B. Related Sections:
   1. Section 08 8000: Glazing; sealants for glazing.
   2. Section 09 2900: Gypsum Board; acoustic sealant.
   3. Section 09 9100: Painting; paintable caulk.

1.02 REFERENCES

A. ASTM International (ASTM):

B. South Coast Air Quality Management District (SCAQMD):
   1. Rule 1168 – Adhesive and Sealant Applications

1.03 QUALITY ASSURANCE

A. Use only qualified workers thoroughly skilled and specially trained in techniques of installing sealant, who can acceptably demonstrate to Architect their ability to fill joints solidly and neatly.

B. Compatibility Tests: Prior to start of sealant work, sealant manufacturer and sealant installer shall conduct compatibility tests of sealant for each different sealing condition and substrate for entire Project.

C. Pre-Installation Meeting:
   1. Arrange meeting when sealant contractor and sealant manufacturers have been selected, but prior to award of contracts.
   2. Schedule meeting with Owner, Architect and General Contractor; arrange for attendance by sealant contractor and sealant manufacturers' technical representatives
   3. Meeting to include, but not limited to, following:
      a. Review of preliminary test results on sealants.
      b. Details of sealant joints.
      c. Sealant application instruction and training of installers.
      d. Scheduling and procedures for periodic field inspections by sealant manufacturers' technical representatives.
   4. Record minutes of meeting and promptly distribute copies of minutes to attendees and other interested parties as may be necessary.
   5. Record issues resolved during meeting.
      a. Include copies of Drawings and application instructions used in meeting.
b. Record changes on Drawings and application instructions made at meeting.

D. Pre-installation Field Testing:
1. Field test adhesion of joint sealant material to Project substrates.
2. Verify joint sealant materials will satisfactorily adhere to substrates.
3. Arrange field testing with manufacturer or designated representative.
4. Notify parties minimum 7 days prior to field testing.

1.04 SUBMITTALS

A. Product Data: Manufacturer's specifications, performance test data, recommendations, handling, installation and curing instructions for each type of sealant, and associated miscellaneous material required.

B. Samples: Minimum of four, 3 inch long samples of each color required (except black) for each type of sealant exposed to view.

C. Compatibility Tests: Results of each compatibility test to Architect and Contractor for approval prior to start of sealant Work.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project Site in original unopened containers bearing manufacturer's name, product designation, date of manufacturer and mixing instructions.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Compatibility: Provide joint sealants, joint fillers and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside building envelope that comply with following limits for VOC content complying with SCAQMD Rule 1168.: 
1. Architectural Sealants: Not more than 250 g/L.
2. Sealant Primers for Nonporous Substrates: Not more than 250 g/L.
3. Sealant Primers for Porous Substrates: Not more than 775 g/L

C. Colors: Provide color of exposed joint sealant indicated or as selected by Architect from manufacturer's standard colors.

D. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealant of base polymer indicated which complies with ASTM C 920 requirements, including those referenced for Type, Grade, and Class,
E. **Sealant No. 1:** Silicone rubber based, one-part, low-modulus, non-acid curing sealant; Type S, Grade NS, Class 50.
   1. Provide one of following product:
      a. Dow Corning 790; Dow Corning Corp.
      b. General Electric Silpruf SCS 2000; Momentive Performance Products
      c. Pecora 890; Pecora Corp.
   2. Apply Sealant No.1 to following exterior joints:
      a. Joints between metal frame and poured-in-place concrete, or masonry
      b. Joints between poured-in-place concrete sections
      c. Vertical expansion and control joints
      d. Horizontal ceiling/soffit joints
      e. Sills, jambs, and heads of window frames, door frames, louvers and similar openings, and where metal, wood, or other materials abut or join concrete, or each other
      f. Other exterior joints
   3. Apply Sealant No. 1 to following interior joints:
      a. Hidden metal to metal storefront joints expected to undergo minimal movement
      b. Under door thresholds
      c. Vertical expansion and control joints
      d. Horizontal ceiling/soffit joints

F. **Sealant No.2:** Two-Component Polyurethane Sealant; Type M, Grade P, Class 25.
   1. Provide one of following products:
      b. MasterSeal SL 2 Sealant: BASF Corporation, Construction Systems
      c. Urexpan NR-200: Pecora, Corp.
   2. Apply Sealant No.2 to following exterior joints:
      a. Horizontal control and expansion joints in concrete slabs and concrete paving
   3. Apply Sealant No.2 to following interior joints:
      a. Horizontal control and expansion joints in concrete slabs and tile flooring.

G. **Sealant No.3:** Mildew-Resistant One-Part Silicone Rubber Sealant; Type S, Grade NS, Class 25; compounded specifically for mildew resistance and recommended by manufacturer for interior joints in wet areas; passing ANSI A 136.1 test for mold growth.
   1. Provide one of following products:
      a. Dow Corning 786: Dow Corning Corp.
      b. General Electric Silicone Sanitary 1702 Sealant: Momentive Performance Products
      c. Pecora 898; Pecora Corp.
   2. Apply Sealant No. 3 to following interior joints:
      a. Joints between plumbing fixtures and other elements

H. **Sealant No.4:** Silicone rubber based, one-part, medium-modulus, neutral curing sealant; Type S, Grade NS, Class 50.
   1. Provide following product:
      a. Dow Corning 756 SMS; Dow Corning Corp., or approved equal
   2. Apply Sealant No.4 to following exterior joints:
      a. Vertical expansion and control joints in tile and concrete masonry
      d. Horizontal ceiling/soffit joints
      e. Other exterior joints where non-staining sealant is required.
2.02 MISCELLANEOUS MATERIALS

A. Joint Primer: Provide type of joint primer recommended by sealant manufacturer for joint surfaces to be primed or sealed.

B. Bond Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer to be applied to sealant-contact surfaces where bond to substrate or joint filler must be avoided for proper performance of sealant.
   1. Provide self-adhesive tape where applicable.

C. Sealant Backer Rod: Compressible rod stock of polyethylene foam, polyethylene jacketed polyurethane foam, neoprene foam or other flexible, permanent, durable non-absorptive material as recommended by sealant manufacturer for compatibility with sealant.
   1. Provide products by one of following, or approved equal.
      a. Denver Foam by Backer Rod Mfg. Inc.
      b. Sof-Rod by Nomaco, Inc.
      c. Sealtight Kool-Rod by W.R. Meadows, Inc.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine joints, with installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint sealant performance.
   1. Correct improper conditions.

3.02 JOINT PREPARATION

A. Clean joint surfaces immediately before installation of sealant or calking compound.
   1. Remove dirt, insecure coatings, moisture and other substances which could interfere with bond of sealant or calking compound.
   2. Etch concrete and masonry joint surfaces as recommended by sealant manufacturer.
   3. Roughen vitreous and glazed joint surfaces as recommended by sealant manufacturer.

B. Prime joint surfaces where recommended by sealant manufacturer.
   1. Do not allow primer to spill or migrate onto adjoining surfaces.

3.03 INSTALLATION OF SEALANT

A. Comply with manufacturer's printed instructions except where more stringent requirements are shown or specified, and except where manufacturer's technical representative directs otherwise.

B. Set joint filler units at proper depth or position in joint to coordinate with other work, including installation of bond breakers, backer rods and sealant.
   1. Do not leave voids or gaps between ends of joint filler units.

C. Install sealant backer rod for sealants, except where recommended to be omitted by sealant manufacturer for application indicated.
D. Install bond breaker tape where required by manufacturer’s recommendations to ensure that elastomeric sealants will perform properly.

E. Employ only proven installation techniques, which will ensure that sealants are deposited in uniform, continuous ribbons without gaps or air pockets, with complete wetting of joint bond surfaces equally on opposite sides.
   1. Except as otherwise indicated, fill sealant rabbet to slightly concave surface, slightly below adjoining surfaces.
   2. Where horizontal joints are between a horizontal surface and vertical surface, fill joint to form slight cove, so that joint will not trap moisture and dirt.
   3. Tool joints to form smooth, uniform beads with slightly concave surfaces, with finished joints straight, uniform, smooth and neatly finished.
   4. Remove excess sealant from adjacent surfaces of joint, leaving work in neat, clean condition.
   5. Do not use tooling agents unless recommended by sealant manufacturer.

F. Seal joints before adjacent surfaces are waterproofed or painted.

G. Install sealant to depths recommended by sealant manufacturer but within following general limitations, measured at center (thin) section of bead:
   1. For sidewalks, pavements and similar joints sealed with elastomeric sealant and subject to traffic and other abrasion and indentation exposures, fill joints to depth equal to 75 percent of joint width, but neither more than 1/2 inch deep nor less than 3/8 inch deep.
   2. For normal moving joints sealed with elastomeric sealant but not subject to traffic, fill joints to depth equal to 50 percent of joint width, but neither more than 1/2 inch deep nor less than 1/4 inch deep.
   3. For joints sealed with non-elastomeric sealants, fill joints to depth in range of 75 percent to 125 percent of joint width.

H. Where irregular surface or sensitive joint border exists apply masking tape at edge of joint to insure joint neatness and protection.
   1. Remove masking tape after sealant is applied.

I. Spillage: Do not allow sealants or compounds to overflow or spill onto adjoining surfaces, or to migrate into voids of adjoining surfaces.
   1. Clean adjoining surfaces by whatever means may be necessary to eliminate evidence of spillage.

J. Recess exposed edges of exposed joint fillers slightly behind adjoining surfaces, unless otherwise shown, so that compressed units will not protrude from joints.

K. Bond ends of joint filler together with adhesive or join by other means as recommended by manufacturer to ensure continuous watertight performance.

3.04 PROTECTION AND CLEANING

A. Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of substantial completion.
1. When, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealant immediately and reseal joints with new materials to produce joint sealant installations with repaired areas indistinguishable from original work.

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

END OF SECTION 07 9200
SECTION 07 9513

EXPANSION JOINT COVER ASSEMBLIES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Expansion and seismic joint cover assemblies for building interior and exterior.

B. Related Sections:
   1. Section 03 3000: Cast-in-Place Concrete
   2. Section 07 0150: Roof Repairs
   3. Section 07 4243: Aluminum Composite Metal Panel System
   4. Section 07 6200: Sheet Metal Flashing and Trim
   5. Section 07 9200: Joint Sealants
   6. Section 08 4413: Aluminum Curtain Wall
   7. Section 09 5100: Acoustical Ceilings

1.02 REFERENCES


B. ASTM International (ASTM):
   1. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
   2. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting
   3. ASTM D2240 - Standard Test Method for Rubber Property—Durometer Hardness
   4. ASTM D2582 - Standard Test Method for Puncture-Propagation Tear Resistance of Plastic Film and Thin Sheeting
   5. ASTM D4833 - Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
   6. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs

C. American Architectural Manufacturers Association (AAMA):

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Approved by manufacturer.

B. Single Source Responsibility: Obtain expansion joint cover assemblies from one source from single manufacturer.
   1. Coordinate compatibility with expansion joint cover assemblies specified in other sections.
C. Product Options: Drawings indicate size, profiles, and dimensional requirements of expansion joint systems and are based on specific systems indicated.
   1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval.
      a. Should modifications be proposed, submit comprehensive explanatory data to Architect for review.

D. Loading Characteristics:
   1. Standard Loading: Refers to covers that are capable of withstanding up to 500 lb. point loads.
   2. Heavy Duty Loading: Refers to covers that are capable of withstanding up to 2000 lb. point loads.

1.04 SUBMITTALS

A. Shop Drawings: Provide following for each joint system specified and obtain approval prior to fabrication and shipment of materials to Project Site:
   1. Placement Drawings: Include line diagrams showing plans, elevations, sections, details, splices, blockout requirement, entire route of each joint system, and attachments to other work.
      a. Show fabrication and installation of expansion joint cover assembly.
   2. Where joint systems change planes, provide isometric or clearly detailed drawing depicting how components interconnect.

B. Product Data: Copies of manufacturer's latest published literature for each type of expansion joint cover assembly specified.
   1. Including, but not limited to, manufacturer's product specifications, installation instructions, details of construction relative to materials, dimensions of individual components, profiles, and finishes.
   2. Obtain approval before materials are fabricated and delivered to Project Site.
   3. Data to clearly indicate movement capability of cover assemblies and suitability of material used in exterior seal for UV exposure.

C. Samples for Verification: Full size units of each type of expansion joint cover assembly indicated.
   1. For each finish and profile specified.
   2. Include related components to show complete joint assembly.

1.05 DEFINITIONS

A. Maximum Joint Width: Widest linear gap joint system tolerates and in which it performs its designed function without damaging its functional capabilities.

B. Minimum Joint Width: Narrowest linear gap joint system tolerates and in which it performs its designed function without damaging its functional capabilities.

C. Movement Capability: Value obtained from difference between widest and narrowest widths of joint.

D. Nominal Joint Width: Width of linear opening specified in practice and in which joint system is installed.
1.06 COORDINATION

A. Coordinate installation of exterior wall joint systems with roof expansion assemblies to ensure that wall transitions are watertight.

1.07 WARRANTY

A. Warranty: Provide manufacturer’s 5 year warranty for expansion joint covers.

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Basis-of-Design: Design for expansion joints is based on products as manufactured by Construction Specialties, Inc.
   1. Provide expansion joints of types indicated on Drawings.
   2. Subject to compliance with specified requirements, provide named product or comparable product by one of following manufacturers:
      a. Balco, Inc.
      b. InPro Jointmaster by InPro Corporation
      c. MM Systems Corporation
      d. Watson Bowman Acme Corporation

2.02 MATERIALS

A. Aluminum:
   1. Extrusions: ASTM B 221, Alloy 6005A-T61, 6063-T5, 6061-T5, 6105-T5
   2. Sheet and Plate: ASTM B 209, Alloy 6061-T6, 3003-H14, 5005-H34
   3. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.

B. Compression Seals: Preformed rectangular elastomeric extrusions having internal baffle system and designed to function under compression.
   1. Joint Assemblies EJ-3:
      a. Primary Seal: Elastomeric
         1) Dual Durometer: 65 Shore A; ASTM D 2240.
   2. Joint Assemblies EJ-4:
      a. Primary Seal: Elastomeric
         1) Single Durometer: 70 Shore A; ASTM D 2240.
      b. Secondary Seal: PVC
         1) Single Durometer: 65 Shore A; ASTM D 2240.
   3. Joint Assemblies EJ-5, EJ-6, and EJ-7:
      a. Primary Seal: Thermoplastic
         1) Single Durometer: 70 Shore A; ASTM D 2240.
   4. Joint Assemblies EJ-8 and EJ-9:
      a. Gasket: Duroflex
         1) Durometer 80 Shore A; ASTM D 2240
      b. Vapor Barrier: Polyethylene; ASTM E 1745
         1) 3 inch Tensile Strength, ASTM D 882: 275 lbs.
         2) Puncture Strength, ASTM D 4833: 72 lbs.
         3) PPT Resistance, ASTM D 2582: 45 lbs.
   5. Elastomeric Material: Santoprene
      a. Colors: As scheduled.
E. Accessories: Manufacturer’s standard anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

### 2.03 EXPANSION JOINT SYSTEMS – GENERAL

A. Provide expansion joint systems of design, basic profile, materials, and operation indicated.
   1. Select units comparable to those indicated or required to suit joint size and to absorb variations in adjacent surfaces and structural movement
   2. Provide units with capability to accommodate variations in adjacent surfaces.

B. Design expansion joint systems for following movement characteristics as indicated on Structural Drawings:
   1. Nominal Joint Width
   2. Maximum Joint Width
   3. Minimum Joint Width
   4. Lateral Shear Movement Capability

### 2.04 SCHEDULE OF EXPANSION JOINT COVERS/ASSEMBLIES

A. Scheduled manufacturer and model number are given here only to identify quality, function, and characteristics, of Basis-of-Design products.
   1. Other listed manufacturers may be used where equal in quality, function, and appearance, as judged solely by Architect.
   2. Following items are products of Construction Specialties, Inc.
      a. Refer to Drawings for locations.

B. Expansion Joint Covers/Assemblies:

<table>
<thead>
<tr>
<th>Type:</th>
<th>Model No./Description:</th>
<th>Finish:</th>
</tr>
</thead>
<tbody>
<tr>
<td>EJ-1</td>
<td>SJPF- 200: Floor Joint System – aluminum frame with aluminum cover plate</td>
<td>Mill finish aluminum</td>
</tr>
<tr>
<td>EJ-2</td>
<td>SJPF- 500: Floor Joint System – aluminum frame with aluminum cover plate</td>
<td>Mill finish aluminum</td>
</tr>
<tr>
<td>EJ-3</td>
<td>SGRW-500: Floor Joint System – aluminum frame with aluminum cover plate and elastomeric primary seal</td>
<td>Mill finish aluminum [color] elastomeric seal</td>
</tr>
<tr>
<td>EJ-4</td>
<td>SF-400: Exterior Wall Cover – aluminum frame with Santoprene primary seal and PVC secondary seal</td>
<td>Mill finish aluminum [color] Santoprene seal [color] PVC seal</td>
</tr>
<tr>
<td>EJ-5</td>
<td>FWF-400: Wall to Wall Joint System – aluminum frame with extruded flexible primary seal</td>
<td>Mill finish aluminum [color] extruded flexible seal</td>
</tr>
<tr>
<td>EJ-6</td>
<td>FWF-500: Wall to Wall Joint System – aluminum frame with elastomeric primary seal</td>
<td>Mill finish aluminum [color] elastomeric seal</td>
</tr>
<tr>
<td>Type:</td>
<td>Model No./Description:</td>
<td>Finish:</td>
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</tr>
<tr>
<td>EJ-7</td>
<td>FCFC-400: Ceiling to Ceiling Joint System - aluminum frame with extruded flexible primary seal</td>
<td>Mill finish aluminum [color] extruded flexible seal</td>
</tr>
<tr>
<td>EJ-8</td>
<td>SRJ-500: Roof Cover – aluminum cover plate and frame with continuous moisture seal and polyethylene vapor barrier</td>
<td>Aluminum Cover Plate finished to match prefinished metal flashing</td>
</tr>
<tr>
<td>EJ-9</td>
<td>SRJW-400: Roof Cover – aluminum cover plate and frame with continuous moisture seal and polyethylene vapor barrier</td>
<td>Aluminum Cover Plate finished to match prefinished metal flashing</td>
</tr>
</tbody>
</table>

### 2.05 METAL FINISHES

A. Comply with NAAMM – Metal Finishes Manual, for finish designation and application recommendations, except as otherwise indicated.
   1. Apply finishes in factory after fabrication.
   2. Protect mechanical finishes on exposed surfaces by applying strippable, temporary protective covering prior to shipment.

B. Aluminum Finishes:
   1. Mill Finish:
   2. Color Finish:
      a. High performance pigmented organic coil coating, meeting or exceeding performance and test provisions of AAMA 2605 for ten years minimum.
      b. Minimum fluoropolymer 70 percent PVDF (Kynar 500 or Hylar 5000) resin system base by weight complying with AAMA 2605.
      c. PPG Duranar Coil Coating System, or approved equal by Valspar.
   3. Appearance of Finished Work: Noticeable variations in same piece are not acceptable.

C. Factory-Primed Concealed Surfaces: Protect concealed metal surfaces to be placed in contact with concrete or masonry with shop-coat of manufacturer’s standard primer on contact surfaces.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

A. Examine surfaces and blockouts where expansion joint systems will be installed for installation tolerances and other conditions affecting performance of Work.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.
3.02 PREPARATION

A. Manufacturer's Instructions: In addition to specified requirements, comply with manufacturer's instructions and recommendations for Work, including preparing substrates, applying materials, and protecting installed units.

B. Repair concrete slabs and blockouts using manufacturer's recommended repair grout of compressive strength adequate for anticipated structural loadings.

C. Coordinate and furnish anchorages, setting drawings, templates, and instructions, installation of expansion joint cover assemblies to be embedded in concrete or have recesses formed into edges of concrete slab for later placement and grouting-in of frames.

D. Cast-In Frames: Coordinate and furnish frames to be cast into concrete.

3.03 INSTALLATION

A. Comply with manufacturer's written instructions for storing, handling, and installing expansion joint cover assemblies and materials, unless more stringent requirements are indicated.

B. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installation of expansion joint covers.
   1. Install joint cover assemblies in true alignment and proper relationship to expansion joints and adjoining finished surfaces, measured from established lines and levels.
   2. Allow adequate free movement for thermal expansion and contraction of metal to avoid buckling of frames.
   3. Set floor frames at elevations to be flush with adjacent finished floor materials.
   4. Locate wall, ceiling, roof, and soffit covers in continuous contact with adjacent surfaces.
   5. Securely attach in place with required accessories.
   6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches from each end and 24 inches on centers.

C. Joinery and Continuity: Maintain continuity of expansion joint cover assemblies with end joints held to minimum and metal members aligned mechanically using splice joints.
   1. Adhere flexible filler materials to seating member with adhesive or pressure sensitive tape as recommended by manufacturer.
   2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation.
   3. Notify Architect where discrepancies occur that will affect proper joint installation and performance.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing expansion joint covers to in-place construction, including threaded fasteners with drilled-in expansion shields for masonry and concrete where anchoring members are not embedded in concrete.
   1. Provide fasteners or proper metal, type, and size to suit type of construction indicated and provide for secure attachment of expansion joint cover assemblies.
   a. Support underside of frames continuously to prevent vertical deflection when in service.
3. Heavy-Duty Systems: Repair or grout blockout as required for continuous frame support and to bring frame to proper level.
   a. Shimming is not allowed.

E. Elastomeric Seal Joint Assemblies: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions.
   1. Provide in continuous lengths for straight sections.
   2. Install with minimum number of end joints.
   3. Seal end joints within continuous runs, and joints at transitions according to manufacturer's written instructions to provide watertight installation.
   4. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
   5. Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.

F. Extruded Preformed Seals: Install seals complying with manufacturer's written instructions and with minimum number of end joints.
   1. For straight sections provide performed seals in continual lengths.
   2. Vulcanize or heat-weld field splice joints in preformed seal material to provide watertight joints using procedures recommended by manufacturer.
   3. Apply adhesive, epoxy, or lubricant-adhesive approved by manufacturer to both frame interfaces before installing preformed seal.
   4. Seal transitions according to manufacturer's instructions.

G. Compression Seals: Apply adhesive or lubricant adhesive as recommended by manufacturer before installing compression seals.

H. Moisture/Vapor Barrier: Provide moisture/vapor barrier at exterior joints and where called for on Drawings.
   1. Provide drainage fittings where indicated.

3.04 CLEANING AND PROTECTION

A. Do not remove strippable protective covering until finish work in adjacent areas is complete.
   1. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

B. Protect installation from damage by work of other Sections.
   1. When necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over joints.
   2. Reinstall cover plates or seals prior to Substantial Completion of Work.

END OF SECTION 07 9513
“L” TOWER BUILDING
SEISMIC AND CODE UPGRADES
RIO HONDO COLLEGE

EXPANSION JOINT COVER ASSEMBLIES
07 9513 - 8
SECTION 08 1113
HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Hollow metal doors and frames as indicated.

B. Related Sections:
   1. Section 07 9200: Joint Sealants
   2. Section 08 7100: Door Hardware
   3. Section 08 8000: Glazing
   4. Section 09 9100: Painting; field painting of steel doors and frames

1.02 REFERENCES

A. California Code of Regulations (CCR), Title 24, Part 2, California Building Code (CBC), Volumes 1 and 2, 2013 edition

B. American National Standards Institute (ANSI)/ Steel Door Institute (SDI):
   1. ANSI/SDI A250.4 – Test Procedure and Acceptance Criteria for – Physical Endurance for Steel Doors, Frames, and Frame Anchors
   2. ANSI/SDI A250.8 – Specifications for Standard Steel Doors and Frames (SDI-100)

C. ASTM International (ASTM):
   1. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
   2. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
   3. ASTM A1008 - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable

D. National Fire Protection Association (NFPA):
   1. NFPA 80 - Standard for Fire Doors and Other Opening Protectives

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum documented experience of more than five years providing hollow metal doors and frames for similar size projects.

B. Coordinate with hardware supplier for fabrication of doors and frames to receive hardware items.
C. Quality Standards: Provide steel doors and frames complying with referenced standards as follows:
   1. ANSI/SDI A250.4
   2. ANSI/SDI A250.8
   3. ANSI A250.10

1.04 SUBMITTALS

A. Product Data: For each type of door and frame indicated.
   1. Including, but not limited to following:
      a. Door designation
      b. Type, level, and model
      c. Material description
      d. Core description
      e. Construction details
      f. Finishes.

B. Shop Drawings: For fabrication and installation of steel doors and frames.
   1. Including, but not limited to following:
      a. Details of each frame type
      b. Elevations of door design types
      c. Conditions at openings
      d. Details of construction
      e. Location and installation requirements of finish hardware and reinforcements.
      f. Details of joints and connections.
   2. Show anchorage and accessory items.

C. Samples:
   1. Hollow Metal Frame: Corner section of typical exterior and interior frame, of sufficient composite size to illustrate following:
      a. Corner joint construction.
      b. Hinge reinforcement.
      c. Closer reinforcement.
      d. Floor anchor, dust cover, and jamb anchors showing galvanizing and prime coat finishes.
   2. Hollow Metal Door: Section of typical interior door of sufficient composite size to illustrate:
      a. Edge, top, and bottom.
      b. Core construction
      c. Hinge reinforcement and face stiffening
      d. Closer and kick plate reinforcement
      e. Corner of vision opening construction with glazing beads.

D. Certification: Certification of compliance with referenced standards and specified criteria, including but not limited to:
   1. Physical Endurance in accordance with ANSI A250.4
   2. Prime Paint performance in accordance with ANSI A250.10, and as specified.

E. Door Schedule: Use same reference designations indicated on Drawings in preparing schedule for doors and frames.
1.05 SYSTEM DESCRIPTION

A. Design Requirements: Door and frame assemblies shall include reinforcing and provisions for hardware as shown and specified.
1. Drawings indicate profile and general details of steel frame fabrication and installation.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames cartoned or crated to provide protection during transit and Project storage.

B. Inspect doors and frames upon delivery for damage and notify shipper and supplier should damage be found.
1. Minor damages may be repaired provided refinished items are equal with respect to new work and acceptable to Architect.
2. Remove and replace damaged items that cannot be repaired as directed.

C. Store doors and frames at Project Site under cover.
1. Place units on minimum 4 inch (100 mm) high wood blocking.
2. Avoid using non-vented plastic or canvas shelters that could create humidity chamber.
3. Should door packaging become wet, remove cartons immediately.
4. Provide minimum 1/4 inch spaces between stacked doors to permit air circulation.

1.07 WARRANTY

A. Manufacturer shall provide 1 year material and workmanship warranty.

B. Installer shall provide 2 year labor warranty.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Hollow metal doors and frames shall be products of single manufacturer.

B. Subject to compliance with specified requirements, provide products by one of following, or approved equal:
1. ASSA ABLOY Door Security Solutions.
2. Door Components, Inc.
3. Steelcraft; division of Allegion

C. Materials, fabrication, and installation must comply with requirements of standards referenced in “Quality Assurance” Article..

2.02 MATERIALS

A. Steel thicknesses must meet minimum requirements of ASTM standards and as described in ANSI/SDI A250.8.

B. Hot Rolled Steel Sheets: ASTM A 1011, Commercial Steel (CS), Type B.
1. Free of scale, pitting, or surface defects; pickled and oiled.
C. Metallic Coated Steel Sheets: ASTM A 653, Commercial Steel (CS), Type B.
   1. A40 zinc-iron-alloy (galvannealed) coating
   2. Stretcher-leveled standard of flatness.

D. Cold Rolled Steel Sheets: ASTM A 1008, Commercial Steel (CS), suitable for exposed applications, Type B.

E. Supports and Anchors: Fabricate from minimum 16 gage sheet steel unless noted otherwise.
   1. After fabricating, galvanize units to be built into exterior walls according to ASTM A 153, Class B.

F. Inserts, Bolts, and Fasteners:
   1. Provide as shown on Drawings and to suit conditions of secure installations.
   2. Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A 153.
   3. Furnish Type 304 stainless steel fasteners at exterior doors.

G. Sound Deadener: Spray-on type, non-combustible and non-bleeding
   1. INC DC-10 Noise Dampening Compound by Industrial Noise Control, Inc., or approved equal

2.03 DOORS

A. General: Provide type and size of doors shown with louvers and openings for glazing where indicated.

B. Interior Doors: Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI A250A for physical endurance level:
   1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless).
      a. 0.053 inch (16 gage) thick faces.

C. Exterior Doors: Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI A250A for physical endurance level:
   1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless).
      a. 0.053 inch (16 gage) thick faces.

D. Door Louvers: Provide louvers for interior doors, where indicated, that comply with SDI-111C
   1. Blades or baffles formed of 0.020 inch thick, cold-rolled steel sheet set into 0.032 inch thick steel frame.
      a. Sightproof Louvers: Stationary louvers constructed with inverted V-shaped or V-shaped blades.

E. Vision Light Systems: Manufacturer's standard kits consisting of glass light moldings to accommodate glass thickness and size of vision light indicated.
2.04 FRAMES

A. General: Provide fully welded steel frames for doors that comply with ANSI/SDI A250.8 and with details indicated for type and profile.
   1. Conceal fastenings, unless otherwise indicated.

B. Frames of 0.067 inch (14 gage) thick steel sheet for:
   1. Level 3 steel doors.

C. Door Silencers: Except on weatherstripped frames, fabricate stops to receive three silencers on strike jambs on single door frames and two silencers on heads of double door frames.

D. Plaster Guards: Provide 0.016 inch thick, steel sheet plaster guards or mortar boxes to close off interior of openings
   1. Place at back of hardware cutouts where mortar or other materials might obstruct hardware operation.

E. Supports and Anchors: Fabricated from not less than 0.042 inch thick, electrolytic zinc-coated or metallic-coated steel sheet.

2.05 FABRICATION

A. General: Fabricate steel door and frame units to comply with ANSI/SDI A250.8 and to be rigid, neat in appearance, and free from defects including warp and buckle.
   1. Where practical, fit and assemble units in manufacturer's plant.
   2. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project Site.

B. Exterior Door Construction: For exterior locations and elsewhere as indicated, fabricate doors and frames from metallic coated steel sheet.
   1. Close top and bottom edges of doors flush as integral part of door construction by addition of 0.053 inch thick, metallic coated steel channels with channel webs placed even with top and bottom edges.

C. Interior Door Faces: Fabricate exposed faces of doors, including stiles and rails of nonflush units, from following material:
   1. Cold-rolled steel sheet.

D. Core Construction:
   1. Vertical Steel Stiffeners: Stiffen door face sheets with continuous vertical-formed steel (rib) sections, minimum 20 gage, full thickness of interior space between door faces, spaced 6 inches on center maximum, and spot welded to both faces 4 inches on center maximum.
   2. Core Insulation: Provide sound deadening and insulating material through entire core of door (full height, width, and thickness of door).
      a. Provide STC ratings where indicated on Drawings, scheduled, or for partition ratings indicated on Drawings.
      b. Doors shall have a minimum sound transmission classification of 28 as tested under ASTM E 90 and ASTM E 413, unless noted otherwise.
      c. Exterior doors shall meet or exceed required thermal rating indicated, scheduled, or for wall rating.
E. Clearances for Non-Fire Rated Doors: Not more than 1/8 inch at jambs and heads, and except not more than 1/8 inch between pairs of doors.
   1. Not more than 3/4 inch from bottom of door to top of concrete slab.

F. Single-Acting, Door Edge Profile: Beveled edge.


H. Fabricate concealed stiffeners, reinforcement, edge channels, louvers, and moldings from either cold or hot rolled steel sheet.

I. Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier.
   1. Comply with applicable requirements in ANSI A250.6 and ANSI A 115 specifications for door and frame preparation for hardware.

J. Frame Construction: Fabricate frames to profiles shown.
   1. Fabricate frames with mitered or coped, continuously welded corners and seamless face joints
   2. For exterior applications, fabricate frames from metallic coated steel sheet, with mitered or coped, continuously welded corners and seamless face joints.
      a. Provide continuously welded 12 gage closure plate of bottom of exterior frames.
   3. Provide welded frames with temporary spreader bars.
      a. Do not remove until frames are installed.
   4. Sound Deadener: Apply sound deadener to concealed surfaces of frames in accordance with manufacturer's instructions
      a. Produce effective sound deadening for each application

K. Supports and Anchors: Fabricate from minimum 16 gage, galvanized steel sheet.
   1. Floor Anchors:
      a. Minimum thickness: 12 gage galvanized steel sheet or bent steel plate, securely fastened inside each jamb, with two holes in anchor at each jamb for 3/8 inch floor anchorage fasteners.
      b. For preframed wood stud walls provide and additional wood stud anchor located as close to bottom of jamb as practical.
      c. Where required at sloping and uneven floor conditions, or to coordinate adjustments for trim alignments, provide adjustable floor anchors, providing at least 2 inch height adjustment.
   2. Jamb Anchors:
      a. Locate anchors near top and bottom and at intermediate points not to exceed 24 inches on center.
      b. Provide 2 anchors per head for openings up to 48 inches wide.
      c. Openings over 48 inches wide provide anchors at 24 inches on center maximum.
   3. Anchors in Stud Partitions: Provide steel anchors, 16-gage minimum sheet steel, of design to suit partition construction, securely welded inside each jamb.
   4. Through-Frame Anchors: At frames indicated to be anchored with bolts through frame, provide countersunk holes for bolts with 16 gage minimum sheet steel stiffeners full thickness of frame, and securely welded inside each frame at each hole.
L. Inserts, Bolts, and Fasteners: Manufacturer’s standard units.
   1. Where zinc-coated items are to be built into exterior walls, comply with ASTM A 153, Class C or D as applicable.

M. Head Reinforcing:
   1. Reinforce internally with full length, 10 gage angles on each side of frame and bar at bottom of stop for closer reinforcement in frames.
   2. Reinforcing shall not act as lintel or load-carrying member.
   3. Provide at frames regardless of whether or not closer is specified.

N. Hardware Reinforcement and Accessories:
   1. Reinforce doors and frames to receive surface applied hardware.
      a. Drilling and tapping for surface applied hardware may be done at Project Site.
      b. Butt Hinge: Minimum 7 gage, 4 inches longer than height of hinge.
      c. Continuous Hinge: Minimum 14 gage continuous strip reinforcing.
      d. Door Closers: Minimum 14 gage channel, 6 inches high on each side of door.
         1) Extend reinforcement full width of door.
      e. Reinforcing for other items of finish hardware shall be accomplished according to ANSI A250.6
   2. Locate hardware as indicated on Shop Drawings
      a. Where not indicated, locate according to ANSI/SDI A250.8, except where modified by requirements of CBC, Section 1008.1.9.2.

O. Glazing Stops: Manufacturer’s standard applied stops with mitered corners, formed from 0.032 inch thick steel sheet.
   1. Provide non-removable stops in one-piece lengths on outside of exterior doors and on secure side of interior doors for glass and louvers in doors.
   2. Provide screw-applied, removable, glazing stops on inside of glass panels in doors.
      a. Secure within 3 inches of each end and at 12 inches on center with oval head countersunk tamper resistant screws

2.06 FINISHES

   A. Shop Prime Finish: Manufacturer's standard, factory-applied coat of rust-inhibiting primer complying with ANSI A250.10 for acceptance criteria.
      1. Coordinate with Paint Systems in Section 09 9100 to ensure compatibility with field applied finish coats.

PART 3 – EXECUTION

3.01 INSTALLATION – GENERAL

   A. Install standard steel doors, frames, and accessories in accordance with final shop drawings, manufacturer's data, and as specified.

3.02 FRAME INSTALLATION

   A. Comply with provisions of SDI-105 – Recommended Erection Instructions for hollow metal frames, unless otherwise indicated.
1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set.
2. Anchor frames in wood frame partitions with manufacturer recommended anchors.
3. Upon completion of wall construction, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
   a. Except for frames located at in-place concrete installations, place frames prior to construction of enclosing walls and ceilings.
4. In existing concrete construction, anchor frames with galvanized anchor bolts 3/8 inch diameter, counter-sunk at 24 inches on center.
   a. Provide at least three completed opening anchors per jamb.
   b. Install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb.
   c. Set frames and secure to adjacent construction with bolts

### 3.03 DOOR INSTALLATION

A. Install hollow metal doors complying with ANSI/SDI A2S0.B and in accordance with manufacturer's installation instructions.
   1. Coordinate with Work of other trades.

B. Fit hollow metal doors accurately in frames, within clearances specified in ANSI/SDI A2S0.8.
   1. Ensure that door and jamb clearances comply with requirements of ANSI/NFPA 80.
   2. Shim as necessary to comply with SDI-122 and ANSI/DHI A 11S.1 G.

C. Adjust operable parts for correct function.

D. Remove hardware, except prime coated items, tag, box, and install after finish painting has been completed.

### 3.04 PRIME COAT TOUCH-UP

A. Prime Coat Touch-Up: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touch-up of compatible air drying primer.

### 3.05 REPAIR, ADJUST, AND CLEAN

A. Repairs: Fill surface depressions, including countersunk fasteners, with metallic paste filler
   1. Allow to thoroughly cure, sand flush, and smooth for invisible appearance with adjacent metal surfaces.

B. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

C. Final Adjustment: Check and readjust operating finish hardware items, leaving hollow metal doors and frames undamaged and in complete and proper operating condition.

D. Remove and legally dispose of rubbish, debris and waste materials off Project Site.
3.06 PROTECTION

A. Protect Work until Substantial Completion.

END OF SECTION 08 1113
SECTION 08 1400

WOOD DOORS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Solid Core Wood Doors.

B. Related Sections:
   1. Section 06 1013: Miscellaneous Carpentry.
   2. Section 06 4000: Architectural Woodwork
   3. Section 08 1113: Hollow Metal Doors and Frames; hollow metal frames for wood doors.
   4. Section 08 7100: Door Hardware.
   5. Section 09 9100: Painting.

1.02 REFERENCES

A. California Code of Regulations (CCR), Title 24, Part 2, California Building Code (CBC), Volumes 1 and 2, 2013 edition

B. American National Standards Institute (ANSI)/Window and Door Manufacturers Association (WDMA):
   1. ANSI/WDMA I.S. 1A – Architectural Wood Flush Doors

C. Woodwork Institute (WI):

D. National Fire Protection Association (NFPA):
   1. NFPA 80 – Standard for Fire Doors and Other Opening Protectives
   2. NFPA 105 – Standard for the Installation of Smoke Door Assemblies and Other Opening Protectives.

E. UL, LLC (UL):
   1. UL 10B – Standard Fire Tests of Door Assemblies

1.03 QUALITY ASSURANCE

A. Wood doors shall conform to industry standards and requirements referenced in Article 1.02.
   1. Including latest revisions, and special requirements specified.

B. Quality Standards: Provide wood flush doors complying with following standards:
   1. ANSI/WDMA I.S. 1A
   2. AWS Section 9 – Doors
      a. Conform to AWS Section 9 Custom Grade requirements, unless noted otherwise
C. Obtain doors from single manufacturer to assure uniformity in quality of appearance and construction, fabricated to dimensions specified.

D. Inspection: Provide for inspections by authorized WI Inspectors complying with following schedule:
   1. Inspection at door manufacturer's shop or supplier's warehouse prior to initial delivery of wood doors to Project Site.
   2. On-Site Inspection: Immediately after completion of installation of wood doors.
   3. Provide additional site inspections as required by Architect and Owner, at no cost to Owner, when WI inspection reports indicate non-compliance with specified requirements.

E. Door modifications are not permitted, unless reviewed and accepted by Architect.

1.04 SUBMITTALS

A. Product Data: Manufacturer's product data, specifications and installation instructions for each type of wood door required, including details of core and edge construction, trim for louvers and similar components.

B. Shop Drawings: Schedules and plans, indicating location and size of each door.
   1. Elevations and details of each kind of door, indicating door construction details,
   2. Include opening identification symbols, sizes, door type and grade fire ratings, swing, louver cutout size and locations, undercuts and other pertinent data.
   3. Show location and extent of hardware blocking.
      a. Provide blocking as required to eliminate need for through-bolting of surface applied hardware.
   4. Use same door numbering system as Drawing door schedules.
   5. Indicate name of door manufacturer on shop drawing.

C. Samples:
   1. Construction Samples: Minimum of 4 samples of not less than 6 inches by 6 inches for each type of door to be furnished, showing face, edge and core construction.
   2. Metal Louvers: Minimum of four 6 inch long sections of louver blade and frame for each material and finish required.

D. Certificates:
   1. Certificate that solid core wood doors comply with requirements of WDMA I.S. 1A. and AWS Section 9.
   2. Certification that fire rated doors comply with UL 10B.

1.05 SYSTEM DESCRIPTION

A. Design Requirements: Drawings indicate sizes, locations and general details of wood door construction and installation.

1.06 PROJECT CONDITIONS

A. Do not install doors until building is enclosed and ambient conditions are within temperature and humidity range recommended by door manufacturer.
1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect wood doors during transit, storage, and handling to prevent damage, soiling and deterioration.
   1. Package doors at factory prior to shipping using manufacturer’s standard method.

B. Deliver materials in manufacturers original, unopened, undamaged containers with identification labels intact.
   1. Include name of manufacturer stamped or marked on packaging.

C. Deliver doors to Project Site only after building has been provided with design temperature and humidity.

D. Store and handle in accordance with ANSI/WDMA I.S.1A.
   1. Store doors protected from exposure to harmful conditions and at temperature and humidity conditions recommended by manufacturer.

1.08 REGULATORY REQUIREMENTS

A. Fire rated doors shall be listed by a nationally recognized testing and certification agency in accordance with local building codes and acceptable to authorities having jurisdiction.
   1. Listed doors shall meet or exceed the requirements of specified reference standards.
   2. Provide required UL or ITS label on each door and panel
      a. Comply with CBC Section 713.2.

B. Provide products that have been tested and passed as an assembly in compliance with CBC requirements.

1.09 WARRANTIES

A. Door Manufacturer’s Warranty:
   1. Written agreement on door manufacturer's standard form signed by manufacturer, installer and Contractor, agreeing to repair or replace defective doors which have warped (bow, cup or twist) or which show telegraphing of core construction in face veneers, or do not conform to tolerance limitations of AWS.
   2. Warranty shall be in effect during following period of time after date of Substantial Completion:
      a. Solid Core Flush Interior Doors: Life of original installation

B. Installer Warranty:
   1. Provide labor warranty for wood doors.
      a. Warranty Period: 2 years

C. Contractor shall be responsible for replacement or refinishing of doors where Contractor's work contributed to rejection or to voiding of manufacturer's warranty.
PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, provide products of one of the following, or approved equal:
   1. Algoma Hardwoods, Inc.
   2. Eggers Industries, Architectural Door Division
   3. Haley Bros., Inc.
   5. Oregon Door.
   6. V.T. Industries

2.02 FLUSH SOLID CORE DOORS

A. Exterior Flush Doors:
   1. Furnish exterior doors as follows:
      a. Opaque Finished (Painted) Custom Grade.
      b. Inside Face: Solid wood core flush veneered, 5 ply minimum, with faced veneer, fully bonded to core.
      c. Outside Face: Solid wood core flush veneered, 5 ply, with smooth resin fiber Custom Grade A medium density overlay, bonded to core.
   2. Staved Lumber Core: Low density, thoroughly kiln-dried wood blocks not more than 2-1/2 inches wide, with joints staggered, and random lengths.
   3. Edge Strips: Kiln-dried birch or maple
      a. Closed grain hardwood.
   4. Full stile edge strip shall be not less that 2 inches wide.
      a. Stiles shall be fully bonded to core.
      b. Outer face stiles shall be full length 3/4 inch Birch or Maple.
      c. Inner back stile shall be 1-1/4 inches, 2 ply of similar species which may have four finger joints well staggered or be full lengths.
   5. Top rail shall be minimum of 2 inches with maximum of 3 plies.
   6. Bottom rail shall be minimum of 5 inches with maximum of 6 plies.
   7. Outer rail faces shall be full length 7/8 inch of same species as edge strips.
   8. Inner rails shall be full length of similar species.
   9. Rails shall be fully bonded to core.
10. Crossbanding: Doors shall be furnished with full width crossbanding of properly dried hardwood, 1/16 inch thick, with density of 52 pounds per cubic foot or higher.
11. Adhesive and Bonding: Bonding between veneer plies of wood face panels, and between door faces, frame and core unit shall be fabricated with Type I waterproof cross-linking emulsion PVA adhesive.
12. Openings: Openings for louvers, shall be fabricated by manufacturer, or in certified door service mill in accordance with manufacturer's details, and in compliance with approved testing agency.
13. Door Louvers:
      a. Provide louvers for interior doors, where indicated, that comply with SDI-111C.
      1. Blades or baffles formed of 0.020 inch thick, cold-rolled steel sheet set into 0.032 inch thick steel frame.
      b. Sightproof Louvers: Stationary louvers constructed with inverted V-shaped or V-shaped blades.
      c. Install louver with tamperproof-head through-bolts:
d. Furnish louvers factory primed for field painting.
   1) Comply with requirements for finish painting in Section 09 9100 for compatibility of finish coats.

B. Interior Flush Doors:
   1. Furnish interior doors as follows:
      a. Opaque Finished (Painted): Custom grade.
      b. Solid wood core flush veneered, 5 ply minimum, faced both sides with smooth resin fiber medium density overlay, fully bonded to core.
   2. Staved Lumber Core: Low density, thoroughly kiln-dried wood blocks not more than 2-1/2 inches wide, with joints staggered, and random lengths.
   3. Edge Strips: Closed grain hardwood. kiln-dried birch or other material as indicated.
   4. Full stile edge strip shall be not less that 1-1/2 inches wide, 2 ply stile.
      a. Stiles shall be fully bonded to core.
      b. Outer face stile shall be full length 3/4 inch Birch or Maple.
      c. Inner back stile shall be 3/4 inch of similar species which may have two finger joints fully bonded to core.
   5. Top and bottom edge rails shall be full length and may be of glued up stock of similar species as edge strip, white fir or Douglas fir, minimum density 24.33 pounds per cubic foot, or higher
      a. Top rail shall be minimum of 2 inches.
      b. Bottom rail shall be minimum of 5 inches, fully bonded to core.
   6. Crossbanding: Doors shall be furnished with full width crossbanding of properly dried hardwood or engineered fiber composite material, 1/16 inch thick, with density of 52 pounds per cubic foot, or higher
   7. Adhesive and Bonding: Bonding between veneer plies of wood face panel, and between door faces, frame and core unit shall be fabricated with Type I or II waterproof adhesives.
   8. Openings: Openings for louvers shall be performed by manufacturer, or in certified door service mill in accordance with manufacturer's details, and in compliance with testing agency requirements.

C. Fire Rated Doors:
   1. Fire rated doors must comply with requirements of recognized fire door tests and bear certifying labels of approved independent testing agency as specified.
   3. Fire rated door shall be constructed so that when installed as an assembly and tested, be rated as required.
   4. Reinforcement Blocking: Provide hardware reinforcement blocking of size as required to secure specified hardware.
      a. Reinforcement blocking shall be in compliance with the manufacturer's labeling requirements and shall not be of mineral material.

2.03 FINISHING

A. Site Finishing:
   1. Doors Scheduled for Opaque Paint Finish: Factory primed with one coat of wood primer indicated in Section 09 9100.
PART 3 – EXECUTION

3.01 INSTALLATION

A. Install Work as specified in Woodwork Institute AWS.
   1. Provide a Woodwork Institute Certified Compliance Certificate for Installation at
      Substantial Completion.
   2. Install fire doors in accordance with NFPA 80.

B. Provide each door accurately cut, trimmed, and fitted to its frame and hardware.
   1. Clearance at lock and hanging stile and at top shall be 1/8 inch.
   2. Undercut: Top of slab to bottom of door shall be 3/4 inch except where otherwise
      indicated.
   3. Arises shall be rounded to 1/16 inch radius
   4. Lock rail edges shall be slightly beveled.
   5. Screws for hardware shall not be driven but screwed into pre-drilled holes.

C. Doors shall operate freely, but not loosely, without sticking or binding, without hinge-
bind conditions and with hardware properly adjusted and functioning.

3.02 CLEAN UP

A. Remove and legally dispose of rubbish, waste and debris off Project Site.

3.03 PROTECTION

A. Protect Work until Substantial Completion.

END OF SECTION 08 1400
SECTION 08 3100

ACCESS DOORS AND PANELS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Access doors and panels occurring in walls and ceilings in finished areas.

B. Related Sections:
   1. Section 06 1013: Miscellaneous Carpentry.
   3. Section 09 2900: Gypsum Board.
   4. Section 09 3000: Tile.
   5. Section 09 5100: Acoustical Ceilings

C. Refer to Division Division 21 through 23, and Division 26 Sections for access doors and panels for mechanical and other equipment requiring maintenance, inspection, adjustment, and monitoring, which are installed in inaccessible areas such as behind walls, above ceilings, and in soffits.

1.02 QUALITY ASSURANCE

A. Size Variations: Obtain Architect's acceptance of manufacturer's standard size units which may vary slightly from sizes indicated.

B. Coordination: Furnish inserts and anchoring devices which must be built into other Work for installation of access doors and panels.
   1. Coordinate delivery with other Work to avoid delay.

C. Verification: Determine specific locations and sizes for access doors or panels needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in schedule specified in "Submittals" Article.
   1. Access doors and panels furnished under Division 21 through 23, and Division 26 Sections that are indicated as occurring in architecturally finished areas are subject to requirements of this Section.

1.03 SUBMITTALS

A. 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.
   1. Provide typed list, based on Owner's directions and verification, of doors to receive locks.

B. Shop Drawings: For fabrication and installation of access doors, panels, and frames.
   1. Include details of each frame type, elevations of door design types, and accessory items.
   2. Indicate sizes, materials, thickness, fabrication methods, access door or panel and frame reinforcement, anchorage, and installation details.
3. Provide layout drawings, indicating dimensioned locations of proposed access doors and panels.
   a. Determine and indicate required access doors panels in finished surfaces, whether furnished under this Section or as part of Work of Divisions 21 through 23, and Division 26.

C. Access Door, Panel, and Frame Schedule: Provide complete access door, panel, and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.
   1. Coordinate with access doors to be provided under Division 22, 23, and 26 Sections.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Access Doors, Panels, and Frames: Provide protection as required by manufacturer to protect from damage during storage.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Provide following types of access doors and panels for locations indicated:

<table>
<thead>
<tr>
<th>Location:</th>
<th>Elmdor/Stoneman</th>
<th>Milcor</th>
<th>Karp</th>
<th>J.R. Smith</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceramic Tile (1)</td>
<td>DW-SS Series</td>
<td>M-SS</td>
<td>DSC-214M-SS</td>
<td>4762</td>
</tr>
<tr>
<td>Gypsum Board Walls/Ceilings</td>
<td>AT-GB Series</td>
<td>DWR Series</td>
<td>RDWPD</td>
<td>4772</td>
</tr>
<tr>
<td>Exterior Plaster (Stucco)</td>
<td>ML Series</td>
<td>K</td>
<td>DSC-214PL</td>
<td>4771</td>
</tr>
<tr>
<td>Other</td>
<td>DW Series</td>
<td>M</td>
<td>DSC-214M</td>
<td>4760</td>
</tr>
</tbody>
</table>

1. Notes:
   (1) Provide brushed stainless steel finish for panels installed in ceramic tile.
   2. Provide prime coat finish suitable for field painting for panels installed in other finishes.

B. Subject to compliance with specified requirements, other manufacturers offering access doors which may be incorporated in Work include following:
   1. Acudor
   2. J.L. Industries
   4. Nystrom, Inc.

2.02 MATERIALS AND FABRICATION

A. Furnish each access door assembly manufactured as factory-fabricated integral unit, complete with parts, attachment devices, and ready for installation.

B. Steel Access Doors, Panels, and Frames: Fabricate units of continuous welded steel construction, unless otherwise indicated.
   1. Grind welds smooth and flush with adjacent surfaces.
2. Furnish attachment devices and fasteners of type required to secure access doors and panels to types of support shown.
3. Frames: Fabricate from 16 gage steel.
4. For exterior plaster applications, furnish frames with expanded metal lath and exposed casing bead, welded to perimeter of frame.
   a. Shop Primer: Manufacturer's factory-applied zinc-rich primer, complying with requirements of Section 09 9600.

C. Flush Panel Doors: Fabricate from not less than 14 gage sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees.
   1. Finish with manufacturer's factory applied prime paint.

D. Recessed Panel Doors: Fabricate from not less than 18 gage sheet steel with face of panel formed to provide recess below surface of applied finish.
   1. Reinforce panel as required to prevent buckling.
   2. Finish with manufacturer's factory-applied prime paint.
   3. Furnish recessed panels for concealed installation in gypsum board ceilings and tile walls.
   4. Furnish perforated flanges with drywall bead for gypsum board.

E. Locking and Latching Devices: Furnish flush, screwdriver-operated cam locks of number required to hold door in flush, smooth plane when closed.
   1. Where shown or scheduled, provide one cylinder lock per access door.
      a. Furnish 2 keys per lock and key locks alike, unless otherwise scheduled.
      b. Verify and coordinate locking requirements with Owner and Architect prior to submittal.
   2. For recessed panel doors, provide access sleeves for each locking device.
      a. Furnish plastic grommets and install in holes cut through finish.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which access door and panel products are to be installed.
   1. Do not proceed with Work until unsatisfactory conditions have been corrected in manner acceptable to installer.

3.02 INSTALLATION

A. Comply with manufacturer's instructions for installation of access doors and panels.

B. Coordinate installation with Work of other trades.

C. Set frames accurately in position and securely attach to supports, plumb and level, with plane of face panels aligned with adjacent finish surfaces.
   1. Brace to prevent displacement by adjacent Work.

D. Examine panels after installation:
   1. Adjust hardware, doors and panels after installation for proper operation.
   2. Replace doors, panels, or frames which are warped, bowed or otherwise damaged.
3.03 CLEAN UP

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

3.04 PROTECTION

A. Protect Work until Substantial Completion.

END OF SECTION 08 3100
SECTION 08 3484
SMOKE CONTAINMENT SYSTEM

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Fire protective smoke containment curtain system for installation at elevator
      hoistway doors.

B. Related Sections:
   1. Section 09 2216: Non-Structural Metal Framing; metal backing in housing
      mounting area.
   2. Section 09 9100: Painting; field painting of specified components and
      repainting of existing field painted elevator door frames.
   4. Section 28 3100: Digital Addressable Fire Alarm and Voice Evacuation
      System; provision of smoke detectors.
   5. Refer to Division 26 Sections for 120VAC and control circuit power including
      conduit, boxes, conductors, wiring devices, and emergency power.

C. Products Supplied But Not Installed Under this Section:
   1. Group Control Panel Unit.
   2. Emergency Up Buttons.

1.02 REFERENCES

A. California Code of Regulations (CCR), Title 24:
   2. Part 3, California Electrical Code (CEC)

B. ASTM International (ASTM):
   1. ASTM E84 – Standard Test Method for Surface Burning Characteristics of
      Building Materials

C. International Code Council (ICC):
   1. ICC Evaluation Service Reports:
      a. ESR-3322 – Acceptance Criteria for Smoke-Containment Systems Used

D. National Fire Protection Association (NFPA): NFPA Codes and Standards:
   1. NFPA 105 – Recommended Practice for the Installation of Smoke-Control Door
      Assemblies.

E. UL LLC (UL):
   1. Minimum Performance Standards and Label Requirements:
      a. UL 10D – Classified Fire Protective Curtains
      b. UL Oversized Certificate Labeled
      c. UL 864 – Classified Control Units for Fire Protective Signaling Systems.
      d. UL 1784 – Air Leakage Tests for Door Assemblies.
e. Impact test required by independent testing laboratory
f. Gravity fail-safe design. No battery back-up will be required for deployment
g. Certified to ISO 9001 1994 for the design, manufacturing, installation, and commissioning of Automatic Smoke Barriers and Partitions.
h. UL follow up service report required

F. Office of Statewide Health Planning and Development (OSHPD):
   1. OSHPD Anchorage Pre-Approved No OPA-2855-10

G. California Department of Forestry and Fire Protection and Office of the State Fire Marshal Listing

1.03 QUALITY ASSURANCE

A. Overall Standards:
   1. Manufacturer shall maintain a quality control program in accordance with ICC-ES Acceptance Criteria 77.

B. Qualifications:
   1. Manufacturer Qualifications: Minimum seven years experience in producing smoke containment systems of the type specified.
   2. Installer Qualifications: Factory trained by manufacturer.

C. Certifications:
   2. California Department of Forestry and Fire Protection and Office of the State Fire Marshal Listing.
   3. UL Testing Laboratory Label.
   4. UL 10D - One Hour Fire Protective Curtain Listing Label.
   5. OSHPD Anchorage Pre-Approval No. OPA-2855-10

D. Test Reports:
   1. Provide test reports for following:
      a. Calculated smoke development (CSD) of 2.
      b. Smoke developed index (SDI) of 0.
      c. Calculated flame spread (CFS) of 0

E. Pre-Installation Meeting:
   1. Schedule and convene pre-installation meeting prior to commencement of field operations with representatives of following in attendance:
      a. Owner
      b. Architect
      c. General Contractor
      d. Smoke containment system sub-contractor
      e. Painting sub-contractor
      f. Electrical sub-contractor.
   2. Review substrate conditions, requirements of related work, installation instructions, storage and handling procedures, and protection measures.
   3. Keep minutes of meeting including responsibilities of various parties and deviations from specifications and installation instructions.
1.04 SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication and installation details for automatic smoke curtains.
   1. Include plans, sections details, attachments to other work and following:
      a. Operating clearances
      b. Requirements for supporting automatic smoke curtains, track, equipment.
      c. Locations of equipment components, switches, motors and controls.
      d. Differentiate between manufacturer-installed and field installed wiring

C. Quality Assurance/Control Submittals:
   1. Qualifications:
      a. Proof of manufacturer qualifications.
      b. Proof of Installer qualifications.
   2. Certifications: Copy of specified items.
   3. Manufacturer’s installation instructions and testing procedures

D. Closeout Submittals:
   1. Comply with requirements of Section 01 7700 for following items:
      a. Operation and Maintenance Manual
      b. Manufacturer’s Warranties

1.05 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Section 01 6600.

B. Follow manufacturer’s instructions.

1.06 WARRANTY

A. Provide manufacturer’s standard one year warranty.

B. Maintenance and Testing:
   1. Perform minimum annual maintenance and testing on each smoke containment system as required by manufacturer’s warranty, code agency evaluation reports, and as required by local authority having jurisdiction.
   2. Provide test documentation.

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Basis of Design: Design of smoke containment system is based on Door Systems, Inc. Model DSI-600 by DSI SD-60GS Smoke Containment System

B. Label each smoke containment system with following information:
   1. Manufacturer’s name.
   2. Maximum leakage rating at specified pressure and temperature conditions.
   3. Label of quality control agency.
2.02 COMPONENTS

A. Curtain head box shall be manufactured from 1.2mm galvanized steel.
   1. Enclosure shall be rated at same temperature as curtain fabric.

B. Removable cover plates shall be incorporated to allow access to curtain rollers.

C. Standard head box sizes shall be 150mm x 150mm for single rollers (maximum width 5.5m) and 250mm x 150mm for multiple rollers (over 5.5m wide).
   1. Larger head boxes may be required where curtain drop is in excess of 3m.

D. Weighted bottom bar shall be provided to prevent deflection and ensure correct operation under gravity.

E. Roller shall be constructed from octagonal tube which will incorporate 24v D.C. motor and gearbox and sealed heavy duty ball bearing assembly.

F. Motor control circuit housed in steel enclosure shall be mounted onto motor end of head box.

G. Provide each motorized curtain with back Electromagnetic force controlled speed of descent of no less than 6 inches per second and no more than 24 inches per second.

H. Fabric curtain shall be manufactured from X32K woven glass fiber cloth incorporating ‘Panama’ weave for increased stability.
   1. Woven glass fiber fabric shall have nominal weight of no less than 540g/square meter and shall be UL listed for at least one hour.

2.03 OPERATION

A. Smoke and fire curtain shall deploy upon signal from fire alarm system in emergency situation.

B. System must be proven to “fail safe” to operational position on total loss of primary and auxiliary power.
   1. System must contain housed battery system at Group Control Panels.

C. Under normal operating conditions curtains would be held in retracted position via motors operating at low voltage.
   1. Manufacture must be able to confirm that motor windings are suitable for this type of operation.

D. Upon activation of fire alarm the control panel will remove supply voltage and curtain shall descend under power of gravity in controlled manner.
   1. Dynamic braking system housed in motor control circuit shall control speed of descent of curtain.
   2. Descent shall be electronically synchronized on overlapping curtains with bottom bar.

E. To retract curtain, control panel shall supply 24v to motor control circuits and motors will drive curtains to upper position.
1. As bottom bar or stopping bar hits curtain head box, current limiting circuit will step back voltage and current and hold bottom bar in retracted position.

F. Limit switches are not to be used to control upper position of curtain.

G. Optional braking system is available at manufacture stage to allow two stage descent during gravity deployment.
   1. Should main power fail to group control panel, supply is automatically switched to integral standby battery.
   2. Curtain remains in retracted position for 1 hour (fully retracted loaded system).
   3. Curtain will remain fully operational until battery low voltage cut off facility reads voltage of 21v.
      a. Curtains will then safely descend under power of gravity to operational position.

H. Group Control Panel: Provide Group Control Panel (GCP) capable of controlling up to 5 No. BLE24v motor assemblies.
   1. During normal operation, GCP will provide 24v AC supply to curtain motor holding them in retracted position.
   2. Should smoke be detected, fire alarm contact in GCP will be opened by fire alarm control system, GCP will remove 24v supply to curtain motors and curtains will descend under power of gravity in controlled manner.

I. Open on fire- configured to be gravity fail safe

J. Test Facility- key switch required

K. Push to exit buttons must contain internal battery back-up power supply for fail safe operation per ICC ES requirements.

L. Weight of bottom to be 1.5 pounds per linear foot of curtain for secondary means of egress in compliance with ICC ES requirements.

2.04 PERFORMANCE

A. Air Leakage: Not to exceed 3 cfm (0.001416 m3/s) per square foot of door opening.

B. Fire Rating: UL 10D One hour fire rated and labeled.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates upon which work will be installed.
   1. Verify related work performed under other sections is complete and in accordance with Shop Drawings.
   2. Verify wall surfaces and elevator door frames are acceptable for installation of smoke containment system components.

3.02 INSTALLATION

A. Install smoke containment system components in accordance with manufacturer’s installation instructions.
3.03 FIELD QUALITY CONTROL

A. Field Test: Follow manufacturer’s cycle test procedures.
   1. Notify Owner’s Representative, local Fire Marshal, alarm sub-contractor and
      elevator sub-contractor minimum one week in advance of scheduled testing.
   2. Complete maintenance service record.

3.04 DEMONSTRATION

A. Demonstrate required testing and maintenance procedures to Owner's Project
   Inspector.

B. Maintenance and Testing:
   1. Perform minimum annual maintenance and testing on each smoke
      containment system as required by manufacturer’s warranty, code agency
      evaluation reports, and as required by local authority having jurisdiction.
   2. Retain permanent record of tests.

C. Qualified Door Systems Inspector assesses units after exposure to fire event.

3.05 MAINTENANCE

A. Engage Door Systems authorized service representative to test, adjust, and maintain
   system once per annum as required per NFPA 80.

END OF SECTION 08 3484
SECTION 08 4413
ALUMINUM CURTAIN WALL

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Primary components of curtain wall Work (Work of this section) includes
      following, including Work cross-referenced to other specification sections for
      requirements:
         a. Aluminum curtain wall framing systems.
         b. Glass and glazing work for openings in curtain wall; refer to Section 08
            8000 for glass types.
         c. Soffits, sills and similar boarder and filler items indicated as integral
            components of curtain wall systems.
         d. Joint sealant work associated with components of curtain wall systems;
            refer to Section 07 9200.
         e. Reinforcing, framing, support brackets and bracing, and embedments,
            including anchorages, shims, fasteners, and accessories for curtain wall
            Work.
         f. Attachments to building structure and related Work.
         g. Thermal insulation and firestopping indicated in direct relation with curtain
            wall systems; refer to Sections 07 2100 and 07 8400.
   2. Vertical Sunshades: Fixed Custom Sunshades as shown and as specified.

B. Related Sections:
   1. Section 05 0513: Shop-Applied Metal Finishes; high performance factory
      Finish on aluminum curtain wall and entrance doors.
   2. Section 05 5000: Metal Fabrications
   3. Section 07 2100: Building Insulation.
   4. Section 07 8400: Firestopping.
   5. Section 08 7100: Door Hardware

1.02 REFERENCES

A. California Code of Regulations (CCR), Title 24, Part 2, California Building Code
   (CBC), Volumes 1 and 2, 2013 edition

B. Aluminum Association (AA):
   1. Aluminum Design Manual
   2. AA-45 – Designations for Aluminum Finishes

C. American Architectural Manufacturers Association (AAMA):
   1. AAMA – Aluminum Curtain Wall Design Guide Manual; for design, materials,
      fabrications, and installation of component parts.

D. ASTM International (ASTM):
      on Iron and Steel Products
2. ASTM B 209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
3. ASTM B 211 – Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire
10. ASTM E 1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference

E. Glazing Association of North America (GANA):
   1. GANA Glazing Manual.
   2. GANA Sealants Manual

F. Insulating Glass Certification Council (IGCC).

G. American Society of Civil Engineers (ASCE):
   1. ASCE 7-10 – Minimum Design Loads for Buildings and Other Structures

1.03 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer's Qualifications: Capable of providing field service representation during construction, approving acceptable installer, and approving application methods.
   2. Installer Qualifications: Not less than five years of successful experience in erection of curtain walls, who has specialized in installation of work similar to that required for Project and who is acceptable to product manufacturer.

B. Pre-Installation Meeting: Conduct pre-installation meeting in accordance with requirements of Division 01 Sections to verify project requirements, substrate conditions, manufacturer's installation instructions, and manufacturer's warranty requirements.

1.04 SUBMITTALS

A. Product Data: Manufacturer's specifications for materials and fabrication of curtain wall work, and instructions/recommendations for installation and maintenance.
   1. Include certified test reports showing compliance with requirements where test method is indicated.
B. Shop Drawings: Show adaptation of manufacturer's standard system to Project
   1. Include typical unit elevations at 1/2 inch scale and details at 3 inch scale.
   2. Show dimensioning, member profiles, anchorage system, interface with building construction, and glazing.
   3. Show section moduli of windload-bearing members, and calculations of stresses and deflections for performance under design loading.
   4. Show clearly on shop drawings where and how manufacturer's system deviates from contract drawings and these specifications.
   5. Show coordination between doors, door hardware, and automatic door operators.

C. Calculations: Three copies of moment of inertia, connection design and deflection calculations, prepared and signed by registered Structural Engineer licensed in State of California.

D. Samples: Minimum of 4 samples of each type and color of aluminum finish, on 12 inch long sections of extrusions or formed shapes and on 6 inch squares of sheet/plate.
   1. Include 2 or more samples in each set, showing near-limits of variations in color and texture of finish.
   2. Architect reserves right to require fabrication samples showing prime members, joinery, anchorage, expansion provisions, glazing, and similar details, profiles and intersections.

E. Quality Control Submittals:
   1. Test Reports: Certified test reports performed on manufacturer's standard assemblies, showing compliance with specified performance characteristics.
   2. Testing laboratories shall comply with requirements of Section 01 4500.

1.05 DEFERRED APPROVAL

A. Portion of Work of this Section is Deferred Approval item.
   1. Comply with Section 01 3300 for Deferred Approval submittal requirements.

B. Do not start fabrication and installation of Deferred Approval item until detailed drawings, specification and engineering calculations have been approved by Architect and Division of the State Architect.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design: Design for Curtain Wall System Type A is based on T-500 Series, nominal 2-1/2 inch by 7 inch (OPG-2900), thermally broken, Pressure Plate Glazed System for 1 inch insulating glass, as manufactured by Arcadia, Inc.
   1. Curtain Wall System Type A is for Curtain Wall that is maximum 10 feet in height.

B. Basis-of-Design: Design for Curtain Wall System Type B is based on T-500 Series, nominal 2-1/2 inch by 7 inch (OPG-2900), thermally broken, Pressure Plate Glazed System for 1 inch insulating glass, as manufactured by Arcadia, Inc.
   1. Curtain Wall System Type B is for Curtain Wall that over 10 feet in height.
   2. Curtain Wall System Type B is Deferred Approval item.
C. Basis-of-Design: Design for Curtain Wall System Type C is based on T-500 Series, nominal 2-1/2 inch by 10 inch (OPG-23011), thermally broken, Pressure Plate Glazed System for 1 inch insulating glass, as manufactured by Arcadia, Inc.
   1. Curtain Wall System Type C occurs at Ground Floor Lobby as indicated.

D. Basis of Design: Design of Vertical Sunshades is based on Brise Soleil Standard Series Model BSS-016 as manufactured by Arcadia, Inc.

E. Subject to compliance with specified requirements, comparable products may be submitted by alternate manufacturers in accordance with requirements for product substitutions specified in Section 01 6000 and following:
   1. Submit items listed in Article 1.06 and as specified in Section 01 3300, for evaluation of proposed system.
   2. Complete project shop drawings for similar project may be submitted for evaluation purposes, however shop drawings specific to this Project will be required from successful bidder.
   3. Tests shall have been made for identical systems within ranges of specified performance criteria.
   4. Copy of manufacturer's finish and material warranty.

2.02 MATERIALS AND COMPONENTS

A. Aluminum Members: Provide curtain wall members, of alloy, temper and thicknesses recommended by manufacturer to comply with requirements
   1. ASTM B 221 for extrusions, 6063-T6.
   3. Member Wall Thickness: Each framing member shall have wall thickness sufficient to meet specified structural requirements, but not less than 1/8 inch.
   4. Tolerances: Reference to tolerances for wall thickness and other crosssectional dimensions of curtain wall members are nominal and in compliance with AA Aluminum Standards and Data.
   5. Apply specified finish to aluminum curtain wall members.

B. Aluminum Sheet/Plate (brake metal): Provide smooth, flat material, mechanically leveled or stretched to produce flatness; smooth and free of surface imperfections.
   1. Minimum material thickness of 1/8 inch for plate, and 0.092 inch for sheet.

C. Framing System Gaskets and Joint Fillers: Curtain wall manufacturer's standard permanent types, depending on joint movement and sealing requirements

D. Glass, Glazing Sealants, and Fillers: Specified in Section 08 8000.

E. Sealants and Joint Fillers: Specified in Section 07 9200, both for joints within curtain wall construction and for joints at interface of curtain wall construction with other work.

F. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum units where feasible, otherwise nonmagnetic stainless steel; except, at fabricator's option, brackets not exposed to weather or abrasion may be hot-dip galvanized steel complying with ASTM A 123.
   1. Provide nonstaining, nonferrous shims for installation and alignment of curtain wall work.
G. Concealed Flashing: Dead-soft stainless steel, 26 gage, type selected by manufacturer for compatibility.

H. Fasteners and Accessories: Manufacturer's standard with exposed portions matching finish of curtain wall system.
   1. Provide slip-joint linings of sheets, pads, shims, or washers of similar material recommended by manufacturer at joints where movement must be accommodated.
   2. Where fasteners anchor into aluminum less than 0.125 inch thick, provide noncorrosive pressed-in splined grommet nuts or other type reinforcement to receive fastener threads.

I. Concrete/Masonry Inserts: Cast-iron, malleable iron or hot-dip galvanized steel complying with ASTM A 123.

J. Firestopping and Insulation Materials: Specified in Sections 07 2100 and 07 8400.

K. Isolation Between Dissimilar Materials:
   1. Provide single-component, inert-type non-corrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities; vac compliant.
   2. Elasto-Deck BT as manufactured by Pacific Polymers International, Inc. or equivalent product acceptable to Architect.

2.03 FABRICATION – CURTAIN WALL

A. Fabricate curtain wall systems to allow for adequate clearances around perimeter of system to enable proper installation.
   1. Fabricate to allow for thermal movement within curtain wall construction.

B. Fabricate curtain wall components allowing for accurate and rigid fit of joints and corners.
   1. Match components carefully ensuring continuity of line and design.
   2. Ensure joints and connections will be flush, hair line and weatherproof.

C. Provide structural reinforcing within framing members where required to maintain rigidity and as required to accommodate design loads.

D. Allow moisture entering joints and condensation occurring within framing members to drain to exterior.

E. Apply coat of specified isolation material on concealed aluminum surfaces in contact with cementitious or dissimilar materials.

2.04 FABRICATION – VERTICAL SUNSHADES

A. General Fabrication: Provide fixed sunshades and accessories of design, material, sizes, depth, arrangement, and thickness as indicated or as required for optimal performance with respect to strength; durability; and uniform appearance.
   1. Include supports, anchorage, and accessories required for complete assembly, including all attachment clips and necessary hardware for attachment to structure.
2. Manufacturer shall allow plus or minus 1/8 inch thermal expansion room at each shade to compensate for dissimilar movement between building structure and aluminum sunshade structure.
   a. Design shall be incorporated so as to not induce self destructing loads onto either shade or building.

3. Fasteners shall not be visible after installation of sections.
   a. Provide cover plates at each anchorage to conceal fasteners.
   b. Only mounting hardware shall be visible after installation.

B. Sunshade Construction:
   1. Components:
      a. Components shall be 6063-T6 extruded aluminum members.
         1) Size and spacing is to be as shown.
      b. Aluminum plate components shall be 6061-T6.
      c. Brackets shall be of carbon steel.
         1) Connection of sunshade to building shall be friction type with ability to properly adjust shade during installation.
         2) Cover plates shall be furnished of 6061-T6 aluminum plates at each end of sunshade to cover extrusion fasteners.
   2. Assembly: Components to be shop assembled in large practical sections to allow for immediate installation.
      a. Sections indicated on shop drawings to be assembled and shipped as units with cover plates and support arms, when required, shipped loose.
      b. Fasteners shall be bagged in groups clearly identifying bolt locations and bag contents for easy installation.
      c. Manufacturer to provide anti-seize compound for field bolted stainless hardware to facilitate proper erection.

2.05 STILE AND RAIL TYPE ALUMINUM DOORS

A. Frame: Provide tubular frame members, fabricated with mechanical joints using heavy inserted reinforcing plates and concealed tie-rods or j-bolts, or fabricate with structurally welded joints, at manufacturer's option.

B. Design: Provide 1-3/4 inch thick heavy duty medium stile doors, of design based on Arcadia MS362HD Series Heavy Medium Stile Door conforming to following:
   1. Aluminum extrusions for door members: 0.188 inch nominal thickness.
   2. Provide square glazing stops, typical, for 1 inch insulated glass.
      a. Glazing Moldings: Minimum 0.050 inch wall thickness.
   3. Vertical Stiles: 3-1/2 inch nominal width.
   4. Top Rail: 3-5/8 inch nominal height.
   5. Bottom Rail: 10 inch nominal height.
   6. Stile and rail dimensions do not include nominal 3/4 inch high glazing stop.

C. Weatherstripping: For exterior doors, provide compression weatherstripping against fixed stops; at other edges, provide sliding weatherstripping retained in adjustable strip mortised into door edge.

D. Coordinate installation of glass and glazing components provided by aluminum curtain wall manufacturer with requirements of Section 08 8000.

E. Glazing: Fabricate doors to facilitate replacement of glass, without disassembly of door stiles and rails.
1. Provide snap-on extruded aluminum glazing stops, with exterior stops anchored for non-removal.
   a. Glazing gaskets shall be either EPDM elastomeric extrusions or thermoplastic elastomer.
   b. Provide adjustable glass jacks to help center glass in door opening.

2.06 ALUMINUM FINISH

A. High Performance Coating System Type A specified in Section 05 0513.
   1. Color: As selected by Architect from manufacturer’s full range.

PART 3 – EXECUTION

3.01 INSTALLATION – CURTAIN WALL

A. Comply with manufacturer’s instructions for protection, handling and installation of fabricated curtain wall components, with particular attention and care in preservation of applied finishes.
   1. Discard or remove and replace damaged members.

B. Erection Tolerances: Install curtain wall components plumb, level, accurately aligned and accurately located in reference to column lines and floor levels; adjust Work to conform with following tolerances (maximum variations).
   1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
   2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
   3. Alignment: Limit offset of member alignment to 1/16 inch where surfaces are flush or less than 1/2 inch out of flush, and separated by less than 2 inches (by reveal or protruding work); otherwise limit offsets to 1/8 inch.
   4. Location: 3/8 inch maximum deviation from measured theoretical location (any member, any location).

C. Anchor components securely in place in manner indicated, shimming and allowing for required movements
   1. Provide separators and isolators to prevent corrosion and electrolytic deterioration, and to prevent "freeze-up" of moving joints.

D. Firestopping: Clean debris from behind curtain wall during erection and provide temporary closures to prevent accumulation.
   1. Install firestopping to comply with governing regulations, and with AAMA TIR-A3.
   2. Securely anchor metal flanges or equivalent provisions to prevent dislocation.

E. Provide anchors to be installed in other work, and setting details, in time for proper installation by trades concerned.
   1. Verify correct placement.

F. Install glass following workmanship and installation technique described in Section 08 8000.

G. Place thermal insulation in shim spaces around perimeter of curtain wall system, and elsewhere as shown, to maintain continuity of thermal barrier.
H. Install sealants and related backing materials around perimeter of curtain wall system, in accordance with workmanship and installation requirements indicated in Section 07 9200.

3.02 INSTALLATION – VERTICAL SUNSHADES

A. Material Inspection:
   1. Examine crates and verify required components are present.

B. Field Dimensions / Site Inspection:
   1. Prior to Anchorage Installation:
      a. Verify conditions and examine areas where Work is to be performed.
      b. Identify conditions that could be detrimental to proper or timely completion.
   2. Prior to Sunshade Installation:
      a. Field confirm openings widths and elevations as shown on shop drawings prior to fabrication of shade sections.
      b. Field dimensions of anchor locations shall be verified prior to fabrication of sections.
      c. Installation of sections should not proceed until conditions are satisfactory.

C. Installation / Erection:
   1. Comply with manufacturer's instructions and recommendations for installation of Work.
   2. Verify dimensions of supporting curtain wall at Site by accurate field measurements so that Work will be accurately designed, fabricated, and fitted to curtain wall.
   3. Anchor sunshades to curtain wall as indicated.
   4. Erection Tolerances: Conform to manufacturer’s recommended tolerances for installation of sunshades.
   5. Do not erect warped, bowed, deformed or otherwise damaged or defaced members.
      a. Remove and replace members damaged in erection process as directed.
   6. Set units level, plumb and true to line, with uniform joints.
   7. Erect sunshade sections after adjacent painting, roofing, electrical, glazing, and other similar work is completed above and below shade sections.

3.03 FIELD QUALITY CONTROL

A. Field Tests: Architect shall select curtain wall units to be tested as soon as representative portion of Project has been installed, glazed, perimeter caulked and cured.
   1. Conduct tests for air infiltration and water penetration with manufacturer's representative present.
   2. Tests not meeting specified performance requirements and units having deficiencies shall be corrected as part of contract amount.
   3. Testing: Perform testing per AAMA 503 by qualified independent testing agency; refer to Division 01.
      a. Air infiltration Tests: Conduct tests in accordance with ASTM E 783.
         1) Allowable air infiltration shall not exceed 1.5 times amount indicated in performance requirements or 0.09 cfm/ft², whichever is greater.
   1) No uncontrolled water leakage is permitted when tested at a static test pressure of two-thirds specified water penetration pressure but not less than 10 psf.

B. Manufacturer's Field Services: Provide manufacturer's field service consisting of product use recommendations and periodic site visit for inspection of product installation in accordance with manufacturer's instructions.

3.03 PROTECTION AND CLEANING

A. Protection: Protect installed product's finish surfaces from damage during construction.
   1. Protect aluminum curtain wall system from damage from grinding and polishing compounds, plaster, lime, acid, cement or other harmful contaminants.

B. Cleaning: Repair or replace damaged installed products.
   1. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance.
   2. Remove construction debris from project site and legally dispose of debris.

END OF SECTION 08 4413
“L” TOWER BUILDING
SEISMIC AND CODE UPGRADES
RIO HONDO COLLEGE

ALUMINUM CURTAIN WALL
08 4413 - 10
SECTION 08 7100

DOOR HARDWARE

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Door hardware.
   2. Aluminum entrance door hardware.
   3. Third-party inspection report for fire-rated door assemblies.

B. Related Sections:
   1. Section 06 4000: Architectural Woodwork; cabinet hardware
   2. Section 07 9200: Joint Sealants; sealant at thresholds.
   3. Section 08 1113: Hollow Metal Doors and Frames
   4. Section 08 1400: Wood Doors
   5. Section 08 4413: Aluminum Curtain Wall; includes entrance doors
   6. Section 08 7113: Automatic Door Operators; low-energy operators and activation controls.
   7. Section 10 1400: Signage

C. Specific Omissions: Hardware for following is specified or indicated elsewhere.
   1. Cabinets, including open wall shelving and locks.
   2. Signs
   3. Toilet accessories, including grab bars
   4. Rough hardware.
   5. Conduit, junction boxes and wiring.
   6. Existing door, frame and hardware.
   7. Stone or transition strip thresholds.

1.02 REFERENCES


B. American National Standards Institute (ANSI):
   1. ANSI 156.18 – Materials and Finishes.

C. Builders Hardware Manufacturers Association (BHMA).

D. Door and Hardware Institute (DHI).

E. National Fire Protection Association (NFPA):
   2. NFPA 105 – Smoke and Draft Control Door Assemblies
   3. NFPA 252 – Fire Tests of Door Assemblies
F. UL (UL LLC):
   1. UL10C – Positive Pressure Fire Tests of Door Assemblies.
   2. UL 305 – Panic Hardware

G. Steel Door Institute (SDI)

H. Woodwork Institute (WI):

I. National Association of Architectural Metal Manufacturers (NAAMM).

1.03 QUALITY ASSURANCE:

A. Qualifications:
   1. Hardware Supplier: Direct factory contract supplier who employs certified
      Architectural Hardware Consultant (AHC), available at reasonable times during
      course of Work for project hardware consultation to Owner, Architect and
      Contractor.
      a. Responsible for detailing, scheduling and ordering of finish hardware.
         1) Detailing implies that the submitted schedule of hardware is correct
            and complete for intended function and performance of openings.

B. Hardware: Free of defects, blemishes and excessive play.
   1. Obtain each kind of hardware (latch and locksets, exit devices, hinges and
      closers) from one manufacturer.

C. Exit Doors: Operable from inside with single motion without use of key or special
   knowledge or effort.

D. Fire-Rated Openings: NFPA 80 compliant.
   1. Hardware UL10C (positive pressure) compliant for given type/size opening and
      degree of label.
   2. Provide proper latching hardware, non-flaming door closers, approved-bearing
      hinges, and resilient seals.
   3. Coordinate with wood door section for required intumescent seals.
   4. Furnish openings complete.

E. Furnish hardware items required to complete Work in accordance with specified
   performance level and design intent, complying with manufacturers’ instructions and
   code requirements.

F. Pre-Installation Meeting: Initiate and conduct with supplier, installer and related
   Trades
   1. Coordinate materials and techniques, and sequence complex hardware items
      and systems installation.
   2. Include manufacturers’ representatives of locks, panic hardware and door
      closers in meeting.
   3. Convene meeting prior to commencement of related work.
1.04 SUBMITTALS

A. Door Schedule: Submit copies of schedule complying with requirements of Section 01 3300 for electronic submittals.
   1. Only submittals printed one sided will be accepted and reviewed.
   2. Organize vertically formatted schedule into “Hardware Sets” with index of doors and headings, indicating complete designations of every item required for each door or opening.
      a. Minimum 10pt font size.
   3. Include following information:
      a. Type, style, function, size, quantity and finish of hardware items.
      b. Use BHMA Finish codes per ANSI A156.18.
      c. Name, part number and manufacturer of each item.
      d. Fastenings and other pertinent information.
      e. Location of hardware set coordinated with floor plans and door schedule.
      f. Explanation of abbreviations, symbols, and codes contained in schedule.
      g. Mounting locations for hardware.
      h. Door and frame sizes, materials and degrees of swing.
      i. List of manufacturers used and their nearest representative with address and phone number.
      j. Catalog cuts.
      k. Point-to-point wiring diagrams.
      l. Manufacturer’s technical data and installation instructions for electronic hardware.

B. Bid and submit manufacturer’s updated/improved item if scheduled item is discontinued.

C. Deviations: Highlight, encircle or otherwise identify deviations from “Schedule of Door Hardware” on submittal with notations clearly designating those portions as deviating from this section.

D. Where discrepancy exists between Drawings and specified material in this Section, bid more expensive of two choices, note discrepancy in submittal and request direction from Architect for resolution.

E. Substitutions: Submit requests for substitutions in accordance with requirements of Section 01 6000.
   1. Include product data and indicate benefit to Project.
   2. Furnish operating samples on request.

F. Items listed with no substitute manufacturers have been requested by Owner to meet existing District Standards.

G. Furnish as-built/as-installed schedule with closeout documents, including keying schedule, riser and point-to-point wiring diagrams, manufacturers’ installation, adjustment and maintenance information, and supplier’s final inspection report.

1.05 ABBREVIATIONS

A. Manufacturers: Refer to table in Article 2.01

B. Finishes: Refer to Article 2.07
1.06 PROJECT CONDITIONS AND COORDINATION:

A. Where exact types of hardware specified are not adaptable to finished shape or size of members requiring hardware, provide suitable types having as nearly as practical same operation and quality as type specified, subject to Architect’s approval.

B. Coordination: Coordinate hardware with other work.
   1. Furnish hardware items of proper design for use on doors and frames of thickness, profile, swing, security and similar requirements indicated, as necessary for proper installation and function, regardless of omissions or conflicts in information on Contract Documents.
   2. Furnish related trades with the following information:
      a. Location of embedded and attached items to concrete.
      b. Location of wall-mounted hardware, including wall stops.
      c. Location of finish floor materials and floor-mounted hardware.
      d. Locations for conduit and raceways as needed for electrical, electronic and electro-pneumatic hardware items.
      e. Fire/life-safety system interfacing.
      f. Point-to-point wiring diagrams plus riser diagrams to related trades.
      g. Coordinate: low-voltage power supply locations.
      h. Coordinate: back-up power for doors with automatic operators.
      i. Coordinate: flush top rails of doors at outswinging exteriors, and
      j. throughout where adhesive-mounted seals occur.
      k. Manufacturers’ templates to door and frame fabricators.

C. Review shop drawings for doors and entrances to confirm that adequate provisions will be made for proper hardware installation.

D. Environmental Considerations: Dispose of unused recyclable paper and paper product packaging, uninstalled metals, and plastics, in accordance with requirements of Section 01 7419.

1.07 DELIVERY, STORAGE, AND HANDLING:

A. Delivery: coordinate delivery to appropriate locations (shop or field).
   1. Permanent keys and cores: secured delivery direct to Owner’s representative.

B. Acceptance at Site: Items individually packaged in manufacturers’ original containers, complete with proper fasteners and related pieces.
   1. Clearly mark packages to indicate contents, locations in hardware schedule and door numbers.

C. Storage: Provide securely locked storage area for hardware.
   1. Protect from moisture, sunlight, paint, chemicals, dust, excessive heat and cold.

1.08 REGULATORY REQUIREMENTS:

A. Locate latching hardware between 34 inches to 44 inches above finished floor, per CBC Section 11B-404.2.7.
   1. Panic Hardware: Locate between 36 inches to 44 inches above finished floor.
B. Handles, Pull, Latches, Locks, Other Operable Parts:
1. Readily openable from egress side with one hand and without tight grasping, tight pinching, or twisting of wrist to operate, per CBC Section 11B-309.4.
2. Force Required to Activate Operable Parts: 5.0 pounds maximum, per CBC Section 11B-309.4.

C. Adjust doors to open with not more than 5.0-pounds pressure to open at exterior doors and 5.0-pounds at interior doors.
1. As allowed per CBC Section 11B-404.2.9, local authority may increase allowable pressure for fire doors to achieve positive latching, but not to exceed 15 pounds.
2. Exception: exterior doors’ pressure-to-open may be increased to 8.5-pounds when, at single location, and one of bank of eight leafs or fraction of eight, and one leaf of this bank is fitted with a low or high energy operator.

D. Low-Energy Powered Doors: Refer to Section 08 7113 for automatic door operators and activation controls.

E. Adjust door closer sweep periods so that from open position of 90 degrees, door will take at least 5 seconds to move to point 12 degrees from latch, measured to landing side of door, per CBC Section 11B-404.2.7.
1. Spring Hinges: Adjust for 1.5 seconds minimum for 70 degrees to fully-closed.

F. Smooth surfaces at bottom 10 inches of push sides of doors, facilitating push-open with wheelchair footrests, per CBC Section 11B-404.2.10.
1. Applied kickplates and armor plates: bevel left and right edges; free of sharp or abrasive edges.

G. Door Opening Clear Width: Not less than 32 inches, measured from face of frame stop, or edge of inactive leaf of pair of doors, to door face with door opened to 90 degrees.
1. Hardware projection not factor in clear width when located above 30 inches and below 80 inches, and hardware projects no more than 4 inches, per CBC Section 11B-404.2.3.
2. Exception: doors not requiring full passage through opening, spaces less than 24 inches in depth, may have clear opening width reduced to 20 inches.

H. Door Closers and Overhead Stops: Not less than 78 inches above finished floor or ground, per CBC Section 11B-307.4.

I. Thresholds: Floor or landing not more than 0.50 inches below top of threshold of doorway, per CBC Section 11B-404.2.5.
1. Vertical rise not more than 0.25 inches
   a. Change in level between 0.25 inches and 0.50 inches
   b. Beveled to slope not greater than 1:2 (50 percent slope), per CBC Sections 11B-303.2 and 11B-303.3.

J. Floor Stops: Do not locate in path of travel.
1. Locate not more than 4 inches from walls, per DSA Policy No. 99-08 (Access).

K. Pairs of Doors with Independently-Activated Hardware Both Leafs: Limit swing of right-hand or right-hand-reverse leaf to 90 degrees to protect persons reading wall-mounted tactile signage, per CBC Section 11B-703.4.2.
L. Door And Door Hardware Encroachment: When door is swung fully-open into means-of-egress path, the door may not encroach/project more than 7 inches into required exit width, with exception of door release hardware such as lockset levers or panic hardware.
   1. These hardware items must be located not less than 34 inches and not more than 48 inches above floor/ground, per CBC Section 1005.7.1.

1.09 WARRANTY

A. Part of respective manufacturers’ regular terms of sale.
   1. Provide manufacturers' written warranties.

B. Include factory order numbers with close-out documents to validate warranty information, required for Owner in making future warranty claims:

C. Minimum Warranties:
   1. Locksets: Three years
   2. Exit Devices: Three years mechanical
      One year electrical
   3. Closers: Thirty years mechanical
      Two years electrical
   4. Hinges: One year
   5. Other Hardware: Two years

1.10 COMMISSIONING

A. Conduct these tests prior to request for certificate of Substantial Completion:
   1. With installer present, test door hardware operation with climate control system and stairwell pressurization system both at rest and while in full operation.
   2. With installer, access control contractor and electrical contractor present, test electrical, electronic hardware systems for satisfactory operation.
   3. With installer and electrical contractor present, test hardware interfaced with fire/life-safety system for proper operation and release.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Listed Acceptable Alternate Manufacturers: Alternate manufacturer’s will be considered when submitted for review for products with equivalent function and features of scheduled products.

<table>
<thead>
<tr>
<th>ITEM:</th>
<th>MANUFACTURER:</th>
<th>ACCEPTABLE ALTERNATE:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hinges</td>
<td>(IVE) Ives</td>
<td>District Standard</td>
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<tr>
<td>Pivots</td>
<td>(IVE) Ives</td>
<td>District Standard</td>
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<tr>
<td>Key System</td>
<td>(SCH) Schlage</td>
<td>District Standard</td>
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<tr>
<td>Mechanical Locks</td>
<td>(SCH) Schlage</td>
<td>District Standard</td>
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<tr>
<td>Mullions</td>
<td>(VON) Von Duprin</td>
<td>District Standard</td>
</tr>
<tr>
<td>Exit Devices</td>
<td>(VON) Von Duprin</td>
<td>District Standard</td>
</tr>
</tbody>
</table>
2.02 HINGING METHODS

A. Drawings typically depict doors at 90 degrees, doors will actually swing to maximum allowable.
   1. Use wide-throw conventional or continuous hinges as needed up to 8 inches in width to allow door to stand parallel to wall for true 180 degree opening.
      a. Advise Architect if 8 inch width is insufficient.

B. Conform to manufacturer’s published hinge selection standard for door dimensions, weight and frequency, and to hinge selection as scheduled.
   1. Where manufacturer’s standard exceeds scheduled product, furnish heavier of two choices.
   2. Notify Architect of deviation from scheduled hardware.

C. Conventional Hinges: Steel or stainless steel pins and approved bearings.
   1. Hinge open widths minimum, but of sufficient throw to permit maximum door swing.
   3. Non-ferrous material exteriors and at doors subject to corrosive atmospheric conditions.

D. Pivots: high-strength forged bronze or stainless steel, tilt-on precision bearing and bearing pin.
   1. Bottom and intermediate pivots: adjustability of minus 0.063 inch, plus 0.125 inch.

2.03 LOCKSETS, LATCHSETS, DEADBOLTS

A. Mortise Locksets and Latchsets: As scheduled.
   1. Chassis: Cold-rolled steel, handing field-changeable without disassembly.
   2. Universal Lock Case: 10 available functions in one case.
   3. Floating mounting tabs automatically adjusts to fit beveled door edge.
   4. Latchbolts: 0.75 inch throw stainless steel anti-friction type.
   5. Lever Trim: Through-bolted, accessible design.
      a. Cast lever or solid extruded bar type levers as scheduled.
      b. Filled hollow tube design is unacceptable.
      c. Spindles: security design independent breakaway.
         1) Breakage of outside lever does not allow access to inside lever’s hubworks to gain wrongful entry.
      d. Inside lever applied by screwless shank mounting – no exposed mounting screws.
      e. Levers rotate up or down for ease of use.
f. Vandalgard Locks: Locked lever freely rotates down while remaining securely locked.
   a. Feature prevents damage to internal lock components when subjected to excessive force.

6. Furnish solid cylinder collars with wave springs.
   a. Wall of collar to cover rim of mortise cylinder.

7. Turnpieces: Accessible offset turn-lever design not requiring pinching or twisting motions to operate.

8. Deadbolts: Stainless steel 1 inch throw.


10. Strikes: 16 gage curved steel, bronze or brass with 1 inch deep box construction, lips of sufficient length to clear trim and protect clothing.


12. Certifications:
   a. ANSI A156.13, Grade 1 Operational, Grade 1 Security
   b. ANSI/ASTM F 476 Grade 31 UL Listed.

13. Accessibility: Require not more than 5 lb to retract the latchbolt or deadbolt, or both, per CBC Sections 11B-309.4 and 11B-404.2.7

### 2.04 EXIT DEVICES / PANIC HARDWARE

**A. General Features:**

1. Independent lab-tested 1,000,000 cycles.

2. Push-through push-pad design. No exposed push-pad fasteners, no exposed cavities when operated.
   a. Return stroke fluid dampeners and rubber bottoming dampeners, plus anti-rattle devices.

3. Deadlocking latchbolts, 0.75 inch projection.

   a. No raised edges or lips to catch carts or other equipment.

5. No exposed screws to show through glass doors.

6. Non-handed basic device design with center case interchangeable with Functions.
   a. No extra parts required to effect change of function.

7. Releasable in normal operation with 15 pound maximum operating force per UL Standard 305, with 32 pound maximum pressure under 250 pound load to door.


9. Accessibility: Require not more than 5 lb to retract latchbolt, per CBC Sections 11B-309.4 and 11B-404.2.7.
   a. Mechanical Method: Von Duprin “AX-” feature, where touchpad directly retracts latchbolt with 5 lb or less of force.
      1) Provide testing lab certification confirming that mechanical device is independent third-party tested to meet 5 lb requirement.
   b. Electrical Method: Von Duprin “RX-QEL-“, where lightly pressing touchpad with 5 lb or less of force closes electric switch, activating quiet electric latch retraction.

**B. Specific Features:**

1. Non-Fire Rated Devices: Cylinder dogging.
2. Lever Trim: Breakaway type, forged brass or bronze escutcheon minimum 0.130 inch thickness, compression spring drive, matching lockset lever design.  
3. Rod and latch guards with sloped full-width kickplates for doors fitted with surface vertical rod devices with bottom latches.  
4. Fire-Labeled Devices:  
   a. UL label indicating “Fire Exit Hardware”.  
   b. Vertical rod devices less bottom rod (LBR) unless otherwise scheduled.  
5. Delayed Egress Devices: Function achieved within single exit device component, including latch, delayed locking device, request-to-exit switch, nuisance alarm, remote alarm, key switch, indicator lamp, relay, internal horn, door position input, external inhibit input plus fire alarm input.  
6. Electrically Operated Devices: Single manufacturer source for electric latch retraction devices, electrically controlled trim, power transfers, power supplies, monitoring switches and controls.  
7. Removable Mullions: Removable with single turn of building key.  
   a. Securely reinstalled without need for key.  
   b. Furnish storage brackets for securely stowing mullion away from door when removed.  

C. Door Closers:  
1. Provide door closers that comply with Grade 1 ANSI A156.4, fire rated to UL 10C  
2. Closers to exceed 10 million full load operating cycles.  
3. Closers to be non sized (1-6), non handed, field adjustable, fully hydraulic, rack and pinion action with high strength cast iron cylinders  
4. Cylinder body to have 1-1/2 inch piston diameter, with 11/16 inch journal double heat treated shaft, 5/8 inch full complement bearing, chrome silicon steel spring  
5. XL cylinder body to have 1-1/2 inch piston diameter with 3/4 inch journal double heat treated shaft, (0.1421 inch teeth thickness,) 5/8 inch full complement bearings, chrome silicon steel spring  
6. Closers to have stamped main arm and forearm, forged steel main arm and forearm for EDA and CUSH type arms.  
   a. Optional arms to be interchangeable, except for track closers.  
7. XP closers to have forged steel main arm and forearm for REG, EDA and CUSH type arms  
8. Track arm type closers to have single lever forged steel arm with low friction track and roller assembly and provisions for optional bumper to assist backcheck.  
9. Cylinder body to have “FAST” power adjust speed dial to show spring size power  
   a. XP cylinder body to have “FAST” power adjust speed dial to show spring size power  
10. Hydraulic fluid of type requiring no seasonal adjustments,  
   a. ULTRA X TM fluid has constant temperature control from +120 degrees F to -30 degrees F.  
11. Hydraulic regulation controlled by tamper-proof, non-critical screw valves, standard “O” ring, adjustable with hex wrench.  
   a. XP closer hydraulic regulation controlled by tamper-proof, non-critical screw valves, abrasion resistant Vitron “O” ring, adjustable with hex wrench.  
12. Separate adjustments for backcheck, general speed and latch speed.  
13. Include high efficiency, low friction pinion bearings.
14. Size 1 manual door closers to provide less than 5 pounds opening force on 900mm door leaf.

15. Size closers in compliance with requirements for accessibility for handicapped and recommendations of manufacturer.
   a. Provide barrier free and delayed action features as needed.
   b. Comply with following maximum opening-force requirements:
      1) Interior Hinged Doors: 5.0 lbs.
      2) Exterior Hinged Doors: 8.5 lbs.
   c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction

16. Door closer with Pressure Relief Valves are not acceptable.

17. Closers with painted finishes shall exceed minimum 100 hour salt spray test, as described in ANSI A156.18 and ASTM B117.
   a. Furnish data upon request.

18. Closers with plated finishes shall include plated covers (or finish plates), arms and visible fasteners.

2.07 OTHER HARDWARE

A. Automatic Flush Bolts: Low operating force design.

B. Overhead Stops: Non-plastic mechanisms and finished metal end caps.
   1. Field-changeable hold-open, friction and stop-only functions.

C. Kick Plates: Four beveled edges, 0.050 inches minimum thickness, height and width as scheduled.
   1. Sheet-metal screws of bronze or stainless steel to match finish of plates.

D. Door Stops: Provide stops to protect walls, casework or other hardware.
   1. Unless otherwise noted in Hardware Sets, provide floor type with appropriate fasteners.
   2. Where floor type cannot be used, provide wall type.
      a. When neither can be used, provide overhead type.
   3. Locate overhead stops for maximum possible opening.
      a. Consult with Owner for furniture locations.
      b. Minimum: 90 degree stop / 95 degree deadstop.
      c. Note degree of opening in submittal.

E. Seals:
   1. Four-fingered type at head and jambs.
      a. Inelastic, rigid back, not subject to stretching.
      b. Self-compensating for warp, thermal bow, door settling, and out-of-plumb.
      c. Adhesive warranted for life of installation.
   2. Three-fingered type at hinge jambs of doors fitted with continuous hinges where jamb leaf of hinge is fastened to the frame reveal.

F. Sound-Reducing Adjustable Seals: Coordinate lockset backsets, rim exit device strikes, and parallel arm closers.
   1. Fabricate 7gage “Z”-brackets as bridging pieces to facilitate installation.
      a. Brackets: mild carbon steel, or stainless steel.
G. Automatic Door Bottoms: Low operating force units.
    1. Doors with automatic door bottoms plus head and jamb seals cannot require
       more than two pounds operating force to open when closer is disconnected.
    2. Include automatic type door bottoms, as opposed to fixed sweeps, at stairs and
       elevator lobbies to allow fine-tuning of pressurization systems.

H. Thresholds: As scheduled and per details.
    1. Comply with CBC Section 11B-404.2.5.
    2. Substitute Products: Certify that products equal or exceed specified material
       thickness.
       a. Submit proposed substitutions for approval.
    3. Saddle Thresholds: 0.125 inches minimum thickness.
    4. Exteriors: Seal perimeter to exclude water and vermin.
       a. Use sealant complying with requirements in Section 07 9200.
       b. Minimum 0.25 inch diameter fasteners and lead expansion shield
          anchors, or Red-Head No. SFS-1420 (or approved equivalent) Flat Head
          Sleeve Anchors.
       c. National Guard Products’ “COMBO” or Pemko Manufacturing’s “FHSL”.
    5. Fire-Rated Openings, 90 Minutes or Less Duration: Use thresholds to interrupt
       floor covering material under door where material has critical radiant flux value
       less than 0.22 watts per square centimeter, per NFPA 253.
       a. Use threshold unit as scheduled.
       b. Where none are scheduled, include 0.25 inch high by 5 inch wide saddle
          in bid, and request direction from Architect.
    6. Fire-Rated Openings, 3 Hour Duration: Thresholds, where scheduled, to
       extend full jamb depth.
    7. Acoustic openings: Set units in full bed of silicone sealant complying with
       Section 07 9200, leaving no air space between threshold and substrate.
    8. Plastic plugs with wood or sheet metal screws are not acceptable substitute for
       specified fastening methods.
    9. Fasteners: Generally, exposed screws to be Phillips or Robertson drive.
       a. Pinned TORX drive at high security areas.
       b. Flat head sleeve anchors (FHSL) may be slotted drive.
       c. Sheet Metal and Wood Screws: full-thread.
       d. Sleeve Nuts: Full length to prevent door compression.

I. Silencers: Interior hollow metal frames, 3 for single doors, 4 for pairs of doors.
    1. Leave no unfilled/uncovered pre-punched silencer holes.
    2. Intent: Door bears against silencers, seals make minimal contact with minimal
       compression – only enough to effect seal.

J. Key Control Software: Same manufacturer as key cylinders, supply to Owner.

2.08 FINISH

A. Generally: BHMA 626 Satin Chromium
    1. Areas using BHMA 626: furnish push-plates, pulls and protection plates of
       BHMA 630, Satin Stainless Steel, unless otherwise scheduled.

B. Door closers: Factory powder coated to match other hardware, unless otherwise
   noted.
2.09 KEYING REQUIREMENTS

A. Key System: Schlage Everest utility-patented keyway, conventional cylinders with exception of interchangeable core type operating cylinders for panic hardware.
   1. Utility patent protection to extend at least until 2024.
   2. Key blanks available only from factory-direct sources, not available from after-market key blank manufacturers.
      a. For estimate use factory GMK charge.
   3. Initiate and conduct meetings with Owner and architectural hardware consultant representative to determine system keyways, structure, and degree of geographic exclusivity.
   4. Furnish Owner’s written approval of system
      a. Do not order keys or cylinders without written confirmation of actual requirements from Owner.
      b. Owner will install permanent cylinders/cores.

B. Keys:
   1. Existing factory registered master key system
      a. At Substantial Completion:
         1) Remove inserts in Owner’s presence.
         2) Demonstrate consequent non-operability of construction key.
         3) Give removed inserts and construction keys to Owner and provide accounting for pieces.
      a. Remove at Substantial Completion
         1) Install permanent cylinders and cores in Owner’s presence.
         2) Demonstrate that construction key no longer operates.
   4. Temporary cylinders/cores remain supplier’s property.
   5. Furnish 10 construction keys.
   7. Furnish 2 construction control keys.

C. Key Cylinders: Furnish utility patented, 6-pin solid brass construction.

D. Cylinders/Cylinder Cores: Furnish keyed at factory of lock manufacturer where permanent records are maintained.
   1. Locks and cylinders by same manufacturer, unless otherwise indicated

E. Permanent Keys: Furnish secured shipment direct from point of origination to Owner.
   1. For Estimate:
      a. 3 keys per change combination, 5 master keys per group, 5 grand-master keys, 3 control keys.
      b. VKC stamping plus “DO NOT DUPLICATE”.

F. Bitting List: Furnish secured shipment direct from point of origination to Owner upon completion.
PART 3 – EXECUTION

3.01 ACCEPTABLE INSTALLERS

A. Able to read and understand manufacturers’ templates, suppliers’ hardware schedule and printed installation instructions.
   1. Readily distinguish drywall screws from manufacturers’ furnished fasteners.
   2. Available to meet with manufacturers’ representatives and related trades to discuss installation of hardware.

3.02 PREPARATION

A. Ensure that walls and frames are square and plumb before hardware installation.
   1. Make corrections before commencing hardware installation.
   2. Installation denotes acceptance of wall/frame condition.

B. Locate hardware per SDI-100 and applicable building, fire, life-safety, accessibility, and security codes.
   1. Notify Architect of code conflicts before ordering material.
   2. Locate latching hardware between 34 inches to 44 inches above finished floor, Per CBC Sections 1008.1.9.2 and 11B-404.2.7.
   3. Locate panic hardware between 36 inches to 44 inches above finished floor.
   4. Where new hardware is to be installed near existing doors/hardware scheduled to remain, match locations of existing hardware, subject to compliance with building code requirements.

B. Overhead Stops: When possible, determine proposed locations of furniture items, fixtures, and other items to be protected by overhead stops prior to installation

3.03 INSTALLATION

A. Install hardware per manufacturer’s instructions and recommendations.
   1. Do not install surface-mounted items until finishes have been completed on substrate.
   2. Set units level, plumb and true to line and location.
   3. Adjust and reinforce attachment substrate for proper installation and operation.
   4. Remove and reinstall or replace work deemed defective by Architect.
   5. Gaskets: Install jamb-applied gaskets before closers, overhead stops, rim strikes, and like items.
      a. Fasten hardware over and through these seals.
      b. Install sweeps across bottoms of doors before astragals, cope sweeps around bottom pivots, trim astragals to tops of sweeps.
   6. When hardware is to be attached to existing metal surface and insufficient reinforcement exists, use RivNuts, NutSerts or similar anchoring device for screws.
   7. Use manufacturer’s fasteners furnished with hardware items, or submit Request for Substitution with Architect.
   8. Do not use power-driven tools to install fasteners.

B. Locate floor stops no more that 4 inches from walls and not within paths of travel.
   1. Refer to Article 2.02 regarding hinge widths.
      a. Door should be well clear of point of wall reveal.
      b. Point of door contact no closer to hinge edge than half the door width.
c. Where situation is questionable or difficult, contact Architect for direction.

C. Do not install floor stops at exterior conditions.
   1. Provide overhead door stops or closers with integral door stops at exterior conditions.

D. Locate overhead stops for minimum 90 degrees at rest and for maximum allowable degree of swing.

E. Drill pilot holes for fasteners in wood doors and frames.

F. Lubricate and adjust existing hardware scheduled to remain.
   1. Carefully remove and give to Owner items not scheduled for reuse.

### 3.04. ADJUSTING

A. Adjust and check for proper operation and function.
   1. Replace units, which cannot be adjusted to operate freely and smoothly.
   2. Repair or replace hardware damaged by improper installation or adjustment methods: to Owner’s satisfaction.
   3. Adjust doors to fully latch with no more than 1 pound of pressure.
      a. Door closer valves: turn valves clockwise until at bottom – do not force.
      b. Turn valves back out one and one-half turns and begin adjustment process from that point.
      c. Do not force valves beyond three full turns counterclockwise.
   4. Adjust delayed-action closers on fire-rated doors to fully close from fully-opened position in no more than 10 seconds.
   5. Adjust door closers per Article 1.08.

B. Inspection of Fire Door Assemblies and Means of Egress Panic Hardware:
   1. In accordance with requirements of NFPA-80, Section 5.2.1:
      a. Employ independent third-party inspection service to prepare report listing these doors, and include statement that there are zero deficiencies with the fire-rated assemblies and openings with panic hardware.
   2. Certification, Testing and Quality Control shall be in accordance with Section 01 4500 testing and inspection services.
      a. Door hardware and installation will be inspected by third party selected by Owner.

C. Field Survey of Fire Door Assemblies and Means of Egress Panic Hardware:
   1. Use third party inspector not associated with construction, supplier, or installation on Project to develop field survey of doors and hardware.
   2. Survey is to be performed by member certified as Fire Door Assembly Inspector (FDAI), Certified Architectural Hardware Consultant (AHC), or certified testing laboratory such as UL or Intertek.
   3. Certified Inspectors may be located through one of following:
      a. Door and Hardware Institute (DHI) at DHI.org.
      b. Intertek at Intertek.com
      c. Certified Association of Fire Door Inspectors (CAFDI) at CAFDI.org.

D. Fire-rated doors:
   1. Wood Doors: Adjust to 0.125 inches clearance at heads, jambs, and meeting stiles.
2. Steel Doors: Adjust to 0.063 inches minimum to 0.188 inches maximum clearance at heads, jambs, and meeting stiles.
3. Adjust wood and steel doors to 0.75 inches maximum clearance (undercut) from floor slab, inclusive of thresholds and floor coverings.

E. Final Inspection: Installer to provide letter to Owner that upon completion installer has visited the Project and has accomplished following:
   1. Has re-adjusted hardware.
   2. Has evaluated maintenance procedures and recommend changes or additions, and instructed Owner’s personnel.
   3. Has identified items that have deteriorated or failed.

3.05 DEMONSTRATION
   A. Demonstrate mechanical hardware and electrical, electronic and pneumatic hardware systems, including adjustment and maintenance procedures.

3.06 PROTECTION/CLEANING
   A. Cover installed hardware, protect from paint, cleaning agents, weathering, carts/barrows, and like items.
      1. Remove protective covering materials and clean hardware just prior to Substantial Completion.
   B. Clean adjacent wall, frame and door surfaces soiled from installation / reinstallation process.

3.07 MAINTENANCE
   A. Maintenance Materials:
      1. Furnish following to Owner at Substantial Completion:
         a. As-built hardware schedule.
         b. Copies of warranty information for each hardware type.
            1) Include requirement for factory order numbers, needed by Owner, should claim need to be made.
         c. Binder of catalog cuts or complete catalog sections, when necessary, of items used/installed.
            1) Include installation and maintenance/adjustment information.

3.08 SCHEDULE OF FINISH HARDWARE
   A. Refer to Door Schedule in Drawings for hardware set assignments.
   B. Do not order material until submittal has been reviewed, stamped, and signed by Architect’s door hardware consultant.
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**DOOR HARDWARE**

08 7100 - 19
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STONE THRESHOLD BY OTHERS
SIGNS AND GRAPHICS BY OTHERS

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SIGNS AND GRAPHICS BY OTHERS

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THRESHOLD AS DETAILED WHERE SHOWN

END OF SECTION 08 7100
Catalog Cuts

for

Rio Hondo College L Tower Seismic and Code Upgrades

Sorted by Manufacturer

Prepared By
RODNEY ROD ISHIZU, AHC
ALLEGION. PLC

Phone 310-515-3730 Fax 855-652-7923

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<td>9927-NL-OP-110MD</td>
<td>VON_9899_014<del>VON_9899_015</del>VON_9899_017</td>
<td></td>
</tr>
</tbody>
</table>
**7226 Pivot Set**

**7226F Pivot Set**

- **3/4" Offset Pivot**
  - Non-handed
  - Top, header mount
  - Bottom, base plate mount
  - Use with 1-3/4" minimum door thickness, with 1/8" bevel in 2"
  - Maximum door load 600 pounds
  - Vertical adjustment range 3/16", with positive locking

Optional 7215-7226-7227 or 7226F-722 Intermediate Pivot (handed) for each additional 100 pounds or doors over 7'. See page A47.

Optional 7226PT Power Transfer (four wires), non-load bearing. See page A49

---

**7226**

**Plated Finishes** brass

<table>
<thead>
<tr>
<th></th>
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<td>625</td>
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</table>

**Painted Finishes** brass

<table>
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<th>SP10</th>
<th>SP28</th>
<th>SP313</th>
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</tbody>
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**7226F**

**Plated Finishes** steel

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**Painted Finishes** steel

<table>
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<th>SP313</th>
<th>SPBLK</th>
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</thead>
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<td>706</td>
<td>691</td>
<td>689</td>
<td>695</td>
<td>622</td>
</tr>
</tbody>
</table>
NFPA 80, Section 3-3.8 requires intermediate pivot on some fire door applications, consult factory. Use for door heights over 7'0" and one every 2'6" or . Use for door weight over the pivot set limit. One additional for every additional 100 pounds. Door thickness 1-3/4" minimum with 1/8" bevel in 2".

**7212-7212V-7222 INT**
- Use with 7212, 7212V or 7222 3/4 Offset Pivot
- Handed
- Vertical adjustment 3/16", include positive locking.

**7215-7226-7227 INT**
- Use with 7215, 7226 or 7227 3/4 Offset Pivot
- Handed
- Vertical adjustment 3/16", include positive locking.

**7215F-7226F-7227F INT**
- Use with 7215F, 7226F or 7227F 3/4 Offset Pivot
- Handed
- Vertical adjustment 3/16", include positive locking.
The door rests on the bottom pivot in this application. This reduces the stress on the frame by distributing the weight of the door throughout the floor and structure. By taking advantage of the strength of the structure, this makes a pivot the ideal solution for your heavy doors. Center and pocket pivots also provide an aesthetic option for your opening.

Pivots Table Of Contents

General Information ............................................ A32
Selection Chart and Parts Reference ............................ A32
How To Order .................................................... A33
7212 ........................................................... 3/4” Offset A34
7212V ........................................................... 3/4” Offset A34
7215, 7215F ....................................................... 3/4” Offset A35
7222 ........................................................... 3/4” Offset A36
7226, 7226F ....................................................... 3/4” Offset A37
7227, 7227F ....................................................... 3/4” Offset A38
7230F ........................................................... 3/4” Offset A39
7237F ........................................................... 3/4” Offset A40
7244F ........................................................... 1-1/2” Offset A41
7245F ........................................................... 1-1/2” Offset A42
7212-722V-7222 INT ........................................... A43
7215-7226-7227 INT ........................................... A43
7215F-7226F-7227F INT ...................................... A43
7230F-7237F INT .............................................. A44
7244F-7245F INT .............................................. A44
7215PT-7226PT-7227PT ..................................... A45
7253 ........................................................... Center Hung A46
7255 ........................................................... Center Hung A47
7255J ........................................................... Center Hung A47
7256 ........................................................... Center Hung A48
7259 ........................................................... Center Hung A49

Pocket Pivots
91105 .............................................................. A50
91105F ............................................................ A50
7200 Series Pivots

General Information:
Complete line of 3/4" offset, 1-1/2" offset, center hung, intermediate and power transfer pivots with all exposed parts made of brass or stainless steel for maximum corrosion resistance.

High strength brass and stainless steel forgings, and castings for rated and non-rated doors combined with precision bearings for smooth operation.

Stainless steel machine screws and wood screws standard. Positive locking vertical adjustment mechanism allows the installer to precisely position the door and balance the load.

Last digit in pivot set number reflects the maximum door weight in hundreds of pound, e.g., 7215 = 500 pounds. For sets designated as "heavy duty", add 1,000 pounds, e.g., 7237F HD set = 1700 pounds.

Pivots for lead lined doors are available, consult factory.

Pivot Type | Bottom Mounting Style | UL Listing | Max. Door Weight | Handing | When Ordering Separate Parts
--- | --- | --- | --- | --- | ---
7212 | 3/4" Offset | Jamb Mounted | none | 200 | LH or RH | 7212-7215-7222-7226-7227 TOP 7212 BTM 7212-7212V-7222 INT
7212V | 3/4" Offset | Jamb Mounted | none | 200 | LH or RH | 7212V TOP 7212 BTM 7212-7212V-7222 INT
7215 | 3/4" Offset | Jamb Mounted | 20 Minute | 500 | LH or RH | 7212-7215-7222-7226-7227 TOP 7215 BTM 7215-7226-7227 INT
7215F | 3/4" Offset | Jamb Mounted | 3 Hour | 500 | LH or RH | 7215F-7226F-7227F TOP 7215F BTM 7215F-7226F-7227F INT
7222 | 3/4" Offset | Floor Mounted | none | 200 | LH or RH | 7212-7215-7222-7226-7227 TOP 7222 BTM 7215-7226-7227 INT
7226 | 3/4" Offset | Floor Mounted | 20 Minute | 600 | Non-Handed | 7212-7215-7222-7226-7227 TOP 7226 BTM 7215-7226-7227 INT
7226F | 3/4" Offset | Floor Mounted | 3 Hour | 600 | Non-Handed | 7215F-7226F-7227F TOP 7226F BTM 7215F-7226F-7227F INT
7227 | 3/4" Offset | Mortise Cement Case | 20 Minute | 700 | Non-Handed | 7212-7215-7222-7226-7227 TOP 7227 BTM 7215-7226-7227 INT
7227F | 3/4" Offset | Mortise Cement Case | 3 Hour | 700 | Non-Handed | 7215F-7226F-7227F TOP 7227F BTM 7215F-7226F-7227F INT
7230F | 3/4" Offset | Floor Mounted | 3 Hour | 1,000 | Non-Handed | 7230F-7237F TOP 7230F BTM 7215F-7226F-7227F INT
7237F | 3/4" Offset | Mortise Cement Case | 3 Hour | 1,750 | Non-Handed | 7230F-7237F TOP 7237F BTM 7230F-7237F INT
7244F | 1-1/2" Offset | Floor Mounted | 3 Hour | 400 | Non-Handed | 7244F-7245F TOP 7244F BTM 7230F-7237F INT
7245F | 1-1/2" Offset | Mortise Cement Case | 3 Hour | 500 | Non-Handed | 7244F-7245F TOP 7245F BTM 7244F-7245F INT
7253 | Center Hung | Floor Mounted | none | 300 | Non-Handed | 7253-7255-7255J-7256 TOP 7253 BTM 7244F-7245F INT
7255 | Center Hung | Floor Mounted | none | 500 | Non-Handed | 7253-7255-7255J-7256 TOP 7255 BTM none
7255J | Center Hung | Jamb Mounted | none | 500 | Non-Handed | 7253-7255-7255J-7256 TOP 7255J BTM none
7256 | Center Hung | Mortise Cement Case | none | 600 | Non-Handed | 7253-7255-7255J-7256 TOP 7256 BTM none
7259 | Center Hung | Mortise Cement Case | none | 1,000 | Non-Handed | 7259 TOP 7259 BTM none
How to Order:

Pivot:
- 7212
- 7212V
- 7215
- 7215F
- 7222
- 7226
- 7226F
- 7227
- 7227F
- 7230F
- 7237F
- 7244F
- 7245F
- 7253
- 7255
- 7255J
- 7256
- 7259

Pivot Style:
- Blank: Top and bottom set
- TOP: Top pivot only
- BTM: Bottom pivot only
- INT: Intermediate pivot only
- PT INT: Power transfer intermediate pivot only

Hand:
- LH: Left hand door
- RH: Right hand door

Finish:
- US3
- US4
- US10
- US10B
- US26
- US26D
- SP4
- SPI0
- SP28
- SP313
- SPBLK
- USP

Optional finishes are available, consult factory.
FS436  Dome Stop
FS438  Dome Stop

- FS436 for doors without threshold.
- FS438 for doors with threshold or undercut doors.
- Heavy-Duty Cast Dome Stops constructed of brass, bronze or aluminum.
- Packed with wood screw and plastic anchor.

Replaceable gray, non-marring rubber bumper.

Dimensions

<table>
<thead>
<tr>
<th>FS436</th>
<th>FS438</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Height: 1”</td>
<td>Overall Height: 1-3/8”</td>
</tr>
<tr>
<td>Base Height: 3/16”</td>
<td>Base Height: 9/16”</td>
</tr>
<tr>
<td>Base Diameter: 1-3/4&quot; x 2&quot; Oval</td>
<td>Base Diameter: 1-3/4&quot; x 2&quot; Oval</td>
</tr>
</tbody>
</table>

Finishes  brass

<table>
<thead>
<tr>
<th></th>
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<td>613</td>
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<td>625</td>
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Finishes  aluminum

<table>
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<tr>
<th>Ives Number</th>
<th>US28</th>
</tr>
</thead>
<tbody>
<tr>
<td>BHMA</td>
<td>628</td>
</tr>
</tbody>
</table>

R435  Riser for FS436 Dome Stop
R437  Riser for FS438 Dome Stop

- Extruded aluminum, mill finish.
- R435 for conversion of FS436 Dome Stop to carpet installation.
- R437 for conversion of FS438 Dome Stop to carpet installation.
- Packed with wood screws, lead shield and stud.

Specify Tampin (TPN) if required.

Dimensions

**FS18S** **Floor Stops**
- Security Door Stops designed for use in high vandalism areas.
- Molded from black flame resistant, resilient material around a heavy-duty stud.
- Once grouted in concrete, leaves no exposed fasteners to be tampered with or removed.
- Ideal for jail or security cell areas where floor mounted stops are required.
- FS18L also ideal for concrete wall applications.

**Dimensions**
- FS18S Height: 1-1/2”
- FS18L Height: 3-1/2”
- FS18S Diameter: 2”
- FS18L Diameter: 2”
- FS18S Stud Length: 2-1/2”
- FS18L Stud Length: 2-1/2”

**FS434 Floor Stop**
- Burnished wrought steel.
- For undercut doors up to 1-1/2”.
- Packed with screws and plastic anchors.
- Replaceable soft, resilient gray rubber.

**Dimensions**
- Overall Height: 2-5/8”
- Base Size: 1-1/2” W x 2-3/4” L

**Finishes**
- Ives Number USC B3 B4 B5 B10B B15 B26 B26D
- BHMA 605 606 609 613 619 625 626

**430 Floor Door Stop**
- Burnished wrought steel.
- For undercut doors up to 1-1/2”.
- Packed with screws and plastic anchors.
- Replaceable soft, resilient gray rubber.

**Dimensions**
- Overall Height: 1-5/16”
- Base Diameter: 1-1/4”

**Finishes**
- *brass*
  - Ives Number B3 B4 B5 B10B B15 B26 B26D
  - BHMA 605 606 609 613 619 625 626

- *aluminum*
  - Ives Number A3* A5 A14 A92
  - BHMA 666 669 673

* only available in Slim-Pak of 25
## Wall Bumpers

### WS401CVX  Wall Bumpers
**WS401CCV**
**WS402CVX**
**WS402CCV**

- Constructed in heavy-duty cast brass.
- Special retainer cup makes rubber tamper resistant.

*WS401CVX (401)* – convex rubber bumper, packed with wood screw and plastic anchor.

*WS401CCV (401-1/2)* – concave rubber bumper which avoids damage to locks with projecting buttons, packed with wood screw and plastic anchor.

*WS402CVX (402)* – convex rubber bumper packed with screw and drywall anchor.

*WS402CCV (402-1/2)* – concave rubber bumper which avoids damage to locks with projecting buttons and is packed with screw and drywall anchor.

### Dimensions

<table>
<thead>
<tr>
<th></th>
<th>Base Diameter: 2-1/2”</th>
<th>Base Thickness: 3/8”</th>
<th>Overall Projection: 1”</th>
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</thead>
</table>

### Finishes

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<tbody>
<tr>
<td>BHMA</td>
<td>605</td>
<td>606</td>
<td>612</td>
<td>613</td>
<td>619</td>
<td>625</td>
<td>626</td>
</tr>
</tbody>
</table>

### WS404CVX  Wall Bumpers

- Compact size.
- Constructed in cast brass.
- Totally concealed mounting discourages vandalism or tampering.
- Unit furnished with grey convex rubber bumper.
- Packed with sheet metal screw, rawl plug and brad.

### Dimensions

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<th>Base Diameter: 1”</th>
<th>Overall Projection: 17/32”</th>
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### Finishes

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<td>612</td>
<td>613</td>
<td>619</td>
<td>625</td>
<td>626</td>
</tr>
</tbody>
</table>
8400 Series Protection Plates

- Door protection plates are available in .050" thick brass, stainless steel or aluminum; and 1/8" thick high impact polyethylene in clear or black.
- Bevel edge options; specify B4E for all four edges.
- Mounting screw pack furnished standard, 16 screws per pack. Optional screw packs are available for TEK or TORK screw heads. Refer to the following chart for ordering.
- Specify NMH for no mounting holes. (Not available on 8402)
- Specify NMH-A for no mounting holes with adhesive. (Not available on 8402)
- Specify CS for counter sunk mounting holes.
- Specify ERS prepped with extra row of screws.

Kickplate Gasket Tape Tape is recommended when using a brass plate on a metal door to reduce tarnishing from electrolytic oxidation. One tape pack will cover an the perimeters of a 8” x 34” kickplate. Order 8401 Gasket Tape.

---

### 8400 Protection Plate Specifications

**8402 (UL)**

*UL mark appears in upper right corner. Factory supplied screws must be used.*

Number of screw packs required by plate size (specify TEK Screws or TORK screws).

<table>
<thead>
<tr>
<th>Plate Size</th>
<th>22”-25”</th>
<th>26”-33”</th>
<th>34”-41”</th>
<th>42”-48”</th>
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<tbody>
<tr>
<td>4”-8”</td>
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<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>9”-16”</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>17”-24”</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>25”-32”</td>
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<td>2</td>
</tr>
<tr>
<td>33”-40”</td>
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<td>2</td>
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<tr>
<td>41”-48”</td>
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<td>2</td>
<td>2</td>
<td>2</td>
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</tbody>
</table>

**Finishes**

- **Brass**
  - BHMA: 605, 606, 612, 613, 619, 625, 626

- **Stainless Steel**
  - BHMA: 629, 630

- **Aluminum**
  - US Number: US28
  - BHMA: 628

- **Plastic**
  - Clear and Black

Residential Grade Kickplates available Carded only, finishes PA28, PA3, PA619, PA716, B3, B505, B619, B716
**Protection Plates**

**Mop Plates**
- Protect the bottom of the pull side of door subject to cleaning and mopping procedures.
- Size Ranges: 4” to 6” high, 22” to 48” wide

**Kick Plates**
- Protect the bottom of the push side of doors subject to scuffing from foot traffic.
- Recommended for all doors subject to normal use (especially doors using a closer).
- Size Ranges: 8” to 24” high, 22” to 48” wide

**Stretcher Plates**
- Protect doors at specific areas where consistent contact is made by stretchers, service carts or other equipment.
- Usually applied to push side of doors.
- Specify “B4E” Option for beveled edges.
- Size Ranges: 6” to 8” high, 22” to 48” wide

**Armor Plates**
- Protect lower half of doors from abuse by hard carts, trucks and rough usage.
- Usually applied to push side of single doors and both sides of double acting doors.
- Size Ranges: 26” to 48” high, 22” to 48” wide
### VR910-DT With black grip
- For use with Von Duprin 98/99 Series rim and vertical rod exit device
- Non-handed
- Thru-bolts direct to the exit device
- Pull operation only.

<table>
<thead>
<tr>
<th>Width</th>
<th>Height</th>
<th>Thru-Bolt Pattern</th>
<th>Clearance Grip to Door</th>
<th>Projection</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-1/4&quot;</td>
<td>11&quot;</td>
<td>1-3/8&quot; wide x 7&quot; high</td>
<td>1-1/2&quot;</td>
<td>1-7/8&quot;</td>
</tr>
</tbody>
</table>

### VR914-DT Without black grip

<table>
<thead>
<tr>
<th>Finishes</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>US Finish</td>
<td>US32D</td>
</tr>
<tr>
<td>BHMA</td>
<td>630</td>
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</table>

### VR910-NL With black grip
- For use with Von Duprin 98/99 rim and vertical rod exit device
- Non-handed
- Thru-bolts direct to the exit device

<table>
<thead>
<tr>
<th>Width</th>
<th>Height</th>
<th>Thru-Bolt Pattern</th>
<th>Clearance Grip to Door</th>
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</tr>
</thead>
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<tr>
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<td>11&quot;</td>
<td>1-3/8&quot; wide x 7&quot; high</td>
<td>1-1/2&quot;</td>
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### VR914-NL Without black grip

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<tr>
<td>US Finish</td>
<td>US32D</td>
</tr>
<tr>
<td>BHMA</td>
<td>630</td>
</tr>
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</table>

### VR910M-DT With black grip
- For use with Von Duprin 9875/9975 mortise lock exit device
- Non-handed
- Thru-bolts direct to the exit device

<table>
<thead>
<tr>
<th>Width</th>
<th>Height</th>
<th>Thru-Bolt Pattern</th>
<th>Clearance Grip to Door</th>
<th>Projection</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-1/4&quot;</td>
<td>11&quot;</td>
<td>1-3/8&quot; wide x 7&quot; high</td>
<td>1-1/2&quot;</td>
<td>1-7/8&quot;</td>
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### VR914M-DT Without black grip

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<tbody>
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<td>US Finish</td>
<td>US32D</td>
</tr>
<tr>
<td>BHMA</td>
<td>630</td>
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</table>

### VR910M-NL RHR With black grip

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<th>Thru-Bolt Pattern</th>
<th>Clearance Grip to Door</th>
<th>Projection</th>
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</thead>
<tbody>
<tr>
<td>7-1/4&quot;</td>
<td>11&quot;</td>
<td>1-3/8&quot; wide x 7&quot; high</td>
<td>1-1/2&quot;</td>
<td>1-7/8&quot;</td>
</tr>
</tbody>
</table>

### VR910M-NL LHR With black grip

<table>
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</thead>
<tbody>
<tr>
<td>US Finish</td>
<td>US32D</td>
</tr>
<tr>
<td>BHMA</td>
<td>630</td>
</tr>
</tbody>
</table>

### VR914M-NL RHR Without black grip

<table>
<thead>
<tr>
<th>Width</th>
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<th>Thru-Bolt Pattern</th>
<th>Clearance Grip to Door</th>
<th>Projection</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-1/4&quot;</td>
<td>11&quot;</td>
<td>1-3/8&quot; wide x 7&quot; high</td>
<td>1-1/2&quot;</td>
<td>1-7/8&quot;</td>
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### VR914M-NL LHR Without black grip

<table>
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<tbody>
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<td>US32D</td>
</tr>
<tr>
<td>BHMA</td>
<td>630</td>
</tr>
</tbody>
</table>

---

**Finishes**
- US Finish US32D
- BHMA 630

---

**Thru-Bolt Clearance**
- Width: 5-1/4"
- Height: 11"
- Pattern: 1-3/8" wide x 7" high
- Projection: 1-1/2"
**Ives Architectural Hardware Products**

**Floor Stops – Dome**

**FS436**  
**Dome Stop**
- **FS436** for doors without threshold.
- **FS438** for doors with threshold or undercut doors.
- Heavy-Duty Cast Dome Stops constructed of brass, bronze or aluminum.
- Packed with wood screw and plastic anchor.

Replaceable gray, non-marring rubber bumper.

**Dimensions**

**FS436**  
- Overall Height: 1”
- Base Height: 3/16”
- Base Diameter: 1-3/4” x 2” Oval

**FS438**  
- Overall Height: 1-3/8”
- Base Height: 9/16”
- Base Diameter: 1-3/4” x 2” Oval

**R435**  
**Riser for FS436 Dome Stop**
- Extruded aluminum, mill finish.
- R435 for conversion of FS436 Dome Stop to carpet installation.
- Packed with wood screws, lead shield and stud.

Specify Tampin (TPN) if required.

**Dimensions**

Available in 1/4”, 3/8”, 1/2”, 5/8”, 3/4” and 1” height.

**Finish**

- **brass**  
  - BHMA 605 606 609 612 613 619 625 626

- **aluminum**  
  - Ives Number US28
  - BHMA 628
3PB1  
**3 Knuckle, Plain Bearing Full Mortise Hinge**
- For standard weight doors
- Low frequency usage
- Packed with wood and metal screws

*Not for use with a door closer.*

**Options**
- NRP, Non-Removable Pin
- SH, Security Stud
- HT, Hospital Tip
- RC, Round Corners - 1/4” or 5/8” Radius
- SEC, Security Fasteners - Pin-in-Socket

**Dimensions**
<table>
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<th>Size (Inches)</th>
<th>Size (mm)</th>
<th>Gauge</th>
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</table>

3CB1  
**3 Knuckle, Concealed Bearing Full Mortise Hinge**
- For standard weight doors
- Medium frequency usage
- Packed with wood and metal screws

**Options**
- NRP, Non-Removable Pin
- SH, Security Stud
- HT, Hospital Tip
- RC, Round Corners - 1/4” or 5/8” Radius
- SEC, Security Fasteners - Pin-in-Socket

**Dimensions**
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**Finishes**
- **Brass**
  - BHMA: 605, 606, 612, 613, 614, 616, 619, 625, 626

- **Steel**
  - BHMA: 600, 632, 633, 639, 640, 641, 643, 646, 651, 652

- **Stainless Steel**
  - Ives Finish: US32, US32D
  - BHMA: 629, 630
3CB1HW 3 Knuckle, Concealed Bearing Full Mortise Hinge

- For heavy weight doors
- High frequency usage
- Packed with wood and metal screws

Options
- NRP, Non-Removable Pin
- SH, Security stud
- HT, Hospital Tip
- RC, Round Corners - 1/4" or 5/8" Radius
- SEC, Security Fastners - Pin-in-Socket

Options
- HT, Hospital Tip
- RC, Round Corners - 1/4" or 5/8" Radius
- SEC, Security Fastners - Pin-in-Socket

Dimensions

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3SP1 3 Knuckle Spring Full Mortise Hinge

- For automatic closing of doors
- Packed with wood and metal screws

Options
- NRP, Non-Removable Pin
- SH, Security stud
- HT, Hospital Tip
- RC, Round Corners - 1/4" or 5/8" Radius
- SEC, Security Fastners - Pin-in-Socket

Options
- HT, Hospital Tip
- RC, Round Corners - 1/4" or 5/8" Radius
- SEC, Security Fastners - Pin-in-Socket

Dimensions

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Finishes steel

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3CB1HW 3 Knuckle, Concealed Bearing Full Mortise Hinge

- For heavy weight doors
- High frequency usage
- Packed with wood and metal screws

Options
- NRP, Non-Removable Pin
- SH, Security stud
- HT, Hospital Tip
- RC, Round Corners - 1/4" or 5/8" Radius
- SEC, Security Fastners - Pin-in-Socket

Dimensions

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<td>5 x 5</td>
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3SP1 3 Knuckle Spring Full Mortise Hinge

- For automatic closing of doors
- Packed with wood and metal screws

Options
- HT, Hospital Tip
- RC, Round Corners - 1/4" or 5/8" Radius
- SEC, Security Fastners - Pin-in-Socket

Dimensions

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Finishes  

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</table>
**4040XP SERIES**

The 4040XP is LCN’s most durable and flexible heavy duty closer designed for institutional and other demanding high traffic applications.

- Cast Iron
- Forged Steel Arm
- Double Heat Treated Steel Pinion
- All Weather Fluid
- Non-Handed
- LCN Patented Green Dial
- Peel-n-Stick Templates for Fast and Accurate Installation
- UL and cUL Listed
- 3/4˝ Journal Diameter Pinion
- Full Compliment Bearing

---

**FEATURES**

- Standard 4040XP Series closer shipped with regular arm, standard plastic cover, and self reaming and tapping screws.
- Non-sized cylinder is adjustable for interior doors to 5’0” and exterior doors to 4’0”.
- Closer mounts hinge side, top jamb, and parallel arm on either right or left swinging doors.
- Closers to meet ADA requirements.
- Standard or optional custom powder coat finish.
- Optional plated finish on cover, arm, and fasteners.
- Optional SRI primer for installations in corrosive conditions. (Available with powder coat finishes only.)
- UL and cUL listed for self-closing doors without hold-open.
- Tested and certified under ANSI Standard A156.4, grade one.

---

**MOUNTING**

<table>
<thead>
<tr>
<th>Hinge (Pull) Side</th>
<th>Top Jamb (Pull)</th>
<th>Parallel Arm (Pull)</th>
<th>Top Jamb (Push)</th>
<th>Parallel Arm (Push)</th>
<th>Stop Face</th>
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<td>○</td>
<td>○</td>
<td>○</td>
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<td>○ <strong>NOT AVAILABLE</strong></td>
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**FINISH**

- Powder Coat
- Plastic
- Metal

**COVER**

- Non-Handed
- Non-Sized
- Accessibility
- Delayed Action

**CYLINDER**

- Regular/Double
- Standard/Single
- Hold Open
- Fusible Link
- Extended Egress

**ARM FUNCTION**

- 120°
- 120°
- 180°
- 110°
- 110°

---

Closer available with less than 5.0 lbs. opening force on 36” door.

** Maximum opening/hold-open point with standard template.

** Advanced Variable Backcheck.

** Delayed Action Closer incorporates standard 4041 Delay Cylinder.
HINGE (PULL) SIDE MOUNTING

MAXIMUM OPENING
Templating allows up to 120°.

Hold-open points 90° up to 120° with hold-open arm.

- **Butt Hinges** should not exceed 5” (127 mm) in width.
- **Auxiliary Stop** is recommended at hold-open point or where a door cannot swing beyond 120°.
- **Reveal** should not exceed 3/4” (19 mm) for regular arm or hold-open arm.
- **Top Rail** less than 3-3/4” (95 mm) requires PLATE, 4040XP-18. Plate requires 2” (51 mm) minimum.
- **Clearance** of 2-3/8” (60 mm) behind door required for 90° installation.
- **Delayed Action** Incorporates standard 4041 cylinder, without XP cylinder. Delays closing from 120° to 70°. Delay time adjustable up to approximately 1 minute.

**Options**
- 4041 Delayed action cylinder*.
- Hold-open arm.
- Metal cover.

**Special Templates**
Customized installation templates or products may be available to solve unusual applications. Contact LCN Product Support for assistance.
TOP JAMB (PUSH SIDE) MOUNTING

MAXIMUM OPENING
Templatting allows up to 120°.

Hold-open points 85° up to 120° with hold-open arm.

- **Butt Hinges** should not exceed 5˝ (127 mm) in width.
- **Auxiliary Stop** is recommended at hold-open point or where a door cannot swing beyond 120°.
- **Reveal** of 2-9/16” (65 mm) allows 120° opening for REGULAR ARM or standard Hold-open ARM. 4-13/16” (122 mm) allows up to 120° opening with LONG ARM where standard rod and shoe is replaced with optional LONG ROD AND SHOE 4040XP-79LR. Use H-LONG ARM with LONG HEAD AND TUBE. 4040XP-78HL for hold-open. 8” (203 mm) allows up to 120° opening with EXTRA LONG ARM where standard rod and shoe is replaced with optional EXTRA LONG ROD AND SHOE, 4040XP-79ELR.
- **Top Rail** requires 1-1/4˝ (32 mm) minimum. 2-1/4˝ (57 mm) minimum with closer on PLATE, 4040XP-18TJ. 3˝ (76 mm) minimum with closer on PLATE, 4040XP-18G.
- **Head Frame** less than 3-1/2” (89 mm) requires PLATE, 4040XP-18TJ. With flush ceiling, use PLATE, 4040XP-18G. Either plate requires 1-3/4˝ (44 mm) minimum.
- ***Delayed Action** incorporates standard 4041 cylinder, without XP cylinder. Delays closing from 120° to 70°. Delay time adjustable up to approximately 1 minute.

**Options**
- 4041 Delayed action cylinder*.
- Hold-open arm.
- Metal cover.

Customized installation templates or products may be available to solve unusual applications. Contact LCN Product Support for assistance.
4040XP SERIES

PARALLEL ARM (PUSH SIDE) MOUNTING
Optional mounting requires PA SHOE, 4040XP-62PA for regular or HOLD-OPEN arms. Add prefix "P" to closer description (eg. P4040XP). P4040XP closer includes 4040XP-201 FIFTH HOLE SPACER to support PA SHOE.

MAXIMUM OPENING
180° opening/hold-open points with all except CUSH arms.
110° opening/hold-open with CUSH arms.

Options
- 4041 Delayed action cylinder*
- Hold-open, EDA, HEDA, CUSH, HCUSH, SPRING CUSH or SPRING HCUSH arm.
- Metal cover.

Special Templates
Customized installation templates or products may be available to solve unusual applications. Contact LCN Product Support for assistance.

-[Butt Hinges] should not exceed 5” (127 mm) in width.
- [Auxiliary Stop] is recommended at hold-open point, where the door cannot swing 180°, or where CUSH-N-STOP arm is not used.
- [Clearance] for 4040XP-62PA shoe is 4” (102 mm) from door face.
  EDA shoe projects 5-1/2” (140 mm) from door face.
  CUSH shoe projects 6” (152 mm) from door face.
- [Top Rail] less than 5-3/8” (137 mm) measured from the stop requires PLATE, 4040XP-18PA. Plate requires 2” (51 mm) minimum from the stop.
- [Head Frame] flush or rabbedted requires PA SHOE ADAPTER, 4040XP-419.
- [Stop Width] minimum 1” (25 mm). CUSH arm requires minimum 1-1/2” (38 mm).
- [Blade Stop] clearance requires 1/2” (13mm) BLADE STOP SPACER, 4040XP-61.
- [Delayed Action] incorporates standard 4041 cylinder, without XP cylinder. Delays closing from 120° to 70°. Delay time adjustable up to approximately 1 minute.
Mounting details are the same as 4040XP Series REGULAR or HOLD-OPEN except as listed below. 4040XP Series closers ordered with EDA or CUSH arms include 4040XP-201 FIFTH HOLE Spacer to support the shoe.

**MAXIMUM OPENING**
EDA arm can be templated for points at: 110°.
- \( A = 6-3/8" \) (162 mm)
- \( B = 7-3/4" \) (197 mm)

or 180°.
- \( A = 2-7/8" \) (73 mm)
- \( B = 4-1/4" \) (108 mm)

Hold-open points up to maximum opening with HEDA arm.

CUSH arms can be templated for opening/hold-open point at:
- 85°.
  - \( A = 7-15/16" \) (202 mm)
  - \( B = 9-1/8" \) (232 mm)
- 90°.
  - \( A = 7-3/16" \) (183 mm)
  - \( B = 8-1/2" \) (216 mm)
- 100°.
  - \( A = 6-1/16" \) (154 mm)
  - \( B = 7-1/4" \) (184 mm)
- or 110°.
  - \( A = 5-1/16" \) (129 mm)
  - \( B = 6-3/8" \) (162 mm)

Spring Cush dead stop points are approximately 5° more than templated stop point. Hold open at templated stop points.

**Clearance** for 4040XP-62EDA is 5-1/2” (140 mm) from door face. 6” (152 mm) for CUSH.

**Head Frame** flush or rabbed requires CUSH FLUSH PANEL ADAPTER, 4040XP-419.

**CUSH ARM** requires SHOE SUPPORT, 4040XP-30 for fifth screw anchorage for narrow frames.

**Delayed Action** incorporates standard 4041 cylinder, without XP cylinder.

Delays closing from maximum opening to: 115° with 180° template, 95° with 110° template, 85° with 100° template, 75° with 90° template. Delay time adjustable up to approximately 1 minute.
**4040XP SERIES**

**CYLINDERS**
**CYLINDER, 4040XP-3071**  
Heavy duty, non-handed cast iron cylinder assembly.
**CYLINDER, 4041-3071 DEL**  
Cylinder used for delayed action options.

**COVERS**
**COVER, 4040XP-72**  
Standard, non-handed plastic cover.
**METAL COVER, 4040XP-72MC**  
Optional, handed cover. Required for plated finishes and custom powder coat finishes.

**ARMS**
**REGULAR ARM, 4040XP-3077**  
Non-handed arm mounts pull side or top jamb with shallow reveal.  
P4041 closer includes PA SHOE, 4040XP-62PA required for parallel arm mounting.
**PA SHOE, 4040XP-62PA**  
Required for parallel arm mounting.
**LONG ARM, 4040XP-3077L**  
Optional non-handed arm includes LONG ROD AND SHOE, 4040XP-79LR for top jamb mount.
**EXTRA LONG ARM, 4040XP-3077ELR**  
Optional non-handed arm includes EXTRA LONG ROD AND SHOE, 4040XP-79ELR for top jamb mount with deep reveal.
**HOLD-OPEN ARM, 4040XP-3049**  
Optional, non-handed arm mounts pull side or top jamb with shallow reveal, hold-open adjustable shoe. 4040XP closer includes 4040XP-62PA shoe required for parallel arm mounting.
**LONG HOLD-OPEN ARM, 4040XP-3049L**  
Optional non-handed arm includes LONG HEAD AND TUBE, 4040XP-3048L, for top jamb mount.
**EXTRA DUTY ARM, 4040XP-3077EDA**  
Non-handed parallel arm features forged, solid steel main and forearm for potentially abusive installations.
**HOLD-OPEN EXTRA DUTY ARM, 4040XP-3049EDA**  
Handed parallel arm features forged, solid steel main and forearm for potentially abusive installations. Hold-open function is adjusted at the shoe.
**EXTRA DUTY ARM WITH 62G, 4040XP-3077EDA/62G**  
Non-handed parallel arm features forged, solid steel main and forearm for potentially abusive installations. 62G shoe provides additional blade stop clearance.
**HOLD-OPEN EXTRA DUTY ARM WITH 62G, 4040XP-3049EDA/62G**  
Handed parallel arm features forged, solid steel main and forearm for potentially abusive installations. 62G shoe provides additional blade stop clearance. Hold-open function is adjusted at the shoe.
ARMS CONT.

CUSH-N-STOP® ARM, 4040XP-3077CNS
Optional, non-handed parallel arm features solid forged steel main arm and forearm with stop in soffit shoe.

HCUSH ARM, 4040XP-3049CNS
Provides hold-open function with templated stop/hold-open points. Handle controls hold-open function.

SPRING CUSH ARM, 4040XP-3077SCNS
Optional, non-handed parallel arm for abusive applications features solid forged steel main arm and forearm with spring loaded stop in the soffit shoe.

SPRING HCUSH ARM, 4040XP-3049SCNS
Optional, non-handed parallel arm for abusive applications features solid forged steel main arm and forearm with spring loaded stop in the soffit shoe. Handle controls hold-open function.

INSTALLATION ACCESSORIES

PLATE, 4040XP-18
Required for hinge side mount where top rail is less than 3-3/4” (95 mm). Plate requires minimum 2” (51 mm) minimum top rail.

PLATE, 4040XP-18G
Locates top jamb mounted closer flush with top of head frame face in flush ceiling condition. Plate requires 1-3/4” (44 mm) minimum head frame.

PLATE, 4040XP-18TJ
Centers top jamb mounted closer vertically on head frame where face is less than 3-1/2” (89 mm). Plate requires 1-3/4” (44 mm) minimum head frame.

PLATE, 4040XP-18PA
Required for parallel arm mounting where top rail is less than 5-1/2” (140 mm), measured from the stop. Plate requires 2” (51 mm) minimum top rail.
INSTALLATION ACCESSORIES CONT.

CUSH SHOE SUPPORT, 4040XP-30
Provides anchorage for fifth screw used with CUSH arms, where reveal is less than 3-1/16” (78 mm).

BLADE STOP SPACER, 4040XP-61
Required to lower parallel arm shoe to clear 1/2” (13 mm) blade stop.

PA FLUSH PANEL ADAPTER, 4040XP-419
Provides horizontal mounting surface for parallel arm shoe on single rabbeded or flush frame.

AUXILIARY SHOE, 4040XP-62A
Requires a top rail of 7” (178 mm). Optional shoe replaces -62PA for parallel arm mounting of regular arm with overhead holder/stop.
TABLE OF SIZES

4040XP cylinders are adjustable from size 1 through size 6 and is shipped set to size 3.
Closing power of 4040XP Series closers may be adjusted 50%.

EXTERIOR (and VESTIBULE) DOOR WIDTH

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<th>24”</th>
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*4040XP  
Minimum  
Door Width

INTERIOR DOOR WIDTH

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<td>1372mm</td>
<td>1524mm</td>
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*4040XP  
Minimum  
Door Width

Indicates recommended range of door width for closer size.

* Adjustable Size 1 thru 6.

REDUCED OPENING FORCE 4040XP SERIES CLOSERS

CAUTION ! Any manual door closer, including those certified by BHMA to conform to ANSI Standard A156.4, that is selected, installed and adjusted based on ADA or other reduced opening force requirements may not provide sufficient power to reliably close and latch a door.

Refer to POWER OPERATORS section for information on systems that meet reduced opening force requirements without effecting closing power.

HOW-TO-ORDER
4040XP SERIES CLOSERS

1. SELECT FINISH
☐ Standard Powder Coat __________  
   Aluminum, Dark Bronze, Statuary,  
   Light Bronze, Black, Brass.

Closer will be shipped with:
- STANDARD CLIP-ON COVER
- SPECIFY ARM WHEN ORDERING
- SELF-REAMING and TAPPING SCREWS,  
  unless options listed below are selected.

CLOSER OPTIONS

CYLINDER
☐ Delayed Action (4041 DEL)

COVER
☐ Metal (specify right or left hand) (MC)

FINISH
☐ Custom Powder Coat (RAL) __________  
   (handed metal cover required)
☐ Plated Finish, US __________  
   (handed metal cover required)
☐ SRI primer (use with powder coat finishes only)

ARM
☐ Regular (REG)
☐ Regular w/62PA (Rw/PA)
☐ Regular w/62A (R/62A)
☐ Long (LONG)
☐ Extra Long (XLONG)
☐ Hold-Open (H)
☐ Hold-Open w/62PA (Hw/PA)
☐ Long Hold-Open (HLONG)
☐ Extra Duty Arm (EDA)
☐ Extra Duty Arm with 62G (EDA/62G)
☐ Hold Open Extra Duty Arm (HEDA) (Handed)
☐ Hold Open Extra Duty Arm with 62G(HEDA/62G)(Handed)
☐ Cush-N-Stop (CUSH)
☐ HCush-N-Stop (HCUSH)
☐ Spring Cush (SCUSH)
☐ Spring HCush (SHCUSH)

OPTIONAL SCREW PACKS
☐ TB* w/Self-Reaming and Tapping (TBSRT)
☐ Wood & Machine Screw (WMS)
☐ TB* Wood & Machine Screw (TBWMS)
☐ TORX Machine Screw (TORX)
☐ TB* & TORX Machine Screw (TBTRX)  
  * Specify door thickness if other than 1-3/4”.

INSTALLATION ACCESSORIES
☐ Plate, 4040XP-18
☐ Plate, 4040XP-18TJ
☐ Plate, 4040XP-18G
☐ Plate, 4040XP-18PA
☐ CUSH Shoe Support, 4040XP-30
☐ Blade Stop Spacer, 4040XP-61
☐ Auxiliary Shoe, 4040XP-62A
☐ PA Flush Panel Adapter, 4040XP-419

SPECIAL TEMPLATE
☐ ST- ______

- STANDARD CLIP-ON COVER
- SPECIFY ARM WHEN ORDERING
- SELF-REAMING and TAPPING SCREWS,
### Saddle Thresholds (Cont.)

- To use a saddle threshold in an offset condition, use an elevator (see page 37).

#### 171

**AVAILABLE FINISHES:** A, B, BDG, D, G, SN

![Diagram of 171 saddle threshold]

#### 172

**AVAILABLE FINISHES:** A, B, D, G, SN

![Diagram of 172 saddle threshold]

#### 176

**AVAILABLE FINISHES:** A, B, D, G

![Diagram of 176 saddle threshold]

#### 2548

**AVAILABLE FINISHES:** A, D, G

![Diagram of 2548 saddle threshold]

#### 254X4

**AVAILABLE FINISHES:** B

Includes two support legs (only one shown due to break in drawing.)

![Diagram of 254X4 saddle threshold]

#### 2549

**AVAILABLE FINISHES:** A, D, G

![Diagram of 2549 saddle threshold]

**NOTE:** Products shown in this section may not be drawn to scale.

▲ **AVAILABLE FINISHES FOR PRODUCTS SHOWN ON THIS PAGE**

- A (Mill Finish Aluminum)
- B (Mill Finish Extruded Bronze [Brass])
- BDG (Bright Dip Gold Anodized)
- D (Dark Bronze Anodized)
- G (Gold Anodized)
- SN (Satin Nickel Anodized)

**NOTE:** G, SN are available with limited inventory.
### Floor Plate Supports/Accessories

- Please see information under Floor Plates and Safety Treads (page 40-41).

#### AVAILABLE FINISHES:

- **A**, **B**, **D**, **G**

#### 189

- **AVAILABLE FINISHES:**
  - **A**, **B**, **D**, **G**

#### 194

- **AVAILABLE FINISHES:**
  - **A**, **B**, **D**, **G**

#### 195

- **AVAILABLE FINISHES:**
  - **A**, **B**, **D**, **G**

#### 200

- **AVAILABLE FINISHES:**
  - **A**, **B**, **D**, **G**

#### Threshold Stop Strips

- Use with standard flat top threshold saddle to provide a door stop and seal at bottom of door.
- Stop strips are supplied predrilled, with #10-24 phillips, flat head machine screws of appropriate length.
- These stops will effect the pivot hole location of an assembly.

#### AVAILABLE FINISHES:

- **A**, **B**, **D**, **G**

#### 1842_S

- **AVAILABLE FINISHES:** **A**, **D**, **G**
  - **Furnished undrilled.**

#### 290_SSTOP

- **AVAILABLE FINISHES:** **A**, **D**, **G**

- Allow 1/8” door clearance from top of threshold.

#### 1842_PK

- **AVAILABLE FINISHES:** **A**, **D**, **G**

### ALTERNATE INSERTS FOR THRESHOLD STOP STRIPS

- **1842_PKSTOP**
- **290_PKSTOP**

- **Penko Prene** (PK)

### AVAILABLE FINISHES FOR PRODUCTS SHOWN ON THIS PAGE

- A (Mill Finish Aluminum) • B (Mill Finish Extruded Bronze [Brass]) • D (Dark Bronze Anodized) • G (Gold Anodized)

**NOTE:** G, SN are available with limited inventory.
**Automatic Door Bottoms - Non-Handed Full-Mortise Models**

**434_NBL**
- AVAILABLE FINISHES: A
- 29/32" (23.0)
- 1 21/32" (42.1)

**434_PKL**
- AVAILABLE FINISHES: A

**434_RL**
- AVAILABLE FINISHES: A
- 29/32" (23.0)
- 1 21/32" (42.1)

**ALTERNATE INSERTS FOR 434**

**434_PKL**
- AVAILABLE FINISHES: A

**411_NBL**
- AVAILABLE FINISHES: A
- 9/16" (14.3)
- 1 3/8" (34.9)

**411_PKL**
- AVAILABLE FINISHES: A

**411_RL**
- AVAILABLE FINISHES: A
- 9/16" (14.3)
- 1 3/8" (34.9)

**411_SL**
- AVAILABLE FINISHES: A

End Plates for 434 and 411 Models
- Aluminum end plates are provided with all 434 and 411 models to protect the mechanism and to give a clean aesthetic appearance.

**411 End Plate**
- Nails included

**434 End Plate**
- Screws included

**420_PKL**
- AVAILABLE FINISHES: A
- For hollow metal doors. Maximum drop is 1/2".

**420_VL**
- AVAILABLE FINISHES: A
- Vinyl products are not BHMA certified

**420_SL**
- AVAILABLE FINISHES: A

▲ AVAILABLE FINISHES FOR PRODUCTS SHOWN ON THIS PAGE (see General Information section for finish chart)

A (Mill Finish Aluminum)
Door Shoes

- Now available with PemkoTene™ (PK) thermo-plastic elastomer, an excellent cold weather seal which stays flexible between -70°F and +250°F.
- Also available with vinyl (V); both seals are the same shape and size.
- Slotted holes for easy adjustment.

**234_V**
**234_PK**
AVAILABLE FINISHES: A, D, G

**211_V**
**211_PK**
AVAILABLE FINISHES: A, D, G

**220_V**
**220_PK**
AVAILABLE FINISHES: A, D, G

**215_V**
**215_PK**
AVAILABLE FINISHES: A, BDG, D, G, PW, SN

**217_V**
**217_PK**
AVAILABLE FINISHES: A, BDG, D, G, PW, SN

**209_V**
AVAILABLE FINISHES: A, D, G

**210_V**
**210_PK**
AVAILABLE FINISHES: A, BDG, D, G, PW, SN

**216_V**
**216_PK**
AVAILABLE FINISHES: A, B, BDG, D, G, PW, SN

**Available Finishes for Products Shown on This Page** (see General Information section for finish chart)

A (Mill Finish Aluminum) • B (Mill Finish Extruded Bronze [Brass]) • BDG (Bright Dip Gold Anodized) • D (Dark Bronze Anodized) • G (Gold Anodized) • PW (Painted White) • SN (Satin Nickel Anodized)
■ Door Bottom Sweeps

**368_N**
AVAILABLE FINISHES: C, D, G

**315_N**
AVAILABLE FINISHES: B, C, D, G, SN
Satin Nickel finished product supplied with BLACK insert. GRAY available upon request.

**315SSN**
AVAILABLE FINISHES: SS (#4 finish)

**321SSN**
AVAILABLE FINISHES: SS (#4 Finish)

**321_N**
AVAILABLE FINISHES: C, D, G

**56_V**
AVAILABLE FINISHES: A, BDG, D, G, PW, SN

**57_V**
AVAILABLE FINISHES: A, BDG, D, G, PW, SN

**99_V**
AVAILABLE FINISHES: PA, PD, PG, PW

**307_V**
AVAILABLE FINISHES: A, BDG, D, G, PW, SN

**308_V**
AVAILABLE FINISHES: A, BDG, D, G, PW, SN

**3452_V**
AVAILABLE FINISHES: A, BDG, D, G, PW, SN

**345_V**
AVAILABLE FINISHES: A, BDG, D, G, PW

**345_P**
AVAILABLE FINISHES: A, BDG, D, G, PW, SN

NOTE: Products shown in this section may not be drawn to scale.

▲ AVAILABLE FINISHES FOR PRODUCTS SHOWN ON THIS PAGE (see General Information section for finish chart)

A (Mill Finish Aluminum) • B (Mill Finish Extruded Bronze[Brass]) • BDG (Bright Dip Gold Anodized) • C (Clear Anodized) • D (Dark Bronze Anodized) • G (Gold Anodized)
PA (Painted Aluminum) • PD (Painted Dark Bronze) • PG (Painted Gold) • PW (Painted White) • SN (Satin Nickel Anodized) • SS (See Individual Part)
Astragal and Meeting Stile Gasketing - Split Astragals

- Astragals and meeting stiles on double doors often present problems because of complex conditions and requirements. Pemko offers some simple and inexpensive solutions as well as more detailed ones. Each job should be carefully studied as to the specific requirements when selecting the appropriate gasketing. Note that some astragals consist of two parts, one for each door, and should be ordered as such.
- Punched with slotted holes for adjustment.

- Astragals and meeting stiles with a fire label may be mounted on pairs of doors wherein the gap meets the requirements of NFPA 80, 2-3.1.7 “The clearance between the meeting edges of doors swinging in pairs on the pull side shall be 1/8” ± 1/16” (3.18mm ± 1.59mm) for steel doors and shall not exceed 1/8” (3.18mm) for wood doors.”
- All clear anodized brush products are supplied with gray brush (available with black brush upon request). Other finishes supplied with black brush.

**AVAILABLE FINISHES FOR PRODUCTS SHOWN ON THIS PAGE (see General Information section for finish chart)**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Available Finishes</th>
</tr>
</thead>
<tbody>
<tr>
<td>297_S</td>
<td>A, BDG, D, G, PW, SN</td>
</tr>
<tr>
<td>303_S</td>
<td>A, BDG, C, D, G, PW, SN</td>
</tr>
<tr>
<td>316_S</td>
<td>A, BDG, D, G</td>
</tr>
<tr>
<td>18041_NB</td>
<td>C, D, G, SN</td>
</tr>
<tr>
<td>18041_SB</td>
<td>C, D, G, SN</td>
</tr>
</tbody>
</table>

**ALTERNATE INSERTS FOR 297**
- 297_V: Vinyl (V) | Available Finishes: A, BDG, D, G, PW, SN

**ALTERNATE INSERTS FOR 303**

**ALTERNATE INSERTS FOR 316**
- 316_PK: PemkoPrene™ (PK) | Available Finishes: A, BDG, D, G
- 316_V: Vinyl (V) | Available Finishes: A, BDG, D, G

**ALTERNATE INSERTS FOR 18041**
- 18041_SB: Soft Brush (BB) | Available Finishes: C, D, G, SN

**NOTE:** Brush should mesh from 1/32” to 1/16”.

A (Mill Finish Aluminum) • BDG (Bright Dip Gold Anodized) • C (Clear Anodized) • D (Dark Bronze Anodized) • G (Gold Anodized) • PW (Painted White) • SN (Satin Nickel Anodized) • Special finishes available upon request.
## Adhesive-Backed Mullion Gasketing

**5110**

AVAILABLE FINISHES: BL  
AVAILABLE LENGTHS: 120"  

![Adhesive-Backed Mullion Gasketing Diagram]

### Split Astragals with Snap Covers – Concealed Fasteners

- Snap covering helps prevent vandalism and adds an attractive finished look by concealing the fasteners.

**29310_S**

AVAILABLE FINISHES: C, D, G

**29324_NB**

AVAILABLE FINISHES: C, D, G

**29326_NB**

AVAILABLE FINISHES: C, D, G

### Alternate Inserts for 29310

- **29310_PK**
  
  AVAILABLE FINISHES: C, D, G

- **29310_P**
  
  AVAILABLE FINISHES: C, D, G

- **29310_V**
  
  AVAILABLE FINISHES: C, D, G

### Alternate Inserts for 29324

- **29324_SB**
  
  AVAILABLE FINISHES: C, D

**NOTE**: Brush should mesh from 1/32" to 1/16".

**NOTE**: Brush should mesh from 1/32" to 1/16".

---

### AVAILABLE FINISHES FOR PRODUCTS SHOWN ON THIS PAGE (see General Information section for finish chart)

- BL (Black)  
- C (Clear Anodized)  
- D (Dark Bronze Anodized)  
- G (Gold Anodized)  

Special finishes available upon request
### Heavy Duty Perimeter Gasketing - Standard Jamb

- We have expanded our offering of heavy-duty rigid jamb weatherstripping. The 290_PK, 290_S, 290_V, 2902_V and 2903_V (standard jamb application gasketing) shown in the drawings below are shown in a standard mounting application for the side sections of the jamb.
- All gasketing shown below is sold individually.

#### AVAILABLE FINISHES:
- A (Mill Finish Aluminum)
- B (Mill Finish Extruded Bronze [Brass])
- D (Dark Bronze Anodized)
- G (Gold Anodized)

#### ALTERNATE INSERTS FOR 290

- **290_S**
  - AVAILABLE FINISHES: A, D, G
  - silicone (S)

- **290_V**
  - AVAILABLE FINISHES: A, D, G
  - Brass only available with black vinyl insert.

### Heavy Duty Perimeter Gasketing - Head Section

- The 2891_PK, 2891_S, 2891_V, 2892_V and 2893_V (heavy duty head section application gasketing) shown below have been added for the head section of the frame where a parallel arm closer bracket or other hardware is required. This head member will be supplied undrilled (36") or drilled (80" and above) and supplied with sheet metal screws for mounting. If used as a stop, flat head machine screws can be provided upon request and take a countersunk 10 hole. Pemko will drill the head member only if drilling instructions for countersink holes are provided. The aluminum retainer is the same for all of these products with five different sealing options.
- All gasketing shown below is sold individually.

#### AVAILABLE FINISHES:
- A, D
- G

#### AVAILABLE FINISHES FOR PRODUCTS SHOWN ON THIS PAGE (see General Information section for finish chart)
- A (Mill Finish Aluminum)
- B (Mill Finish Extruded Bronze [Brass])
- D (Dark Bronze Anodized)
- G (Gold Anodized)
  - Special finishes available upon request

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NOTE: Products shown in this section may not be drawn to scale.
**SiliconSeal™ Adhesive-Backed Fire/Smoke Gasketing**

- SiliconSeal™ is extruded from high-temperature silicone; effective between -58°F and 450°F.
- Self-extinguishing and non-toxic. Unaffected by sunlight, ozone and ultraviolet rays.
- Impervious to fungus and mildew; will not deteriorate under normal exposure.
- Meets FAR 25.853 Airworthiness Standards for Compartment Interiors.
- Smoke tested in accordance with UBC 7-2 and UL 1784-01; meets the requirements of NFPA 105 “Standard for the Installation of Smoke Door Assemblies and Other Opening Protectives”.
- S44, S77 and S88 are air infiltration tested in accordance with ASTM E-283-04. Air infiltration is only .09 CFM / ft of crack.

### S44
- **Available Finishes:** BL, D, W
- **Available Lengths:** 17', 18', 20', 21', 25', 510'
- Designed for tighter frames.
- Demonstrates extremely low closing force.
- Seal begins compressing at 5/16"; compresses to seal up to a 1/16" gap.

### S77
- **Available Finishes:** C, D, W
- **Available Lengths:** 17', 18', 20', 21', 25'
- Designed for hollow metal and wood meeting stile applications.
- Seal begins compressing at 5/16"; compresses to seal up to a 1/16" gap.

### S88
- **Available Finishes:** BL, C, D, GR, TAN, W
- **Available Lengths:** 17', 18', 20', 21', 25', 30', 204', 510'
- Seal begins compressing at 1/4"; compresses to seal up to a 1/16" gap.

**Application Details for S44**

Application is acceptable anywhere along jamb face (door must be able to operate properly).

**Application Details for S77**

Application is acceptable anywhere along jamb face (door must be able to operate properly).

**Application Details for S88**

Application is acceptable anywhere along jamb face (door must be able to operate properly).

**Available Finishes for Products Shown on This Page** (see General Information section for finish chart)

- BL (Black) • C (Clear) • D (Dark Brown) • GR (Light Gray) • TAN (Tan) • W (White)
Nothing is tougher

At Schlage we know that every product you specify has to stand up to constant use and abuse. Your building’s locking systems face an additional challenge – keeping people and other assets safe while delivering constant, reliable performance. Schlage L Series Extra Heavy Duty Mortise Locks are built to withstand the rigors of daily use without fail.

We don't compromise on security

The safety and security of your clients' buildings is something we take very seriously. That's why every Schlage lock and deadbolt undergoes intensive testing to determine its ANSI grade level:

- Cycle tests
- Resistance tests
- Door impact tests
- Warped door tests
- Bolt strength tests

We pay attention to these details so you can focus on creating a functional and aesthetically pleasing environment for your clients. In fact, every one of our L Series locks meets ANSI Grade 1 standards for safety.
The L Series Vandlgard is ideal for areas subject to abuse or anywhere vandalism is likely to be present. Vandlgard prevents damage to internal lock components caused by excessive force from kicking, hitting or standing on the lever to gain access.

It’s easy to retrofit standard L Series locks with Vandlgard using the Vandlgard Retrofit Kit and an instructional DVD that shows installation on existing hardware.
The right lock for every application

Schlage L9000 Series

Our L9000 Series locks are ideal for use in schools, hospitals and factories, where the finest hardware must also deliver consistent, dependable operation and stand up to constant use and abuse.

Strength and durability
1. Fully wrapped heavy-gauge steel case protects against door edge attacks
2. All-metal zinc dichromate-plated working parts
3. Inside lock case protects electronic components
4. Two-piece anti-friction tongue reduces wear and tear
5. Outside and inside trim thru-bolted together and through the door

Security built in
6. Break-away spindle prevents unsecured failures and provides easy spindle replacement
7. Hub blocking plate protects lock against spindle manipulation
8. Spring-loaded fusible link provides fail secure mode in case of fire
9. Inside lever applied by screwless shank mounting – no exposed trim mount screws

Adaptable to your application
10. Universal lock case – ten functions in one case
11. Floating mounting tabs automatically adjust to fit a beveled door edge
12. Field-reversible handing without opening lock case
13. External spring cages allow for simple trim retrofit
14. Locking thumbturn on the inside of door visually shows when the door is locked and unlocked
15. Lever rotation in both directions (up and down) for ease of use
16. Independent lever rotation

Schlage L400 Series

Our L400 Series locks are designed for use as primary locks where no latching is required, such as restrooms and small doors to utility spaces. They also offer optimum security when used as auxiliary locks in other applications.

1. High-strength steel alloy cylinder retainer
2. Armored front in brass, bronze or stainless steel; adjustable for door bevel
3. 1" (25 mm) stainless steel throw deadbolt
4. Deeper retainer groove in cylinder shell increases security against wrenching and pullout; all cylinders backward compatible
5. 6-pin Everest® cylinder with patented keys standard
6. Steel case and parts are corrosion resistant
The M Collection
A range of options. A single standard of quality.

Introducing the M Collection, an entire lineup of decorative levers designed to maintain a custom high-style look on doors throughout any building—from the main entrance to the supply closet. The ability to suite M Collection levers across multiple platforms from Schlage and Von Duprin means consistent style and functionality—along with unrivaled security.

The M Collection was designed to function as a visual extension of any interior, from contemporary to classic.
All lever designs shown (M Collection and Standard) can be paired with any of the following commercial graded products for suitting across an office, a floor or an entire building.

<table>
<thead>
<tr>
<th>Finish options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
</tr>
<tr>
<td>ANSI/BHMA number</td>
</tr>
</tbody>
</table>

AM = Antimicrobial.
See pricebook for additional trim and finish availability. 33A, 95 & 99 devices not available in 619 & 630 finishes.

### Locks

**Schlage L Series mortise locks**
Grade 1
Schlage L Series locks have long been the industry standard for mortise locks, with a comprehensive offering of functions and options to support any opening need.

**Schlage LT Series tubular locks**
Grade 2
The perfect compliment to the Schlage L Series or the Von Duprin exit devices, the LT Series tubular chassis is based on venerable L Series mortise lock and provides an alternative to lever suitting for interior doors.

### Exit devices

**Von Duprin 98/99 exit devices**
Grade 1
Von Duprin created the first exit device in 1908, and continues to redefine the industry today with unsurpassed quality and industry-unique features such as concealed vertical cables. The 98/99 Series exit device is intended for standard-stile doors. For use with 996L trim only.

**Von Duprin 33A/35A exit devices**
Grade 1
Offering the same innovate features as the 98/99 Series, the 33A/35A Series of exit devices is intended for narrow-stile doors. For use with 360L trim only.

**Von Duprin 94/95 exit devices**
Grade 1
The 94/95 has the pushbar trim recessed into the door to minimize the external profile, allowing more room for people and equipment to pass through. For use with 940L trim only.

Images shown with Schlage L Mortise 'X' rose; additional rose and escutcheon designs available.
The Standard Collection
Built on our tradition of raising industry standards.

Like the M Collection, these lever designs suite with exit devices and locks from our trusted Schlage and Von Duprin brands. And, they are built to the same exacting standards.

Our Standard Collection levers offer a more traditional style that is appropriate for use in a number of commercial applications.
To learn more about suiting of Schlage and Von Duprin products with our decorative or standard levers contact your security consultant or visit allegion.com/us.
Choose from three types of escutcheon and two rose sizes to add tough, durable performance to your lockset.

### Escutcheons

**L Full face**
Specify by adding ‘L’ after lever design.

**Material:** Cold-forged brass, bronze or stainless steel

**Finishes:** 605, 606, 609, 612, 613, 619, 625, 626, 629, 630, 643e

**Size:** 8” x 1 1/2” x 7/16” (203 mm x 44 mm x 11 mm)

### Roses

**A Wrought rose**
2 1/4” (54 mm) diameter
Available for use on L Series knob and lever designs. Specify by adding ‘A’ after lever design.

**Finishes:** 605, 606, 609, 612, 613, 619, 625, 626, 629, 630, 643e

**B Wrought rose**
2 9/16” (65 mm) diameter
Available for use on L Series knob and lever designs. Specify by adding ‘B’ after lever design.

**Finishes:** 605, 606, 609, 612, 613, 619, 625, 626, 629, 630, 643e

**C Wrought rose**
2 5/8” (66 mm) diameter
Available for use on L Series knob and lever designs. Specify by adding ‘C’ after lever design.

**Finishes:** 605, 606, 609, 612, 613, 619, 625, 626, 629, 630, 643e

**N Escutcheon**
Specify by adding ‘N’ after lever design.

**Material:** Heavy wrought reinforced brass, bronze or stainless steel

**Finishes:** 605, 606, 609, 612, 613, 619, 625, 626, 629, 630, 643e

**Size:** 8” x 2 9/16” x 7/16” (203 mm x 65 mm x 11 mm)
Thumbturns

Choose from three variations of thumbturn locks that help you meet the demands of specialized commercial projects.

Hotel occupancy indicator
09-611
For lock function L9486P, this unit can be used with A or B roses. Requires a 1 3/8" (35 mm) cylinder for 1 3/4" (44 mm) doors. Specify finish when ordering separately.

Optional EZ turn
L583-363
Available for rose and escutcheon trim. Disability turn (ADA) option to standard thumbturn. Can be used with thumbturn-function L Series lock except L9463 and L463. Specify lock per L583-363 when ordering.

Coin turn
For lock function L9044 and L9444 with rose trim. Specify 09-509 and finish per L283-124 when ordering.

Tactile warning (knurling)
Schlage L Series commercial levers feature knurling only on the outside lever unless otherwise specified. This feature is available on the following lever models: 01, 02, 03, 05, 06, 07, 12, 17, 18, 41, 42 and 93.

Products featuring a knurled surface will be indicated by adding the prefix “8” to the lever number. For example, L9050P 803A/03A.
Lock functions

Lock components

Deadbolt

Stopworks functions by turn-piece
Auxiliary guarded latch

Latchbolt with anti-friction tongue

Symbol key

Cylinder

Outside knob or lever

Inside knob or lever

Thumbturn

Thumbturn cylinder

Coin turn

Solid spindle

Two-piece spindle

Emergency turn piece

Occupy indicator

Product identification guide

L/LV 9 4 5 3 P

Lock series
L = standard
LV = Vandigard

0 = dummy trim without lock case
9 = functions with lock case

0 = no deadbolt
1 = dummy trim
4 = with deadbolt

Cylinder suffix
P = 6-pin full-face mortise cylinder with Schlage logo*
L = less full-face cylinder
C = concealed mortise cylinder
W = less concealed cylinder
R = full-size interchangeable core with Schlage logo
J = less full-size interchangeable core
F = full-size interchangeable core less Schlage logo
T = full-size construction core
BD = SFIC less core
BDC = disposable SFIC
GD = Everest patented SFIC
HD = construction SFIC

SFIC = Small Format (Best® style) Interchangeable Core
To order less Schlage logo, specify lock
"with K510-612 faceplate."

LV = Vandigard® function allows exterior lever to rotate
freely down while remaining securely locked.
Lock functions
ANSI A156.13, Series 1000

Schlage ANSI
L9010 FO1
Passage latch
Latchbolt retracted by knob/lever from either side at all times. Inside lever is always free for immediate egress.

L9040 F22
LV9040
Bath/bedroom privacy lock
Latchbolt retracted by knob/lever from either side unless outside is locked by inside thumbturn. Turning inside knob/lever or closing door unlocks outside knob/lever. To unlock from outside remove emergency button, insert emergency thumbturn (furnished) in access hole and rotate. Inside lever is always free for immediate egress.

L9044
LV9044
Privacy with coin turn outside
Latchbolt retracted by knob/lever from either side unless outside is locked by inside thumbturn or outside coin turn. Operating inside knob/lever, closing door, rotating inside thumbturn or rotating outside coin turn unlocks outside knob/lever. Specify per L283-056 for Torx® screws. Available with rose trim only. (Previously XL11-868)

L9440
LV9440 F19
Privacy with deadbolt
Latchbolt retracted by knob/lever from either side. Deadbolt thrown or retracted by inside thumbturn. Throwing deadbolt locks outside knob/lever. Rotating inside knob/lever simultaneously retracts deadbolt and latchbolt, and unlocks outside knob/lever. To unlock from outside remove emergency button, insert emergency thumbturn in access hole and rotate. Inside lever is always free for immediate egress. (Previously XL11-761.)

Schlage ANSI
L9444
LV9444
Privacy with deadbolt and coin turn outside
Latchbolt retracted by knob/lever from either side. Deadbolt thrown or retracted by inside thumbturn or outside coin turn. Throwing deadbolt locks outside knob/lever. Rotating inside knob/lever simultaneously retracts deadbolt and latchbolt, and unlocks outside knob/lever. Rotating outside coin turn retracts deadbolt and unlocks outside knob/lever. Specify per L283-056 for Torx screws. Available with rose trim only. Inside lever is always free for immediate egress. (Previously XL11-868)

L0170
Half dummy trim
Knob/lever on one side fixed by mounting bar.

L0172
Full dummy trim
Knob/lever on both sides fixed by mounting bar.

L9175
Half dummy trim with lock case
Fixed knob/lever on one side inoperable. Includes lock case and armored front. Options same as L9176 below.

L9176
Full dummy trim with lock case*
Fixed knob/lever on both sides. Includes lock case and blank armor front. May be ordered with optional XL11-743 armored front with cutout to receive deadbolt.

*In a double-door application where the dummy will be used as the strike order 10-091 Armored Front Strike separately.
Lock functions
Single cylinder non-deadbolt functions

Schlage  ANSI
L9050  F04
LV9050

Office and inner entry lock
Latchbolt retracted by knob/lever from either side unless outside is made inoperative by key outside or by turning inside thumbturn. When outside is locked, latchbolt is retracted by key outside or by knob/lever inside. Outside knob/lever remains locked until thumbturn is returned to vertical or unlocked by key. Auxiliary latch deadlocks latchbolt when door is closed. Inside liner is always free for immediate egress.

L9056
LV9056

L9050 with automatic unlocking
Latchbolt retracted by knob/lever from either side unless outside is made inoperative by key outside or by rotating inside thumbturn. Outside knob/lever unlocked by key outside, thumbturn or closing door. Rotating inside knob/lever simultaneously retracts latchbolt and unlocks outside knob/lever. Auxiliary latch deadlocks latchbolt when door is closed. Inside lever is always free for immediate egress.

L9070  F05
LV9070

Classroom lock
Latchbolt retracted by knob/lever from either side unless outside is locked by key. Unlocked from outside by key. Inside knob/lever always free for immediate exit. Auxiliary latch deadlocks latchbolt when door is closed. Inside lever is always free for immediate egress.

L9076  F06
LV9076

Classroom holdback lock
Latchbolt retracted by knob/lever from either side unless outside is locked by key. When locked, latchbolt retracted by key outside or knob/lever inside. Auxiliary latch deadlocks latchbolt when door is closed. Depress inside knob/lever and turn key 360° for holdback feature. Inside lever is always free for immediate egress.

L9080  F07
LV9080

Storeroom lock
Latchbolt retracted by key outside or by knob/lever inside. Outside knob/lever is always inoperative. Auxiliary latch deadlocks latchbolt when door is closed. Inside lever is always free for immediate egress.

Schlage  ANSI
L9080EL
LV9080EL

Electrically locked (fail safe)
Outside knob/lever continuously locked by 24V AC or DC. Latchbolt retracted by key outside or by knob/lever inside. Switch or power failure allows outside knob/lever to retract latchbolt. Auxiliary latch deadlocks latchbolt when door is closed. Inside knob/lever always free for immediate exit. Inside lever is always free for immediate egress.

L9080EU
LV9080EU

Electrically unlocked (fail secure)
Outside knob/lever unlocked by 24V AC or DC. Latchbolt retracted by key outside or knob/lever inside. Auxiliary latch deadlocks latchbolt when door is closed. Inside lever is always free for immediate egress.

L9080EL-RX / LV9080EL-RX
L9080EU-RX / LV9080EU-RX

Request to exit (RX) electrified lock
Same as L9080EL and L9080EU functions. In addition, a micro-switch positioned inside the lock case monitors the retractor crank, and is actuated when rotation of the inside or outside knob/levers rotates the retractor hub. The switch signals the use of that opening to security systems, allowing a non-disruptive means of immediate egress. Specify per L283-263 with L functions, specify L283-239 with L V functions. Inside lever is always free for immediate egress.
## Lock functions

**Single cylinder deadbolt functions**

<table>
<thead>
<tr>
<th>Schlage</th>
<th>ANSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>L9453</td>
<td>F20</td>
</tr>
<tr>
<td>LV9453</td>
<td></td>
</tr>
</tbody>
</table>

**Entrance lock**

Latchbolt retracted by knob/lever from either side unless outside is locked by 20° rotation of thumbturn. Deadbolt thrown or retracted by 90° rotation of thumbturn. When locked, key outside or knob/lever inside retracts deadbolt and latchbolt simultaneously. Outside knob/lever remains locked until thumbturn is restored to vertical position. Throwing deadbolt automatically locks outside knob/lever. Auxiliary latch deadlocks latchbolt when door is closed. Inside lever is always free for immediate egress.

<table>
<thead>
<tr>
<th>Schlage</th>
<th>ANSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>L9456</td>
<td>F13</td>
</tr>
<tr>
<td>LV9456</td>
<td></td>
</tr>
</tbody>
</table>

**Corridor lock**

Latchbolt retracted by knob/lever from either side. Deadbolt thrown or retracted by key outside or inside thumbturn. Throwing deadbolt locks outside knob/lever. Turning inside knob/lever simultaneously retracts deadbolt and latchbolt and unlocks outside knob/lever. Inside lever is always free for immediate egress.

<table>
<thead>
<tr>
<th>Schlage</th>
<th>ANSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>L9465</td>
<td></td>
</tr>
</tbody>
</table>

**Closet/storeroom lock**

Latchbolt retracted by knob/lever from either side. Deadbolt thrown or retracted by key outside.

<table>
<thead>
<tr>
<th>Schlage</th>
<th>ANSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>L9473</td>
<td>F21</td>
</tr>
</tbody>
</table>

**Dormitory/bedroom lock**

Latchbolt retracted by knob/lever from either side. Deadbolt thrown or retracted by key outside or thumbturn inside.

<table>
<thead>
<tr>
<th>Schlage</th>
<th>ANSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>L9480</td>
<td></td>
</tr>
</tbody>
</table>

**Storeroom lock with deadbolt**

Latchbolt retracted by key outside or by lever or knob inside. Outside knob/lever always fixed. Deadbolt thrown or retracted by key outside or thumbturn inside. Turning inside knob/lever simultaneously retracts both deadbolt and latchbolt. Auxiliary latch deadlocks latchbolt when door is closed. Inside lever is always free for immediate egress. (Previously XL11-561)

<table>
<thead>
<tr>
<th>Schlage</th>
<th>ANSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>L9485</td>
<td>F15</td>
</tr>
<tr>
<td>LV9485</td>
<td></td>
</tr>
</tbody>
</table>

**Faculty/hotel/restroom lock**

Latchbolt retracted by key outside or by knob/lever inside. Outside knob/lever always fixed. Deadbolt thrown or retracted by inside thumbturn. When deadbolt is thrown “do not disturb” plate is displayed. All keys become inoperative except emergency or display keys. Turning inside knob/lever retracts both deadbolt and latchbolt simultaneously. Auxiliary latch deadlocks latchbolt when door is closed. Inside lever is always free for immediate egress.

<table>
<thead>
<tr>
<th>Schlage</th>
<th>ANSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>L9486</td>
<td>F15</td>
</tr>
<tr>
<td>LV9486</td>
<td></td>
</tr>
</tbody>
</table>

**Faculty/hotel/restroom lock**

Latchbolt retracted by key outside or by knob/lever inside. Outside knob/lever always fixed. Deadbolt thrown or retracted by inside thumbturn. When deadbolt is thrown “Occupied” plate is displayed and all keys become inoperative except emergency keys. Turning inside knob/lever simultaneously retracts both deadbolt and latchbolt. Auxiliary latch deadlocks latchbolt when door is closed. Inside lever is always free for immediate egress. (Previously XL11-580)

<table>
<thead>
<tr>
<th>Schlage</th>
<th>ANSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>L9496</td>
<td></td>
</tr>
</tbody>
</table>

**Privacy with “occupied” indicator**

Knob/lever retracts latchbolt from either side. Deadbolt thrown or retracted by key outside (retraction by key required in the event of an emergency) or inside thumbturn. Throwing deadbolt locks outside knob/lever and displays “Occupied” plate. Rotating inside knob/lever simultaneously retracts both deadbolt and latchbolt, and unlocks outside knob/lever. Inside lever is always free for immediate egress. (Previously XL11-885)

<table>
<thead>
<tr>
<th>Schlage</th>
<th>ANSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>L9485 x XL11-557</td>
<td></td>
</tr>
</tbody>
</table>

**Prison function lock**

Latch retracted by key outside or knob inside. Outside knob always free spinning. Deadbolt only thrown or retracted by guard’s key. Inside knob becomes fixed when deadbolt is thrown. Prisoner’s key only retracts latchbolt. Furnished standard with tamper-resistant Torx screws. Specify per XL11-557.

*In a double-door application where the dummy will be used as the strike order 10-091 Armored front strike separately.*
Lock functions
Double cylinder
non-deadbolt functions

Schlage  ANSI
L9060  F09
LV9060

Apartment entrance lock
Latchbolt retracted by knob/lever from either side unless outside is locked by key from inside. When locked, latchbolt retracted by key outside or knob/lever inside. Auxiliary latch deadlocks latchbolt when door is closed. Inside lever is always free for immediate egress.

L9071  LV9071

Classroom security lock
Latchbolt retracted by knob/lever from either side unless outside is locked by key from either side. When locked, latchbolt retracted by key outside or knob/lever inside. Auxiliary latch deadlocks latchbolt when door is closed. Inside lever is always free for immediate egress.

L9077  LV9077

Classroom security holdback lock
Latchbolt retracted by knob/lever from either side unless outside is locked by key from either side. When locked, latchbolt retracted by key outside or knob/lever inside. Auxiliary latch deadlocks latchbolt when door is closed. Depress inside knob/lever and turn key 360° for holdback feature. Inside lever is always free for immediate egress.

L9082  F30
LV9082

Institution lock
Latchbolt retracted by key from either side. Knob/lever on both sides always inoperative. Auxiliary latch deadlocks latchbolt when door is closed.

L9082EL  L9082EU

L9082 electrically locked or electrically unlocked both sides
EL: Outside and inside knob or lever continually locked electrically. Latchbolt retracted by key either side. Switch or power failure allows outside and inside knob/lever to retract latchbolt. Auxiliary latch deadlocks latchbolt when door is closed. EU: Outside and inside knob/lever unlocked electrically. Latchbolt retracted by key either side. Switch or power failure keeps inside and outside knob/lever locked. Auxiliary latch deadlocks latchbolt when door is closed. (Previously XL11-452)

In a double-door application where the dummy will be used as the strike order 10-091 Armored front strike separately.

*Caution: Double cylinder locks on residences and any door in any structure which is used for egress are a life safety hazard in times of emergency and their use is not recommended. Installation should be in accordance with existing codes only.

Lock functions
Double cylinder
deadbolt functions

Schlage  ANSI
L9457  LV9457

Classroom security lock with deadbolt
Latchbolt retracted by knob/lever from either side. Deadbolt thrown or retracted by key from either side. Throwing deadbolt locks outside knob/lever. Turning inside knob/lever simultaneously retracts deadbolt and latchbolt, and unlocks outside knob/lever. Inside lever is always free for immediate egress.

L9466  F14

Store/utility room lock with deadbolt
Latchbolt retracted by knob/lever from either side. Deadbolt thrown or retracted by key from either side.

L9482 x XL11-943  LV9482 x XL11-943

Institution lock with deadbolt
Latchbolt retracted by key from either side. Knob/lever on both sides always inoperative. Deadbolt thrown or retracted by key either side. Auxiliary latch deadlocks latchbolt when door is closed. Specify per XL11-543.

L9082 F30  LV9082

Institution lock
Latchbolt retracted by key from either side. Knob/lever on both sides always inoperative. Auxiliary latch deadlocks latchbolt when door is closed.

L9082EL  L9082EU

L9082 electrically locked or electrically unlocked both sides
EL: Outside and inside knob or lever continually locked electrically. Latchbolt retracted by key either side. Switch or power failure allows outside and inside knob/lever to retract latchbolt. Auxiliary latch deadlocks latchbolt when door is closed. EU: Outside and inside knob/lever unlocked electrically. Latchbolt retracted by key either side. Switch or power failure keeps inside and outside knob/lever locked. Auxiliary latch deadlocks latchbolt when door is closed. (Previously XL11-452)
## Lock functions

### Full mortise deadlocks

<table>
<thead>
<tr>
<th>Model</th>
<th>ANSI</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L9460</td>
<td>F17</td>
<td>Cylinder x thumbturn lock. Deadbolt thrown or retracted by key outside or thumbturn inside.</td>
</tr>
<tr>
<td>L9462</td>
<td>F16</td>
<td>Double cylinder lock. Deadbolt operated by key from either side.</td>
</tr>
<tr>
<td>L9463</td>
<td></td>
<td>Classroom lock. Deadbolt thrown or retracted by key from outside. Inside thumbturn cylinder retracts deadbolt, but cannot project it.</td>
</tr>
<tr>
<td>L9464</td>
<td>F18</td>
<td>Cylinder lock. Deadbolt thrown or retracted by key from one side. No trim on opposite side.</td>
</tr>
<tr>
<td>L9460 x XL11-635</td>
<td></td>
<td>L9460 with pull. Knob/lever both sides fixed. Deadbolt thrown or retracted by key outside or thumbturn inside.</td>
</tr>
<tr>
<td>L9460 x XL11-886</td>
<td></td>
<td>Single cylinder deadlock with pull. Deadbolt thrown or retracted by key outside or thumbturn inside. No latch, but inside knob or lever is spring-loaded. Rotating inside knob/lever also retracts deadbolt. Fixed outside knob/lever.</td>
</tr>
<tr>
<td>L9462 x XL11-886</td>
<td></td>
<td>Double cylinder deadlock with pull. Deadbolt thrown or retracted by key from either side. No latch, but inside knob/lever is spring-loaded. Rotating inside knob/lever also retracts deadbolt. Fixed outside knob/lever.</td>
</tr>
<tr>
<td>L9464 x XL11-886</td>
<td></td>
<td>Deadlock with pull. Deadbolt thrown or retracted by key from one side. No latch, but inside knob/lever is spring-loaded. Rotating inside knob/lever also retracts deadbolt. Fixed outside knob/lever.</td>
</tr>
</tbody>
</table>

### Small mortise deadlocks

<table>
<thead>
<tr>
<th>Model</th>
<th>ANSI</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L460</td>
<td>E06071</td>
<td>Cylinder x thumbturn lock. Deadbolt thrown or retracted by key outside or thumbturn inside.</td>
</tr>
<tr>
<td>L462</td>
<td>E06061</td>
<td>Double cylinder lock. Deadbolt operated by key from either side.</td>
</tr>
<tr>
<td>L463</td>
<td>E06091</td>
<td>Classroom lock. Deadbolt thrown or retracted by key from outside. Inside thumbturn cylinder retracts deadbolt, but cannot project it.</td>
</tr>
<tr>
<td>L464</td>
<td>E06081</td>
<td>Cylinder lock. Deadbolt thrown or retracted by key from one side. No trim on opposite side.</td>
</tr>
<tr>
<td>L480</td>
<td></td>
<td>Door bolt. Deadbolt thrown or retracted by thumbturn from one side. No trim on opposite site.</td>
</tr>
<tr>
<td>L496</td>
<td></td>
<td>Deadbolt with “occupied” indicator. Deadbolt thrown or retracted by key outside or thumbturn inside. When deadbolt is thrown “Occupied” plate is displayed. (Previously XL11-911)</td>
</tr>
</tbody>
</table>
## Schlage L Series universal transformation instructions

The L9050 universal case can be transformed into nine different functions* with just a few additional parts.

For some functions, additional parts are not necessary.

<table>
<thead>
<tr>
<th>ANSI function</th>
<th>Function type</th>
<th>Function description</th>
</tr>
</thead>
<tbody>
<tr>
<td>F04</td>
<td>L9050 (w/thumbturn) office</td>
<td>Latchbolt operated by lever either side except when outside lever is made inoperative by a stop or other mechanical means other than key. When outside lever is locked, latchbolt is retracted by key from outside or by operating inside lever. Auxiliary deadlatch.</td>
</tr>
<tr>
<td>F01</td>
<td>L9010 passage</td>
<td>Latchbolt operated by lever from either side at all times.</td>
</tr>
<tr>
<td>F05</td>
<td>L9070 classroom</td>
<td>Latchbolt operated by lever either side except when outside lever is locked from outside by key or push button mechanism. When outside is locked latchbolt is retracted by key or by operating key or push button, and outside lever from outside or by operating inside lever. Auxiliary deadlatch.</td>
</tr>
<tr>
<td>F07</td>
<td>L9080 storeroom</td>
<td>Latchbolt operated by key outside or by operating inside lever. Outside lever always inoperative. Auxiliary deadlatch.</td>
</tr>
<tr>
<td>F09</td>
<td>L9060 apartment entrance</td>
<td>Latchbolt operated by lever either side, except when made inoperative by key from inside. When outside is locked latchbolt is retracted by key from outside or by operating inside lever. Auxiliary deadlatch.</td>
</tr>
<tr>
<td>F31</td>
<td>L9080 (less outside cylinder) exit or communicating</td>
<td>Latchbolt operated by inside lever. Non-removable blank trim or no trim outside.</td>
</tr>
<tr>
<td>F32</td>
<td>L9071 classroom security</td>
<td>Latchbolt retracted by lever either side except when outside lever is locked by key from inside or outside. When outside lever is locked latchbolt is retracted by key either side or by inside lever. Auxiliary deadlatch.</td>
</tr>
<tr>
<td></td>
<td>L9080 (less outside lever) service</td>
<td>Latchbolt operated by key outside or by operating inside lever. No outside lever. Auxiliary deadlatch.</td>
</tr>
<tr>
<td></td>
<td>L9080 (less inside trim) utility</td>
<td>Latchbolt retracted by key outside; outside lever always inoperative. No inside trim. Auxiliary deadlatch.</td>
</tr>
<tr>
<td></td>
<td>L9070 (less inside trim) closet</td>
<td>Latchbolt operated by lever on outside except when outside lever is locked from outside by key. When outside is locked latchbolt is retracted by key or by operating key from outside lever. Auxiliary deadlatch.</td>
</tr>
</tbody>
</table>

* Assumes Everest cylinders and L9050 as base function (L283-133 chassis/L9050LB distributor lock case) — only applies to sectional trim (not escutcheon).
<table>
<thead>
<tr>
<th>Transformation instructions</th>
<th>Additional part(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Install cloverleaf cam cylinder on outside; install thumbturn assembly 09-509-027 on inside.</td>
<td>No additional parts required.</td>
</tr>
<tr>
<td>Do not install thumbturn unit 09-509-027 on inside or cylinder outside. Install chassis in the unlocked position.</td>
<td>No additional parts required.</td>
</tr>
<tr>
<td>Install cloverleaf cam cylinder on outside: do not install thumbturn assembly 09-509-027 on inside.</td>
<td>No additional parts required.</td>
</tr>
<tr>
<td>Do not install thumbturn unit 09-509-027 on inside. Install chassis in the locked position. Replace cloverleaf cam L583-153 with straight cam B502-948 (Everest), LS83-255 with K510-680 (IC and SFIC) and install on outside.</td>
<td>Cams B502-948 (Everest), K510-680 (IC and SFIC) or L583-476 or L583-477 for modular cylinders</td>
</tr>
<tr>
<td>Do not install thumbturn unit 09-509-027 on inside. Install cloverleaf cam cylinder on inside. Replace clover leaf cam L583-153 with straight cam B502-948 (Everest), LS83-255 with K510-680 (IC and SFIC) and install on outside.</td>
<td>Mortise cylinder assembly and cams B502-948 (Everest), K510-680 (IC and SFIC) or L583-476 or L583-477 for modular cylinders</td>
</tr>
<tr>
<td>Do not install thumbturn unit 09-509-027 on inside. Install chassis in the locked position. Install inside lever with L285-150 mounting plate; do not install outside lever or cylinder.</td>
<td>Mounting plate L283-150</td>
</tr>
<tr>
<td>Do not install thumbturn unit 09-509-027 on inside. Install cloverleaf cam cylinder on inside and outside.</td>
<td>Mortise cylinder assembly and cam L583-153</td>
</tr>
<tr>
<td>Do not install thumbturn unit 09-509-027 on inside. Install chassis in the locked position. Replace cloverleaf cam L583-153 with straight cam B502-948 (Everest), LS83-255 with K510-680 (IC and SFIC) and install on outside. Install inside lever with L285-150 mounting plate; do not install outside lever.</td>
<td>Cams B502-948 (Everest), K510-680 (IC and SFIC), mounting plate L283-150 or L583-476 or L583-477 for modular cylinders</td>
</tr>
<tr>
<td>Do not install thumbturn unit 09-509-027 on inside. Install chassis in the locked position. Replace cloverleaf cam L583-153 with straight cam B502-948 (Everest), LS83-255 with K510-680 (IC and SFIC) and install on outside. Install inside lever on outside with L283-150 mounting plate; do not install inside lever.</td>
<td>Cams B502-948 (Everest), K510-680 (IC and SFIC), mounting plate L283-150 or L583-476 or L583-477 for modular cylinders</td>
</tr>
<tr>
<td>Install cloverleaf cam cylinder on outside: do not install thumbturn assembly 09-509-027 on inside. Install inside trim on outside with L283-150 mounting plate.</td>
<td>Mounting plate L283-150</td>
</tr>
</tbody>
</table>
Specifications

Handing:
L9000 Series lock bodies are field-reversible without disassembly. L400 Series locks are non-handed.

Door thickness:
1 1/4" (44 mm) standard. 1 1/4" (35 mm) to 2 1/2" (64 mm) optional. Over 2 1/2" (64 mm) door ranges vary by function. No escutcheon available for 1 1/4" (44 mm) doors standard. 2" to 2 7/8" (51 mm to 60 mm) optional. Specify door thickness if other than 1 1/4".

Backset:
2 1/4" (70 mm) only.

Armored front:
L9000 Series: 1 1/4" x 8" x 7/32" (32 mm x 203 mm x 6 mm) standard. 1 1/4" x 8" x 1 1/4" (27 mm x 203 mm x 6 mm) optional. L400 Series: 4 7/16" x 3 3/8" x 1" (113 mm x 92 mm x 25 mm)

Case size:
L9000 Series: 4 7/16" x 6 3/8" x 1" (113 mm x 154 mm x 25 mm) L400 Series: 4 7/16" x 3 3/8" x 1" (113 mm x 92 mm x 25 mm)

Spacing:
Knob or lever to cylinder, 3 7/8" (98 mm); knob or lever to thumbturn hub, 2 1/4" (68 mm).

Bolts:
1" (25 mm) throw stainless steel deadbolt and 3/4" (19 mm) throw stainless steel latch with anti-friction tongue.

Exposed trim:
Knobs: #41 and #42 heavy-duty wrought brass, bronze or stainless steel knobs match D Series knobs.
Levers: Forged brass or bronze and cast stainless steel. Designs available to match D Series levers.
93 Lever design: Extruded brass, bronze or stainless steel.
Mediterranean designs: Forged-brass lever and rose.
Escutcheons: L escutcheons are cold-forged brass or bronze and stainless steel. N escutcheons are heavy wrought reinforced brass, bronze and stainless steel.
Trim combinations: Available with knob both sides, lever both sides, or knob and lever with rose or escutcheon both sides.

Strike:
L9000 Series: ANSI curved lip strike 1 1/4" x 4 7/8" (32 mm x 124 mm) x 1 1/4" (30 mm) lip to center with dust box standard. L400 Series: 1 1/4" x 3 3/8" (29 mm x 92 mm) with dust box.

Cylinder & keys:
6-pin Everest C123 keyway cylinder with two patented keys standard.
Keying options:
Interchangeable core and Primus high security cylinders. Master keying, grand master keying and construction keying.

Certifications

ANSI:

California State Reference Code:
(Formerly Title 19, California State Fire Marshal Standard) All levers with returns comply; levers return to within 1/2" of door face.

UL / cUL:
All locks listed for A label single doors, 4' by 10'. Letter F and UL symbol on latch front indicate listing. Electrified functions are UL19X Listed for single-point locking applications. UL437 Listed locking cylinder optional: specify Primus 20-500 Series cylinder.
**How to order**

To order Schlage products, descriptive data should be in the same sequence as shown.

<table>
<thead>
<tr>
<th>Line item</th>
<th>Qty</th>
<th>Product</th>
<th>Outside Des</th>
<th>Outside Fin</th>
<th>Inside Des</th>
<th>Inside Fin</th>
<th>Hand</th>
<th>Front</th>
<th>Strike</th>
<th>Door thickness</th>
<th>Ext</th>
<th>Dim</th>
<th>Additional details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>L9453P</td>
<td>03A</td>
<td>626</td>
<td></td>
<td></td>
<td>RH</td>
<td></td>
<td></td>
<td>10-091</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>50</td>
<td>L9453P</td>
<td>03A</td>
<td>626</td>
<td></td>
<td></td>
<td>RH</td>
<td></td>
<td></td>
<td>10-091</td>
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<tr>
<td>3</td>
<td>10</td>
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<td>03A</td>
<td>626</td>
<td>625</td>
<td>LH</td>
<td>RH</td>
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<td>4</td>
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<td>07L</td>
<td>626</td>
<td>625</td>
<td>LH</td>
<td>RH</td>
<td></td>
<td>09-668</td>
<td>138</td>
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<tr>
<td>5</td>
<td>50</td>
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<td>07L</td>
<td>626</td>
<td>625</td>
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<td>6</td>
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<td>07L</td>
<td>626</td>
<td>625</td>
<td>LH</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**To order cylinder options, change “P” at the end of the model number as follows:**

- **L9453P** Standard
- **L9453L** Less standard cylinder. For Primus cylinder, specify this option and order Primus cylinder separately.
- **L945C** With temporary plastic construction cylinder. Double cylinder functions ordered less cylinder are furnished with these construction cylinders to maintain timing of key cams.
- **L9453J** Prepared for full size interchangeable core, less core. For Primus core, specify this option and order Primus core separately.
- **L9453R** With full-size conventional interchangeable core installed. Order control keys separately.
- **L9453T** With full-size (temporary) construction core installed. Order all keys separately.
- **L9453BD** Prepared for small format (Falcon, Best, etc.) interchangeable core (SFIC), less core.
- **L9453GD** With Everest B Family restricted keyway small format core installed. Order control keys separately.
- **L9453HD** With small format keyed brass construction core installed. Order all keys separately.
- **L9453BDC** With small format disposable plastic construction core installed.

**Example**

<table>
<thead>
<tr>
<th>Line item</th>
<th>Qty</th>
<th>Product</th>
<th>Outside Des</th>
<th>Outside Fin</th>
<th>Inside Des</th>
<th>Inside Fin</th>
<th>Hand</th>
<th>Front</th>
<th>Strike</th>
<th>Door thickness</th>
<th>Ext</th>
<th>Dim</th>
<th>Additional details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>50</td>
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<td>03A</td>
<td>626</td>
<td></td>
<td></td>
<td>RH</td>
<td></td>
<td></td>
<td>10-091</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>50</td>
<td>L9453P</td>
<td>03A</td>
<td>626</td>
<td></td>
<td></td>
<td>RH</td>
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<td>10-091</td>
<td></td>
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<td></td>
</tr>
<tr>
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<td>10</td>
<td>L94040</td>
<td>03A</td>
<td>626</td>
<td>625</td>
<td>LH</td>
<td>RH</td>
<td></td>
<td></td>
<td>138</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>L94040</td>
<td>03A</td>
<td>626</td>
<td>625</td>
<td>LH</td>
<td></td>
<td>09-668</td>
<td></td>
<td>138</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>50</td>
<td>L9456P</td>
<td>07L</td>
<td>626</td>
<td>625</td>
<td>RH</td>
<td></td>
<td>09-668</td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td>6</td>
<td>50</td>
<td>L9456P</td>
<td>07L</td>
<td>626</td>
<td>625</td>
<td>LH</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Note:** Schlage order forms are available at no charge by contacting your Allegion security & safety consultant or customer service.
**Full Size Interchangeable Core Availability**

- **A-Series**
  - Orbit design

- **AL-Series**
  - Saturn design

- **B500-Series**

- **B600 / 700-Series**

- **D-Series knob**
  - Orbit design

- **ND-Series lever**
  - All designs

- **H-Series knob**
  - Orbit design

- **L-Series**
  - All designs except concealed

- **S-Series**
  - All designs except Flair

- **S200-Series**
  - All designs for S210
  - All except Flair for other functions

---

**Lockset Series Description Number Specify Finish**

- **B500-Series**
  - Outside: B610-203, B610-205 605, 609, 612, 613, 619, 625, 626, and 716
  - Inside: B610-028** 605, 609, 612, 613, 619, 625, 626, and 716

- **B250, H, S200-Series**
  - Outside: 22-061 605, 606, 609, 610, 611, 612, 613, 616, 625, 626
  - Inside: B252 22-062

- **B600 / 700-Series**
  - Outside: B610-027 605, 606, 609, 612, 613, 625, 626
  - Inside: B610-028 See Note Below

  Specify finish of B610-031 inside snap-on faceplate ordered separately for BC162 and B662/762.

  **Inside housing does not include snap-on faceplate**

---

**Part # Shackle Dimensions**

<table>
<thead>
<tr>
<th>Part #</th>
<th>Shackle Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>KS43A3200</td>
<td>3/8&quot; - 3/4&quot; - 3/4&quot;</td>
</tr>
<tr>
<td>KS43D3200</td>
<td>3/8&quot; - 1 1/2&quot; - 3/4&quot;</td>
</tr>
<tr>
<td>KS43F3200</td>
<td>3/8&quot; - 2&quot; - 3/4&quot;</td>
</tr>
<tr>
<td>KS43G3200</td>
<td>3/8&quot; - 4&quot; - 3/4&quot;</td>
</tr>
<tr>
<td>KS72M3200</td>
<td>7/16&quot; - 1&quot; - 7/8&quot;</td>
</tr>
<tr>
<td>KS72F3200</td>
<td>7/16&quot; - 2&quot; - 7/8&quot;</td>
</tr>
<tr>
<td>KS92M3200</td>
<td>3/8&quot; - 1&quot; - 3/4&quot;</td>
</tr>
</tbody>
</table>
Full Size Interchangeable Core Availability

A-Series
- Orbit design
- ND-Series lever
- all designs

AL-Series
- Saturn design
- H-Series knob
- Orbit design

B500-Series
- L-Series
- all designs

B600 / 700-Series
- S-Series
- all designs

except Flair

D-Series knob
- Orbit design

S200-Series
- all designs for S210
- All except Flair for other functions

Full Size Interchangeable Core Cylinders for Schlage Locksets

Full Size Core Only

<table>
<thead>
<tr>
<th>Number</th>
<th>Mechanism</th>
</tr>
</thead>
<tbody>
<tr>
<td>23-030</td>
<td>Conventional core</td>
</tr>
<tr>
<td>30-120</td>
<td>Conventional core for hotel function (specify hand)</td>
</tr>
<tr>
<td>20-740-XP</td>
<td>Primus XP core (not available in hotel function)</td>
</tr>
</tbody>
</table>

Available 606 and 626 finish only. Order control keys separately.

Full Size IC Housings for Bored Deadlocks, Less Core

<table>
<thead>
<tr>
<th>Lockset Series</th>
<th>Description</th>
<th>Number</th>
<th>Specify Finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>B500-Series</td>
<td>Outside</td>
<td>B610-203, B610-205</td>
<td>605, 609, 612, 613, 619, 625, 626, and 716</td>
</tr>
<tr>
<td></td>
<td>Inside</td>
<td>B610-028**</td>
<td>605, 609, 612, 613, 625, 626, and 716</td>
</tr>
<tr>
<td>B250, H, S200-Series</td>
<td>Outside</td>
<td>22-061</td>
<td>605, 606, 609, 610, 611, 612, 613, 616, 625, 626</td>
</tr>
<tr>
<td></td>
<td>Inside of B252</td>
<td>22-062</td>
<td></td>
</tr>
<tr>
<td>B600 / 700-Series</td>
<td>Outside</td>
<td>B610-027</td>
<td>605, 606, 609, 612, 613, 625, 626, 629</td>
</tr>
<tr>
<td></td>
<td>Inside</td>
<td>B610-028</td>
<td>See Note Below</td>
</tr>
</tbody>
</table>

Specify finish of B610-031 inside snap-on faceplate ordered separately for BC162 and B662/762.

**Inside housing does not include snap-on faceplate

Full Size Interchangeable Core Padlocks

<table>
<thead>
<tr>
<th>Part #</th>
<th>Shackle Dimensions</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>LESS CYLINDER - FULL SIZE INTERCHANGEABLE CORE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BRASS BODY</td>
<td>KS43A3200</td>
<td>1/8&quot;</td>
<td>1/8&quot;</td>
<td>1/4&quot;</td>
</tr>
<tr>
<td></td>
<td>KS43D3200</td>
<td>1/4&quot;</td>
<td>1/8&quot;</td>
<td>1/4&quot;</td>
</tr>
<tr>
<td></td>
<td>KS43F3200</td>
<td>1/4&quot;</td>
<td>2&quot;</td>
<td>1/4&quot;</td>
</tr>
<tr>
<td></td>
<td>KS43G3200</td>
<td>1/8&quot;</td>
<td>4&quot;</td>
<td>1/4&quot;</td>
</tr>
<tr>
<td>STEEL BODY</td>
<td>KS72M3200</td>
<td>7/16&quot;</td>
<td>1&quot;</td>
<td>7/8&quot;</td>
</tr>
<tr>
<td></td>
<td>KS72F3200</td>
<td>7/16&quot;</td>
<td>2&quot;</td>
<td>7/8&quot;</td>
</tr>
<tr>
<td></td>
<td>KS92M3200</td>
<td>7/16&quot;</td>
<td>1&quot;</td>
<td>7/8&quot;</td>
</tr>
</tbody>
</table>

Note: To order Primus XP add the suffix - XP to the Primus part number. (Example: 12-345-XP)
Full Size Interchangeable Core Mortise Cylinders

Cylinders for Schlage L-Series Mortise Locks

<table>
<thead>
<tr>
<th>Design</th>
<th>Function</th>
<th>Core Mechanism</th>
</tr>
</thead>
<tbody>
<tr>
<td>L &amp; N Escutcheons (cylinders with compression ring)</td>
<td>All Except Below</td>
<td>Conventional: 30-008, Primus, Primus XP: 20-798, 20-798-XP: 30-007</td>
</tr>
<tr>
<td>L9060P Outside</td>
<td>Conventional: 30-030, Primus, Primus XP: 20-782, 20-782-XP: 30-032 + 36-083</td>
<td></td>
</tr>
<tr>
<td>L9485P, L9486P Hotel Functions</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>L9485P, L9486P Hotel Functions</td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>

* Hotel function cores are handed. Specify hand of door.

Mortise Cylinders with Straight Cam for Exit Devices

<table>
<thead>
<tr>
<th>Number</th>
<th>Core Mechanism</th>
<th>Collar</th>
</tr>
</thead>
<tbody>
<tr>
<td>26-091</td>
<td>Conventional core</td>
<td>Compression ring &amp; spring</td>
</tr>
<tr>
<td>20-061</td>
<td></td>
<td>3/16&quot; blocking rings + compression ring &amp; spring</td>
</tr>
<tr>
<td>20-763, 20-763-XP</td>
<td>Primus/Primus XP core</td>
<td>Compression ring &amp; spring</td>
</tr>
<tr>
<td>20-771, 20-771-XP</td>
<td></td>
<td>3/16&quot; blocking rings + compression ring &amp; spring</td>
</tr>
<tr>
<td>20-059</td>
<td>Housing less core</td>
<td>None</td>
</tr>
<tr>
<td>26-064</td>
<td></td>
<td>Compression ring &amp; spring</td>
</tr>
</tbody>
</table>

Notes:
1. Available 605, 606, 609, 610, 612, 613, 625, and 626 finish. Cores furnished 606 and 626 only.
2. To differentiate between Classic and Everest, specify keyway. Example: K or CP (Classic), C123 (Everest). Everest C123 keyway standard.
3. All cylinders are 1 1/2" long.
4. Specify LKB if 0-bitted Primus XP cylinders are required less key blanks.
Full Size Interchangeable Core Cylinders for Exit Devices, Aluminum Doors, etc.

Interchangeable Core Rim Cylinders for Exit Devices

<table>
<thead>
<tr>
<th>Number</th>
<th>Core Mechanism</th>
<th>Collar</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-057</td>
<td>Conventional core</td>
<td>Compression ring &amp; spring</td>
</tr>
<tr>
<td>20-757</td>
<td>Primus core</td>
<td>3/16&quot; + 3/8&quot; blocking rings</td>
</tr>
<tr>
<td>20-757-XP</td>
<td>Primus XP core</td>
<td>3/16&quot; + 3/8&quot; blocking rings</td>
</tr>
<tr>
<td>20-079</td>
<td>Housing only, less core</td>
<td>None</td>
</tr>
</tbody>
</table>

Available 605, 606, 609, 610, 612, 613, 625 and 626 finish.

Cylinders for Adams Rite M5 and 4700 Series
Lori 4500 Series and Corbin Russwin DL3000 Series

<table>
<thead>
<tr>
<th>Number</th>
<th>Core Mechanism</th>
<th>Collar</th>
</tr>
</thead>
<tbody>
<tr>
<td>26-098</td>
<td>Conventional core</td>
<td>Compression ring &amp; spring</td>
</tr>
<tr>
<td>20-062</td>
<td>Conventional core</td>
<td>3/8&quot; + 1/8&quot; blocking rings</td>
</tr>
<tr>
<td>20-766</td>
<td>Primus core</td>
<td>3/8&quot; + 1/8&quot; blocking rings</td>
</tr>
<tr>
<td>20-766-XP</td>
<td>Primus XP core</td>
<td>3/8&quot; + 1/8&quot; blocking rings</td>
</tr>
<tr>
<td>20-060</td>
<td>Housing only, less core</td>
<td>None</td>
</tr>
</tbody>
</table>

These cylinders include set screw pack B220-050 for Adams Rite locks.

Cylinders for Adams Rite 4070 Series Deadlocks

<table>
<thead>
<tr>
<th>Number</th>
<th>Core Mechanism</th>
<th>Collar</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-091</td>
<td>Conventional core</td>
<td>3/8&quot; + 1/8&quot; blocking rings</td>
</tr>
<tr>
<td>20-722</td>
<td>Primus core</td>
<td>3/8&quot; + 1/8&quot; blocking rings</td>
</tr>
<tr>
<td>20-722-XP</td>
<td>Primus XP core</td>
<td>3/8&quot; + 1/8&quot; blocking rings</td>
</tr>
<tr>
<td>20-090</td>
<td>Housing less core</td>
<td>None</td>
</tr>
</tbody>
</table>

Notes
1. Mortise cylinders available 605, 606, 609, 610, 612, 613, 625, and 626 finish. Cores furnished 606 and 626 only.
2. To differentiate between Classic and Everest, specify keyway. Example: C or CP (Classic), C123 (Everest).
3. All cylinders are 1 1/2" long.
4. Specify LKB if 0-bitted Primus XP cylinders are required less key blanks.
98 and 99 rim exit devices for all types of single and double doors with mullion, UL listed for Panic Exit Hardware. Devices are ANSI A156.3 – 2001 Grade 1. The 98 device has a smooth mechanism case and the 99 device has a grooved case. The rim device is non-handed except when the following device options are used: SD (Special Dogging), -2 (Double Cylinder) or SS (Signal Switch). See Opposite page for available outside trim and device functions. Covers stock hollow metal doors with 86 or 161 cutouts on single doors (may cover cutouts on pairs – consult template).


### Specifications

<table>
<thead>
<tr>
<th>Device Functions</th>
<th>Device ships EO/DT/NL. Field selectable. For TP,K,or L remove NL drive screw from device</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device Lengths</td>
<td>3’ 2 4” to 3’ (711 mm to 914 mm) Door Size</td>
</tr>
<tr>
<td></td>
<td>4’ 2 10” to 4’ (864 mm to 1219 mm) Door Size</td>
</tr>
<tr>
<td>Strikes</td>
<td>299 – Dull Black</td>
</tr>
<tr>
<td></td>
<td>Optional Strikes – see page 39</td>
</tr>
<tr>
<td>Dogging Feature</td>
<td>Hex key dogging standard</td>
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<tr>
<td>Dogging Options</td>
<td>CD Cylinder Dogging</td>
</tr>
<tr>
<td></td>
<td>SD Special Center Case Dogging</td>
</tr>
<tr>
<td></td>
<td>LD Less Dogging</td>
</tr>
<tr>
<td>Electric Options</td>
<td>LX Latchbolt Monitor Switch</td>
</tr>
<tr>
<td></td>
<td>RX Pushpad Monitor Switch</td>
</tr>
<tr>
<td></td>
<td>RX2 Double Pushpad Monitor Switch</td>
</tr>
<tr>
<td></td>
<td>E Electric Locking &amp; Unlocking</td>
</tr>
<tr>
<td></td>
<td>EL Electric Latch Retraction</td>
</tr>
<tr>
<td></td>
<td>SS Signal Switch</td>
</tr>
<tr>
<td></td>
<td>CX Chexit Delayed Exit</td>
</tr>
<tr>
<td></td>
<td>ALK Alarm Exit Kit</td>
</tr>
<tr>
<td>Miscellaneous Options</td>
<td>PN Pneumatic Latch Retraction</td>
</tr>
<tr>
<td></td>
<td>-2 Double Cylinder</td>
</tr>
<tr>
<td></td>
<td>GBK Glass Bead Kit</td>
</tr>
<tr>
<td>Fasteners &amp; Sex Bolts (SNB)</td>
<td>Includes 1 3/4” (19mm) – 2 1/4” (57mm) Wood &amp; Metal Doors</td>
</tr>
<tr>
<td></td>
<td>Optional SNB available for device, see next page for quantities</td>
</tr>
<tr>
<td>Latch Bolt</td>
<td>Deadlocking, 3/4” (19mm) throw</td>
</tr>
<tr>
<td>Device Centerline from Finished Floor</td>
<td>39 15/16” (1011 mm)</td>
</tr>
<tr>
<td></td>
<td>39 1 1/4” (1008 mm) with Mullion</td>
</tr>
<tr>
<td>Center Case Dimensions</td>
<td>8” x 2 3/4” x 2 3/8” (203mm x 70mm x 60mm)</td>
</tr>
<tr>
<td>Mechanism Case Dimensions</td>
<td>2 1/4” x 2 1/4” (57mm x 57mm)</td>
</tr>
<tr>
<td>Projection</td>
<td>Pushbar Neutral – 3 13/16” (97 mm)</td>
</tr>
<tr>
<td></td>
<td>Pushbar Depressed – 3 1/2” (78 mm)</td>
</tr>
</tbody>
</table>

See page 53 for How to Order specification
### Strikes for rim devices

<table>
<thead>
<tr>
<th>Strike Code</th>
<th>Branding</th>
<th>Projection</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>264</td>
<td></td>
<td>9/16&quot; (14mm)</td>
<td></td>
</tr>
<tr>
<td>299</td>
<td></td>
<td>13/16&quot; (21mm)</td>
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</tr>
<tr>
<td>299F</td>
<td></td>
<td>13/16&quot; (21mm)</td>
<td></td>
</tr>
<tr>
<td>499F</td>
<td></td>
<td>15/16&quot; (24mm)</td>
<td></td>
</tr>
<tr>
<td>1408</td>
<td></td>
<td>1/2&quot; (13mm)</td>
<td>One per pair of doors</td>
</tr>
<tr>
<td>1439 • Blade Stop</td>
<td></td>
<td>1/2&quot; (13mm)</td>
<td>Projection 1/2&quot; (13mm)</td>
</tr>
<tr>
<td>1410 • Integral Stop</td>
<td></td>
<td>1/2&quot; (13mm)</td>
<td>Projection 1/2&quot; (13mm)</td>
</tr>
<tr>
<td>1606</td>
<td></td>
<td>3/8&quot; (10mm)</td>
<td>Projection 3/8&quot; (10mm)</td>
</tr>
<tr>
<td>1609</td>
<td></td>
<td>3/8&quot; (10mm)</td>
<td>Panic Devices Only, Requires Coordinator, For Fire Rated Application, consult factory</td>
</tr>
</tbody>
</table>

### Strikes for vertical rod devices

<table>
<thead>
<tr>
<th>Strike Code</th>
<th>Branding</th>
<th>Projection</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>248L-4</td>
<td></td>
<td>3/8&quot; (10mm)</td>
<td>Projection 3/8&quot; (10mm)</td>
</tr>
<tr>
<td>260U</td>
<td></td>
<td>3/8&quot; (10mm)</td>
<td>Projection 3/8&quot; (10mm)</td>
</tr>
<tr>
<td>260L-4</td>
<td></td>
<td>13/16&quot; (21mm)</td>
<td>Projection 13/16&quot; (21mm)</td>
</tr>
<tr>
<td>299</td>
<td></td>
<td>13/16&quot; (21mm)</td>
<td>Projection 13/16&quot; (21mm)</td>
</tr>
<tr>
<td>299F</td>
<td></td>
<td>13/16&quot; (21mm)</td>
<td>Projection 13/16&quot; (21mm)</td>
</tr>
<tr>
<td>304L</td>
<td></td>
<td>3/8&quot; (10mm)</td>
<td>Mortise 3/8&quot; (10mm) (4mm)</td>
</tr>
<tr>
<td>338</td>
<td></td>
<td>5/8&quot; (16mm)</td>
<td>Mortise 5/8&quot; (16mm)</td>
</tr>
<tr>
<td>385A</td>
<td></td>
<td>2-1/2&quot; (64mm)</td>
<td>Mortise 2-1/2&quot; (64mm)</td>
</tr>
<tr>
<td>283</td>
<td></td>
<td>1-1/4&quot; (32mm)</td>
<td>For use with WDC devices when used with wood frames</td>
</tr>
</tbody>
</table>

### Strikes for mortise lock devices

<table>
<thead>
<tr>
<th>Strike Code</th>
<th>Branding</th>
<th>Projection</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>575</td>
<td></td>
<td>1-1/4&quot; (32mm)</td>
<td>For use on 1-1/4&quot; (34mm) or 2-1/4&quot; (57mm) Single door and 2-1/4&quot; (57mm) double door with coordinator.</td>
</tr>
<tr>
<td>575-2</td>
<td></td>
<td>1-1/4&quot; (32mm)</td>
<td>For use on 1-1/4&quot; (34mm) thick double door with coordinator and astragal.</td>
</tr>
<tr>
<td>576A</td>
<td></td>
<td>1-1/4&quot; (32mm)</td>
<td>Open back strike for 1-1/4&quot; (34mm) thick double doors without coordinator.</td>
</tr>
<tr>
<td>576B</td>
<td></td>
<td>2-1/4&quot; (64mm)</td>
<td>Open back strike for 2-1/4&quot; (57mm) thick double doors without coordinator.</td>
</tr>
</tbody>
</table>

- Not for use with astragals
- Not for use on wood doors
- Acceptable for 90 minute pair of hollow metal doors
### 98/99™ Rim Exit Device Standard Trim

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Exit only</th>
<th>Dummy Trim</th>
<th>Night Latch</th>
<th>Night Latch</th>
</tr>
</thead>
<tbody>
<tr>
<td>98EO</td>
<td>98DT</td>
<td>98NL</td>
<td>98NL-OP</td>
<td></td>
</tr>
<tr>
<td>99EO</td>
<td>99DT</td>
<td>990NL-R/V</td>
<td>110NL-MD</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>990NL-R/V</td>
<td>110NL-WD</td>
<td></td>
</tr>
<tr>
<td>Trim Description</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Escutcheon Plate Size</td>
<td>—</td>
<td>3” x 14½” x ¾” (76x360x2mm)</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Pull Center to Center</td>
<td>—</td>
<td>5½” (140mm)</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Projection</td>
<td>—</td>
<td>2” (51mm)</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>ANSI Function</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>Cylinder Type</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>Rim</td>
</tr>
<tr>
<td>Optional Trim (See pages 32 – 34)</td>
<td>x990EO x991K-DT x991K-NL</td>
<td>x992EO x992L-DT x992L-NL</td>
<td>x994EO x994L-DT x994L-NL</td>
<td>x996DT x697DT x697NL</td>
</tr>
<tr>
<td>Optional #425 Sex Bolt</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Quantity for Device</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>6</td>
</tr>
</tbody>
</table>

### Lever

- **Key Locks & Unlocks**
- **Lever – Night Latch**
  - Key Retracts Latchbolt
  - Always operable (No Cylinder)
- **Lever Dummy Trim**
  - Pull when Dogged

<table>
<thead>
<tr>
<th>Product Description</th>
<th>98L</th>
<th>98L-NL</th>
<th>98L-BE</th>
<th>98L-DT</th>
</tr>
</thead>
<tbody>
<tr>
<td>99L</td>
<td>99L-NL</td>
<td>99L-BE</td>
<td>99L-DT</td>
<td></td>
</tr>
<tr>
<td>Trim Description</td>
<td>996L-R/V</td>
<td>996L-NL-R/V</td>
<td>996L-BE-R/V</td>
<td>996L-DT-R/V</td>
</tr>
<tr>
<td>Escutcheon Plate Size</td>
<td>2¾” x 10¾” x ½” (70x273x21mm)</td>
<td>2¾” x 10¾” x ½” (70x273x21mm)</td>
<td>2¾” x 10¾” x ½” (70x273x21mm)</td>
<td>2¾” x 10¾” x ½” (70x273x21mm)</td>
</tr>
<tr>
<td>Pull Center to Center</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Projection</td>
<td>2¾” (73mm)</td>
<td>2¾” (73mm)</td>
<td>2¾” (73mm)</td>
<td>2¾” (73mm)</td>
</tr>
<tr>
<td>ANSI Function</td>
<td>08</td>
<td>09</td>
<td>—</td>
<td>02</td>
</tr>
<tr>
<td>Cylinder Type</td>
<td>Rim</td>
<td>Rim</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Optional Trim (See pages 32 – 34)</td>
<td>x992L x992L-NL x992L-BE x992L-DT</td>
<td>x994L x994L-NL x994L-BE x994L-DT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optional #425 Sex Bolt</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Quantity for Device</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

For optional trims and functions see pages 32-34
The exit device that requires only 5 lbs. of force to operate

The AX was born out of a need to provide the market with a solution that meets the 2010 ADA Standards for Accessible Design (Chapters 404.2.7 and 309.4) that state the force required to activate operable parts shall be 5 lbs. maximum. The 2013 California Building Code (Chapter 11B-309.4) adopted virtually identical requirements that went into effect January 1st, 2013.

Since pioneering the first exit device in 1908, Von Duprin life safety products have provided unparalleled quality, performance and flexibility for schools, hospitals, stadiums and public buildings. These products come with the support and customer care only offered by Von Duprin. Providing the confidence and peace of mind at critical moments of life safety.

AX device specification requirements

Provide exit devices tested to ANSI/BHMA A156.3 Grade 1, [OPTION for specific compliant products/applications: UL certified to meet maximum 5 pound requirements according to the 2010 ADA Standards for Accessible Design (Chapters 404.2.7 and 309.4) and California Building Code (Chapter 11B-309.4)] and UL listed for Panic Exit or Fire Exit Hardware.

How to identify the Von Duprin AX device

1. Look for the “AX” Prefix in the door schedule and/or specification.
2. In the field, look for the Compliance note on the UL Label and the AX Device Label. Both labels can be found on the center case cover of the exit device as shown below.

Contact Allegion today at 888.925.4359 or ax.allegion.com to learn how the AX device can help you provide accessibility without compromise.
**AX98/99 Series Specifications**

<table>
<thead>
<tr>
<th>Device types</th>
<th>AX98/99 - Rim</th>
</tr>
</thead>
<tbody>
<tr>
<td>AX98/99 - Rim</td>
<td></td>
</tr>
<tr>
<td>AX98/99 - LBR</td>
<td></td>
</tr>
<tr>
<td>AX2227 - LBR</td>
<td></td>
</tr>
<tr>
<td>AX9949 WDC-LBL</td>
<td></td>
</tr>
<tr>
<td>AX9949 LBL &amp; LBL-AFL</td>
<td>- Concealed Vertical Cable Less Bottom Latch</td>
</tr>
</tbody>
</table>

**Device options**

- EO, DT, L, LDT, LBE, LNL

**Device lengths**

- 3' / 4'

**Electric rating**

- Panic and Fire

**Electric options**

- AX - Accessible Device
- EL - Electric latch retraction
- LX - Latchbolt monitor switch
- LXL - Latchbolt monitor switch low current
- LXR - Latchbolt pushpad monitor
- LXRXL - Latchbolt pushpad monitor low current
- RX - Pushpad monitor switch
- RXL - Pushpad monitor switch low current
- RX2 - Double pushpad monitor switch
- SS - Signal switch

**Mechanical options**

- GBK - Glass bead kit
- SNB - Sex bolts
- SEC - Security screws
- WP - Weep holes

**Dogging options**

- Hex key dogging = Standard
- CD - Cylinder dogging
- DI - Dogging indicator
- LD - Less dogging
- SD - Special dogging

**Accessories**

- 06 LBL 06 LBL-AFL

**AX94/95 Series Specifications**

<table>
<thead>
<tr>
<th>Device types</th>
<th>AX94/9547</th>
</tr>
</thead>
<tbody>
<tr>
<td>EO, DT, L, LDT, LBE, LNL</td>
<td></td>
</tr>
</tbody>
</table>

**Device lengths**

- 3' / 4'

**Electric options**

- LX - Latchbolt monitor switch

**AX33/35A Series Specifications**

<table>
<thead>
<tr>
<th>Device types</th>
<th>AX33/35A - Rim</th>
</tr>
</thead>
<tbody>
<tr>
<td>AX33/35A - Rim</td>
<td></td>
</tr>
<tr>
<td>AX33/35A - Rim</td>
<td></td>
</tr>
<tr>
<td>AX33/35A - Rim</td>
<td></td>
</tr>
<tr>
<td>AX33/35A - Rim</td>
<td></td>
</tr>
<tr>
<td>AX33/35A - Rim</td>
<td></td>
</tr>
</tbody>
</table>

**device functions**

- EO, DT, NL, NLOP, L, LBE, LDT

**Device lengths**

- 3' / 4'

**Electric rating**

- Panic and Fire

**Electric options**

- LX - Latchbolt monitor switch

**AX22 Series Specifications**

<table>
<thead>
<tr>
<th>Device types</th>
<th>AX22 - Rim</th>
</tr>
</thead>
<tbody>
<tr>
<td>AX2227 - LBR</td>
<td></td>
</tr>
</tbody>
</table>

**Device functions**

- EO, DT, NL, NLOP, L, LBE

**Device lengths**

- 3' / 4'

**Electric options**

- LX - Latchbolt monitor switch

**Mechanical options**

- GBK - Glass bead kit

**Dogging options**

- Hex key dogging = Standard

**Accessories**

- ALK - Alarm Kit
- GBK - Glass Bead Kit
- SNB - Sex Bolts

---

**Ordering information**

```
AX - 98 - - - L - F - -2 - US26D - 3' - RHR - 996L - 06 - SNB
```

**Selections correspond with the numbers above.** See price book for specific configuration options.

1. **Prefix**
   - AX* - Accessible Device
     - EL - Electric latch retraction
     - LX - Latchbolt Monitor Switch
     - LXL - Latchbolt Monitor Switch Low Current
     - LXR - Latchbolt Pushpad Monitor
     - LXRXL - Latchbolt Pushpad Monitor Low Current
     - RX - Pushpad Monitor Switch
     - RXL - Pushpad Monitor Switch Low Current
     - RX2 - Double Pushpad Monitor Switch
     - SS - Signal Switch
     - *Must be specified; may select more than one prefix.

2. **Series**
   - 98 - Series 98 - smooth
   - 99 - Series 99 - grooved
   - 94 - Series 94 - smooth
   - 95 - Series 95 - grooved
   - 33A - Series 33A - grooved
   - 35A - Series 35A - smooth
   - 22 - Series 22

3. **Device Type**
   - N/A  
     - Rimm Surface Vertical Rod
     - N/49 Concealed Vertical Rod
     - N/49 Concealed Vertical Cable

4. **Function**
   - EO - Exit Only
   - DT - Dummy Trim
   - LNL - Night Latch
   - LLOP - Night Latch - Optional Pull LBE - Lever, Blank Escutcheon
   - LDT - Lever, Rigid - Dummy Trim
   - LNL - Lever, Rigid - Night Latch

5. **Rating**
   - N/A  
     - Panic
     - F - Fire-rated

6. **Suffix**
   - LBL/LBR
     - Double Cylinder
   - LBL-AFL
     - Less Bottom Latch / Less Bottom Rod
   - WH
     - Weep Holes

7. **Finish**
   - See pricebook for finish offering

8. **Door Width**
   - 3' - Standard Default
   - 4' - Special

9. **Handing**
   - RHR - Right Hand Reverse
   - LHR - Left Hand Reverse

10. **Trim**
    - See pricebook for trim/control offering

11. **Lever Style**
    - See pricebook for lever style offering

12. **Accessories**
    - ALK - Alarm Kit
    - GBK - Glass Bead Kit
    - SNB - Sex Bolts

Contact Allegion today at 888.925.4359 or ax.allegion.com to learn how the AX device can help you provide accessibility without compromise.

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98-F and 99-F rim fire exit devices are available for all types of single doors up to 4’ x 10’ (1219mm x 3048mm) or 8’ x 10’ (2438mm x 3048mm) double doors with 9954 or 9854 mullion, UL listed for Fire Exit Hardware. See page 41 for detailed information on UL listed fire exit hardware label and door opening size information. Devices are ANSI A156.3 – 2001 Grade 1. The 98-F device has a smooth mechanism case and the 99-F device has a grooved case. The rim device is non-handed except when the following device options are used: -2 (Double Cylinder) or SS (Signal Switch). See Opposite page for available outside trim and device functions.


### Specifications

<table>
<thead>
<tr>
<th>Device Functions</th>
<th>Device ships EO/DT/NL. Field selectable. For TP,K,or L remove NL drive screw from device</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device Lengths</td>
<td>3’ 2’4” to 3’ (711mm to 914 mm) Door Size 4’ 2’10” to 4’ (864 mm to 1219 mm) Door Size</td>
</tr>
<tr>
<td>Strikes</td>
<td>299F – Dull Black, 499F with Mullions Optional Strikes – see page 39</td>
</tr>
<tr>
<td>Dogging Feature</td>
<td>No Mechanical Dogging, EL option available</td>
</tr>
<tr>
<td>Electric Options</td>
<td>LX Latchbolt Monitor Switch see page 42 RX Pushpad Monitor Switch see page 42 RX2 Double Pushpad Monitor Switch see page 42 E Electric Locking &amp; Unlocking see page 44 EL Electric Latch Retraction see page 43 SS Signal Switch see page 43 CX Chexit Delayed Exit see page 45 ALK Alarm Exit Kit see page 42</td>
</tr>
<tr>
<td>Miscellaneous Options</td>
<td>PN Pneumatic Latch Retraction see page 48 -2 Double Cylinder see page 48 GBK Glass Bead Kit see page 49</td>
</tr>
<tr>
<td>Fasteners &amp; Sex Bolts (SNB)</td>
<td>Includes 1 ¾” (19mm) – 2 ¾” (57mm) Wood &amp; Metal Doors Optional SNB available for device, see next page for quantities Optional SLM Blocking Pkg for wood doors with SLM blocking SNB required for wood doors, unless SLM Blocking Pkg specified</td>
</tr>
<tr>
<td>Latch Bolt</td>
<td>Deadlocking, ¾” (19mm) throw</td>
</tr>
<tr>
<td>Device Centerline from</td>
<td>39 13/₆₄” (1011 mm)</td>
</tr>
<tr>
<td>Finished Floor</td>
<td>39 11/₆₄” (1008 mm) with Mullion</td>
</tr>
<tr>
<td>Center Case Dimensions</td>
<td>8” x 2 ¾” x 2 ¾” (203mm x 70mm x 60mm)</td>
</tr>
<tr>
<td>Mechanism Case Dimensions</td>
<td>2 ¼” x 2 ¼” (57mm x 57mm)</td>
</tr>
<tr>
<td>Projection</td>
<td>Pushbar Neutral – 3 13/₆₄” (97 mm) Pushbar Depressed – 3 1/₆” (78 mm)</td>
</tr>
</tbody>
</table>

See page 53 for How to Order specification
### 98-F/99-F Fire Exit Rim Device Standard Trim

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Exit only</th>
<th>Dummy Trim</th>
<th>Night Latch</th>
<th>Night Latch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trim Description</td>
<td>98EO-F</td>
<td>99EO-F</td>
<td>98NL-F</td>
<td>98NL-OP-F</td>
</tr>
<tr>
<td>Escutcheon Plate Size</td>
<td>—</td>
<td>990DT</td>
<td>990NL-R/V</td>
<td>110NL-MD</td>
</tr>
<tr>
<td>Pull Center to Center</td>
<td>—</td>
<td>3” x 14½” x ½” (76x360x2mm)</td>
<td>3½” x 14½” x ½” (76x360x2mm)</td>
<td>—</td>
</tr>
<tr>
<td>Projection</td>
<td>—</td>
<td>5½” (140mm)</td>
<td>5½” (140mm)</td>
<td>—</td>
</tr>
<tr>
<td>ANSI Function</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>Cylinder Type</td>
<td>—</td>
<td>—</td>
<td>Rim</td>
<td>Rim</td>
</tr>
<tr>
<td>Optional Trim</td>
<td>x990EO</td>
<td>x991K-DT</td>
<td>x991K-NL</td>
<td>x991K-NL</td>
</tr>
<tr>
<td>#425 SNB req.</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>#925 SNB req.</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>#425 SNB req. w/ 499F</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

### 98-L-F/99-L-F Fire Exit Rim Device Standard Trim

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Lever Key Locks &amp; Unlocks</th>
<th>Lever – Night Latch Key Retracts Latchbolt</th>
<th>Lever – Blank Escutcheon Always operable (No Cylinder)</th>
<th>Lever Dummy Trim Pull when Dogged (Not recommended for Fire Device)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trim Description</td>
<td>98L-F</td>
<td>98L-NL-F</td>
<td>98L-BE-F</td>
<td>—</td>
</tr>
<tr>
<td>Escutcheon Plate Size</td>
<td>2¾” x 10¾” x 25/32” (70x273x21mm)</td>
<td>2¾” x 10¾” x 25/32” (70x273x21mm)</td>
<td>2¾” x 10¾” x 25/32” (70x273x21mm)</td>
<td>2¾” x 10¾” x 25/32” (70x273x21mm)</td>
</tr>
<tr>
<td>Pull Center to Center</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Projection</td>
<td>2½” (73mm)</td>
<td>2½” (73mm)</td>
<td>2½” (73mm)</td>
<td>2½” (73mm)</td>
</tr>
<tr>
<td>ANSI Function</td>
<td>08</td>
<td>09</td>
<td>—</td>
<td>02</td>
</tr>
<tr>
<td>Cylinder Type</td>
<td>Rim</td>
<td>Rim</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Optional Trim</td>
<td>x992L</td>
<td>x992L-NL</td>
<td>x992L-BE</td>
<td>x992L-DT</td>
</tr>
<tr>
<td>#425 SNB req.</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>#925 SNB req.</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>#425 SNB req. w/ 499F</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

For optional trims and functions see pages 32-34.
9827/9927 surface mounted vertical rod device for all types of single or double doors, UL listed for Panic Exit Hardware. Devices are ANSI A156.3 – 2001 Grade 1. Covers stock hollow metal doors with 86 or 161 cutouts. The 9827 device has a smooth mechanism case and the 9927 device has a grooved case. The surface vertical rod device is non-handed except when the following device options are used: SD (Special Dogging), or SS (Signal Switch). See Opposite page for available outside trim and functions.


Vertical rod and latch guards are available to protect the bottom rod of the exit device from damage by impacts of carts or gurneys passing through doors. Refer to page 49

Specifications

<table>
<thead>
<tr>
<th>Device Functions</th>
<th>Device ships EO/DT/NL. Field selectable. For TPK, or L remove NL drive screw from device</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dogging Feature</td>
<td>Hex key dogging standard</td>
</tr>
<tr>
<td>Dogging Options</td>
<td>CD Cylinder Dogging see page 48</td>
</tr>
<tr>
<td>Electric Options</td>
<td>LX Latchbolt Monitor Switch see page 42</td>
</tr>
<tr>
<td>Miscellaneous Options</td>
<td>PN Pneumatic Latch Retraction see page 48</td>
</tr>
<tr>
<td>Fasteners &amp;</td>
<td>Includes 1 3/4&quot; (19mm) – 2 1/4&quot; (57mm) Wood &amp; Metal Doors Sex Bolts (SNB)</td>
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<tr>
<td>Latch Bolt</td>
<td>Deadlocking Anti-friction Top &amp; Bottom Bolt, 3/8&quot; (16mm) throw</td>
</tr>
<tr>
<td>Device Centerline from Finished Floor</td>
<td>39 5/8&quot; (1006 mm)</td>
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<tr>
<td>Door Undercut</td>
<td>1/4&quot; (7mm)</td>
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<tr>
<td>Center Case Dimensions</td>
<td>8 x 2 3/4 x 2 3/8&quot; (203mm x 70mm x 60mm)</td>
</tr>
<tr>
<td>Mechanism Case Dimensions</td>
<td>2 1/4 x 2 1/4&quot; (57mm x 57mm)</td>
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<tr>
<td>Top &amp; Bottom Latch Case</td>
<td>4 1/2&quot; x 2 1/2 x 1 1/2&quot; (114mm x 54mm x 38mm)</td>
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<tr>
<td>Vertical Rods</td>
<td>1/2&quot; square tubing, standard rods accommodate 7' (2134mm) door</td>
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<tr>
<td>Projection</td>
<td>Pushbar Neutral – 3 3/4&quot; (97 mm)</td>
</tr>
</tbody>
</table>

See page 53 for How to Order specification

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<table>
<thead>
<tr>
<th>Product Description</th>
<th>Trim Description</th>
<th>Escutcheon Plate Size</th>
<th>Pull Center to Center</th>
<th>Projection</th>
<th>ANSI Function</th>
<th>Cylinder Type</th>
<th>Optional Trim</th>
<th>Quantity for Device</th>
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<tr>
<td>9827L 9927L</td>
<td>996L-R/V</td>
<td>2½&quot; x 10¼&quot; x 7/32a&quot;</td>
<td>2½&quot; (73mm)</td>
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<td>Rim</td>
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<tr>
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<td>996L-NL-R/V</td>
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<td>Rim</td>
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<td>996L-BE-R/V</td>
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<td>9827L-DT</td>
<td>996L-DT-RV</td>
<td>2½&quot; x 10¼&quot; x 7/32a&quot;</td>
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<td>02</td>
<td>Rim</td>
<td>x992L-DT</td>
<td>2</td>
</tr>
</tbody>
</table>

For optional trims and functions see pages 32-34
Removable Mullions

Removable Steel Mullions Mullions provide single door performance in double door openings with rim devices. Mullions are easily removed by loosening bottom set screw and removing top fitting cover. The top mullion fitting is attached to the frame and is concealed by the fitting cover.

Steel mullions are 2’’ (51mm) wide and 3’’ (76mm) deep, with a wall thickness of 1/8’’ (3mm).

Mullions are shipped with mounting screws and prepared for strikes. Strikes are not included except where indicated.

Steel mullions are available in SP28 and SP313 finishes. Consult factory for other powder coat finish options.

KR – Keyed Removable Steel Mullions makes removal faster and easier by a single operation of the mortise cylinder. Once mullion is removed, large equipment or furniture can freely pass through the opening. The unit will self lock when re-installed, without use of the cylinder key. Uses a 1 1/4’’ mortise cylinder with a straight cam (Schlage cam reference B502-191). Cylinders are sold separately. Prefix mullion model with “KR”.

Removeable Aluminum Mullions are 1 1/8’’ (27mm) wide on face closest to the door and 2 3/8’’ (60mm) at the widest point. The depth is 3 1/8’’ (79mm) with a wall thickness of 1/8’’ (3mm).

Aluminum mullions are available in US4, US10, US28, 313AN and 315AN finishes. Consult factory for other powder coat finish options.

Stock Hollow Metal Applications for devices mounted to cover ANSI 161 cutouts are higher than the standard mullion strike location. Consult the factory for special strike preparation or order a blank mullion. See below.

Blank Mullions are furnished without strike preparation. They are used to mount devices at a strike height different from the standard mullion preparation.

To Order, specify
1. For keyed Removable option on steel mullions, prefix model number with “KR”
2. Model number.
3. Height of opening
4. Finish
5. Handing if required.
6. Centerline deviation (refer to device template for standard centerline).
7. Strikes, when required, should be ordered with device.
8. For keyed Removable option on steel mullions, prefix model number with “KR”

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Steel Mullions

1654  Prepared for two 1606 strikes. If 1606 strikes are not specified on the order, two per mullion will be added. Additional charges apply.

4954  Prepared for 264 or 299 strikes. For use with all Von Duprin Panic rim devices. Note: specify strike choice with device.

9954  Prepared for and must be used with two 268 strikes (88-F device), or two 499F (22-F, 98-F, 99F devices). UL fire labeled mullion for up to 3 hour opening using Von Duprin fire exit rim devices. This mullion is not easily removed due to special fittings.

22-F and 88-F devices are rated up to 8’ x 8’ (2438mm x 2438mm).

98-F and 99-F devices are rated up to 10’ 0” (3048mm).

Note: If 268 or 499F strikes are not specified on the order, two per mullion will be added. Additional charges apply.

4754  Prepared for two 4263 monitor strikes.

4854  Prepared for one 299 and one 6111 electric strike. Indicate handing for electric strike.

9854  Prepared for one 268 or 499F strike and one 6111 electric strike. Indicate handing for electric strike. UL fire labelled mullion for up to 3 hour openings up to 8’ x 8’ (2438mm x 2438mm) using Von Duprin Fire Exit Rim Devices

Aluminum Mullions

5654  Prepared for two 264 or 299 strikes with weatherstripping. Includes one set of 154 stabilizers.

5754  Prepared and furnished with one 1408 double door strike. Includes one 154 stabilizer set. Note: specify device “less strike”.

Sizes for Mullions

1654, 4954, 4854, 4754, 5654, 5754  9854, 9954

7’ 2” (2184mm)  7’ 3” (2210mm)
*8’ 2” (2489mm)  8’ 3” (2475mm)
*10’ 2” (3099mm)  10’ 3” (3124mm)


7’ 6” (2286mm)  7’ 5” (2261mm)
8’ 6” (2591mm)  *8’ 5” (2565mm)
10’ 6” (3200mm)  *10’ 5” (3175mm)

* Only qualifying applications will be provided with UL Label.
** Fire rated same as 9854
*** Fire rated same as 9954
Weatherstripping

Weatherstripping retards cold air from blowing between doors and mullion. It also serves as a silencer when the door is closed against the mullion. The silicone treated weatherstrip pile is bonded to a polypropylene backing. A slide-in molding houses the weatherstripping, covers mounting screws of the strike and extends to both the top and bottom of the mullion. Available on Aluminum Mullions only.

Angle Plate is used with narrow transom frames. The plate attaches to the transom extending the surface area needed to mount the mullion. Must be ordered separately. Specify finish.

154 Stabilizer is a two-piece interlocking set. One piece mounts on the mullion with the top mounting hole 5\(\frac{5}{16}\)" (148mm) below the centerline of the strike; the other piece mounts on the door. Shims are provided to adjust for misalignment between the door and mullion.

The set maintains integrity between the door and mullion to prevent vandalism and to ensure contact between the device and strike as the doors expand and contract with temperature changes.

Furnished standard on aluminum mullions; optional for steel and all blank steel mullions.

MT54 Storage Kit is a set of floor and wall brackets that provide convenient storage of the keyed removable mullion when removed from the opening.

To Order, specify
1. Model MT54.
2. Finish SP28, SP313, or SPBLK
SECTION 08 7113

AUTOMATIC DOOR OPERATORS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Automatic door operators for exterior and interior swinging stile and rail doors.

B. Motion detectors, actuators, and safety systems.

1.02 RELATED SECTIONS

A. Section 07 9200: Joint Sealants

B. Section 08 7100: Door Hardware; hardware not furnished with automatic door operator

C. Section 08 8000: Glazing; glass for doors

D. Section 08 4100: Entrances and Storefronts; door panels and frames

E. Division 26 Sections for related electrical work.

1.03 PERFORMANCE REQUIREMENTS

A. Automatic entrance door operators capable of withstanding structural loads and thermal movements based on testing manufacturer's standard units similar to those indicated for this Project.

B. Thermal Movements: Allow for thermal movements resulting from following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects.
   1. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   2. Temperature Change (Range): 120 degrees F, ambient; 180 degrees F, material surfaces.

C. Operating Range: Minus 30 degrees F to 130 degrees F

D. Opening-Force Requirements for Egress Doors: Not more than 50 lbf required to manually set door in motion if power fails, and not more than 15 lbf required to open door to minimum required width.

E. Closing-Force Requirements: Not more than 30 lbf required to prevent door from closing.
1.04 SUBMITTALS

A. Product Data: Manufacturer’s product data, standard details, and installation recommendations; include following:
   1. Door hardware not included or specified in Section 087100.
   2. Operators, actuators, accessories, and other components of Work.
   3. Certified test data.

B. Templates and Diagrams: Furnish templates, rough-in and wiring diagrams, and other data to fabricators and installers of related work, as necessary for coordination of automatic door operator installation.

C. Shop Drawings: Show exact dimensions of each unit with operator details and wiring details.

D. Maintenance Data: Manufacturer's maintenance and service data, including name, address and telephone number of nearest authorized service representative.

1.05 QUALITY ASSURANCE

A. Standards:
   1. UL 325: Provide powered door operators that comply with UL 325, Electrical Door, Drapery, Gate, Louver and Window Operators and Systems.
   2. ANSI/BHMA A 156.19 – “Standard or Power Assist and Low-Energy Power Operated Doors"

B. Manufacturer's Qualifications: Provide units produced by firm with not less than five years successful experience in fabrication of operators of type required for this Project.
   1. Qualified manufacturer with manufacturing facility certified under ISO 9001, with company certificate issued by American Association of Automatic Door Manufacturers (AAADM).

C. Installer's Qualifications: Engage installer who is factory trained authorized representative of manufacturer for both installation and maintenance of type of units required for Project.

D. Electrical Requirements: Comply with requirements of Title 24 California Electrical Code (CEC)

E. Source Limitations: Obtain automatic entrance door operators through one source from single manufacturer.

F. Emergency Exit Door Requirements: Comply with requirements of authorities having jurisdiction for automatic entrance doors serving as required means of egress.

1.06 WARRANTIES

A. Manufacturer’s Warranty: Units to be warranted against defects in material and workmanship for period of one year from Date of Substantial Completion.
   1. Manufacturer's warranty is in addition to, and not limitation of, other rights Owner may have under Contract Documents.
B. Distributor/Installer's Warranty: One year warranty for labor and transportation charges for defective parts replacement.

C. During warranty period Owner shall engage factory trained technician to perform service and affect repairs.
   1. Safety inspection shall be performed after each adjustment or repair and completed inspection form shall be submitted to Owner.

1.07 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions/openings by field measurements before fabrication and record on shop drawings.
   1. Coordinate with fabrication and construction schedule to avoid construction delays.

B. Mounting Surfaces: Verify surfaces to be plumb, straight and secure; substrates to be of proper dimension and material.

C. Other Trades: Advise of inadequate conditions or equipment.

1.08 DELIVERY, STORAGE AND HANDLING

A. Ordering and Delivery: Comply with factory's ordering instructions and lead time requirements.
   1. Deliver in factory's original, unopened, undamaged containers with identification labels intact.

B. Storage and Protection: Provide protection from exposure to harmful weather conditions and vandalism.

1.09 COORDINATION

A. Templates: Review shop drawings of other work to confirm that adequate provisions have been made for locating and installing automatic entrance doors to comply with indicated requirements.

B. Electrical System Roughing-in: Coordinate layout and installation of automatic entrance door operators with connections to power supplies.

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Basis-of-Design: Design for low energy power operated door system for swinging doors is based on HD-Swing® Series 4000LE Automatic Door Operator as manufactured by Horton automatics division of Overhead Door Corporation.

B. Subject to compliance with specified requirements, comparable products may be submitted by alternate manufacturers in accordance with requirements for product substitutions specified in Section 01 6000 and following:
   1. Submit items listed in “Submittals” Article and as specified in Section 01 3300, for evaluation of proposed system.
2. Complete project shop drawings for similar project may be submitted for evaluation purposes, however shop drawings specific to this Project will be required from successful bidder.
3. Tests shall have been made for identical systems within ranges of specified performance criteria.

2.02 FUNCTIONAL REQUIREMENTS
A. Design equipment to support doors weighing up to 350 lbs, complying with following:
   1. Fully lubricated and sealed bearings.
   2. Operator completely removable from header as unit.

2.03 MATERIALS
A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
B. Sealants and Joint Fillers: Comply with requirements of Section 07 9200.

2.04 SWINGING DOOR OPERATOR
A. Swing Door Operator: Type 4100LE Surface Applied Operator with Connecting Arms, isolation mounted concealed in extruded aluminum case, with access header cover running full width of operator in length.
   1. Operator readily convertible to hand required.
   2. Opening Force: Accomplished by 1/8 HP D.C. permanent magnet motor working through reduction gears to output shaft.
      a. When door is in closing mode or fully closed, motor voltage is not required and will be off.
      b. Door can be manually operated with power on or off without damage to operator.
   4. Opening Speed: Field adjusted doors so opening speed to back check or 80 degrees shall be minimum of 3 seconds or longer as required in Table 1 of ANSI/BHMA A 156.19.
   5. Opening speed to fully open: 4 seconds or longer.
   6. Hold open: Field adjusted doors to remain fully open for not less than 5 seconds or more than 30 seconds.
   7. Closing Speed:
      a. Field adjust doors to close from 90 degrees to 10 degrees or longer as required in Table 1 of ANSI/BHMA A 156.19.
      b. Field adjust doors to close from 10 degrees to fully closed in not less than 1.5 seconds.
   8. Force required to prevent door from closing not to exceed 15 lbf. applied 1 inch from latch edge of door at any point in opening or closing cycle.
   9. In event of power failure, doors open with manual pressure not to exceed 8.5 lbf. at point 1 inch from latch edge of door.
10. Equip doors with sign visible from each side, instructing user as to operation and function of door.
B. Entrapment Protection: Conform to requirements of A 156.19 for door forces and speeds generated during power opening and manual opening in both directions of swing and spring closing in both directions of swing.

C. System Operation Accessible Mode:
   1. In accessible mode, push plate switch on either side of door is actuated and door opens slowly, to back check (80 degrees) in 3 to 6 seconds and to fully open position in 4 to 7 seconds.
   2. Door will remain open for period of 5 to 30 seconds as determined by setting Owner puts into variable time delay on control box.
   3. After time delay, door closes by spring in door operator from 90 degrees to 10 degrees in 3 to 6 seconds and from 10 degrees to fully closed in 1-1/2 to 2 seconds.
   4. When object is encountered during opening cycle, door will stop and slowly return to closed position.
      a. Once object is removed and an activation signal is received door will cycle to full 90 degrees open, time out and close.
      b. Door operator reactivates to 90 degrees full opening when activation signal is received at any point in closing cycle.

2.05 EQUIPMENT

A. Provide equipment complying with requirements of ANSI/BHMA A 156.19 and following:
   1. CBC Chapter 11B.

B. Operator Header: Fabricate from extruded aluminum, extending full width of automatic entrance door units to conceal door operators.
   1. Provide hinged or removable access panels for service and adjustment of door operators and controls.
      a. Secure panels to prevent unauthorized access.
   2. Mounting: Surface mounted for swing doors, as detailed.
   3. Header Finish: Finish and color matching door frame.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   1. Coordinate provision of 120 VAC, 60 cycle, 1 phase, 15 amp service to operator with work of Division 26.

D. Locking Hardware: ANSI A 156.5, Grade 1, 2 point locking
   1. Furnish and install in strike rail as follows:
      a. Hook Latch: 5/8 inch laminated stainless steel, latching into jamb
      b. Provide 3/8 inch hex bolt into breakout carrier frame.
      c. Cylinder: 1-5/32 inch cylinder with 31/32 inch backset, furnished under Section 08 7100, mounted on both sides of door
         1) Thumbturns not permitted

E. Thresholds: As indicated and specified in Section 08 7100
   1. Continuous standard tapered extrusion double bevel.
   2. Conform to details and requirements for specified code compliance.
F. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.

2.06 ELECTRICAL CONTROLS

A. Electrical Control: Solid state electronic microprocessor controller and position encoder with quick connect plugs incorporating following features:
   1. Encoder monitors revolutions of operator shaft and send signals to microprocessor controller to define door position and speed.
      a. Systems utilizing external magnets and magnetic switches are not acceptable.
   2. Mode of Operation: Low energy as defined by A 156.19.
   3. Respond to infrared sensors.
   4. Immediate reverse-on-obstruction during opening capability.
   5. Open, open check and closing speed adjustment.
   6. Adjustable time delays.
   7. On/Off switch.
      a. Provide interface with specified remote keyswitch.
   8. Power assist closing at swinging doors.
   9. Provide single controller capable of controlling up to 2 operators per entrance system.

B. Life Cycle Data Counter: Microprocessor control shall incorporate non-re-settable counter to track door operation cycles.

C. Controller Protection: Microprocessor controller shall incorporate following features to ensure trouble free operation:
   1. Automatic Reset Upon Power Up
   2. Fuse Protection
   3. Electronic Surge Protection
   5. Software protection in case of software malfunction.

D. Provide motor driving circuit for smooth normal opening and recycling.

E. Programmable Controller: Programmable Microprocessor controller designed for connection to local configuration tool.
   1. Software driven local configuration tool utilized via handheld interface.
   2. Following parameters may be adjusted via configuration tool.
      a. Operating speeds and forces as required to meet ANSI/BHMA A 156.10.
      b. Adjustable and variable features as specified in 2.05, B., 2.
      c. Reduced opening position.
      d. Firmware update.
      e. Trouble Shooting:
         1) I/O Status.
         2) Electrical component monitoring including parameter summary.
   3. Entrance profile copy/paste.
   4. Provide for local configuration tool software available as free download from automatic door operator manufacturer's internet site.
2.07 ACTIVATION CONTROLS AND SAFETY DEVICES

A. Control Switch: Provide manufacturer's standard header mounted rocker switches to allow for full control of automatic entrance door.
   1. Controls to include, but are not limited to:
      a. Power On/Off
      b. Reduced Opening
      c. Open/Closed/Automatic

B. Activation Controls:
   1. Vertical touch activation pillar.
      a. Model No. LPR36 by BEA, Inc. (No Substitutions)
   2. Mount on exterior wall in locations indicated on Drawings.

C. Motion Sensor/Presence Detector: Header mount infrared sensor that will provide activation for approaching traffic on inside of exterior doors and both sides of interior (vestibule) doors.
   1. SafePath Model DH400 Maximum Pattern Infrared (MPI) Motion Sensor with Floor Reflection Method (FRM-AI) technology by MS Sedco (No Substitutions)
      a. Rectangular, 10.43 inches wide by 2.40 inches high by 1.47 inches deep with black finish.

D. Accessories:
   1. Remote Key Switch: Provide On/Off key switch mounted adjacent to interior Door actuator to lockout automatic operation after hours.
      a. MS Sedco Model 730-L with stainless steel face plate. (No Substitutions)

2.08 DOOR HARDWARE

A. Refer to Section 08 7100 for door hardware not included under this section.
   1. Including, but not limited to following:
      a. Door seals at swinging doors and frames
      b. Provide for exit devices at swinging doors in path of travel where indicated in Door Schedule
      1) Provide electric latch retraction devices specified in Section 08 7100 for electric interlock with automatic door operator.
      c. Coordinate type and installation of hardware with automatic door operator manufacturer and aluminum door fabricator.

2.09 FABRICATION AND FINISHES

A. Factory fabricate automatic entrance door operator components to designs, sizes, and thickness indicated, complying with indicated standards.
   1. Form aluminum shapes before finishing.
   2. Use concealed fasteners to greatest extent possible.
      a. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
      b. Reinforce members as required to receive fastener threads.

B. Door Operators: Factory fabricate and install in headers, including adjusting and testing.
C. Hardware: Factory install hardware to greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project Site.

D. Finish: For exposed aluminum surfaces.
   1. High Performance Coating System Type A as specified in Section 05 0513.
      a. Color to match that of adjacent aluminum storefront framing.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Site Verification of Conditions: Verify that base conditions previously installed under other sections are acceptable for product installation according to manufacturer's instructions.
   1. Examine conditions for compliance with requirements for installation tolerances, header support, and other conditions affecting performance of automatic entrance doors.
   2. Notify Contractor in writing of conditions detrimental to proper and timely completion of Work.
   3. Do not start Work until negative conditions are corrected in manner acceptable to installer and manufacturer.

3.02 INSTALLATION

A. Installation: In strict accordance with manufacturer's instructions.
   1. Comply with manufacturer's recommendations and installation guide when installing automatic door operators.
      a. Do not install damaged components.
      b. Set units plumb, level and true.
   2. Fit frame joints to produce joints free of burrs and distortion.
      a. Rigidly secure non-movement joints.
   3. Thoroughly test items and equipment and leave door and operator properly adjusted, fully operative and clean.
   4. Provide fasteners required for installation of automatic swing door system.

B. Entrances: Install automatic entrance doors plumb and true in alignment with established lines and grades without warp or rack of framing members and doors.
   1. Anchor securely in place.
   2. Install surface mounted hardware using concealed fasteners to greatest extent possible.
   3. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.

C. Door Operators: Connect door operators to electrical power distribution system as specified in Division 26 Sections.

D. Glazing: Provide glazing as specified in Section 08 8000.

E. Sealants: Comply with requirements specified in Section 07 9200 to provide weather tight installation.
F. Install signs visible from each side instructing user as to operation and function of door, per ANSI/BHMA A 156.19.

3.03 FIELD QUALITY CONTROL

A. Testing Services: Provide factory trained installer to test and inspect each automatic entrance door to determine compliance of installed systems with requirements of ANSI/BHMA A 156.10. standards.
   1. Thoroughly test items and equipment and leave door and operator properly adjusted, fully operative, and clean.
   2. Adjust door operators, controls, and hardware for smooth and safe operation, for weather-tight closure.

3.04 CLEANING AND PROTECTION

A. Clean glass and aluminum surfaces promptly after installation.
   1. Remove excess glazing and sealant compounds, dirt, and other substances.
   2. Repair damaged finish to match original finish.
   3. Comply with requirements in Section 088000, for cleaning and maintaining glass.

B. Adjustment: After repeated operation of completed installation, re-adjust door operators and controls for optimum operating condition and safety.

C. Demonstrate unit, review safety features and instruct Owner on "Daily Safety Check" to be performed.
   1. Provide service call information to Owner.

END OF SECTION 08 7113
SECTION 08 8000
GLAZING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Glass and glazing as indicated and specified.

B. Related Sections:
   1. Section 07 9200: Joint Sealants; sealants other than glazing sealant.
   2. Section 08 4413: Aluminum Curtain Wall

1.02 REFERENCES


B. Comply with applicable performance standards of following:
   1. Glazing Association of North America (GANA);
      a. Glazing Manual
      b. Sealants Manual
   2. Insulating Glass Manufacturers Alliance (IGMA);
      a. "TM-3000 - Glazing Guidelines for Sealed Insulating Glass Units".
   3. Insulating Glass Certification Council (IGCC)

C. ASTM International (ASTM):

1.03 QUALITY ASSURANCE

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations listed under "References", except where more stringent requirements are indicated.
   1. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

B. Grading and Labeling: Grade and label each light stating quality and grade of glass and manufacturer's name and brand designation.
   1. Leave labels intact until removal is directed by Architect.
C. Glazier Qualifications: Engage experienced glazier who has completed glazing similar in material, design, and extent to that indicated for Project with record of successful in-service performance.

D. Single-Source Responsibility for Glass: Obtain glass from one source for each product indicated below:
   1. Primary glass (ASTM C 1036) of each type and class indicated.
   2. Heat treated glass (ASTM C 1048) of each condition indicated.
   3. Solar control low-emissivity glass (ASTM C 1376) of each condition indicated.
   4. Insulating glass of each construction indicated.

E. Field Constructed Mockups: Prior to glazing, erect mockups for each glass product indicated below to verify selections made under sample submittals and to demonstrate aesthetic effects and quality of materials and execution.
   1. Construct mockups to comply with following requirements, using materials indicated for final unit of Work:
   2. Erect mockups with following kinds of glass to match glazing systems required for Project, including typical light size, framing systems, and glazing methods:
      a. Tinted and coated insulating vision glass.
      b. Tinted and coated insulating glass units with ceramic frit (Acid Etch)
   3. Place mockups on Project Site in location and of size indicated or as directed by Architect.
   4. Notify Architect one week in advance of dates and times when mockups will be erected.
   5. Obtain Architect's acceptance of mockups before start of final unit of Work.
   6. Demonstrate proposed range of aesthetic effects and workmanship.
   7. Retain and maintain mockups during construction in undisturbed condition as standard for judging completed unit of Work.
      a. When directed, demolish and remove mockups from Project site.
      b. Accepted mockups in undisturbed condition at time of Substantial Completion may become part of completed unit of Work.

F. Preconstruction Compatibility and Adhesion Testing: Submit to sealant manufacturers, samples of each glass, gasket, glazing accessory, and glass framing member that will contact or affect glazing sealants for compatibility and adhesion testing as indicated below.
   1. Use test methods standard with sealant manufacturer to determine if priming and other specified preparation techniques are required for rapid, optimum glazing sealants adhesion to glass and glazing channel substrates.
      a. Perform tests under normal environmental conditions during installation.
   2. Submit quantity of each type and finish of glass framing members and each type, class, kind, condition, and form of glass sufficient for adhesion testing, as well as one sample of each glazing accessory for compatibility testing.
   3. Schedule sufficient time to test and analyze results to prevent delay in Work.
   4. Investigate materials failing compatibility or adhesion tests and obtain sealant manufacturer's written recommendations for corrective measures, including use of specially formulated primers.

G. Pre-Installation Conference: Conduct conference at Project Site to comply with requirements of Section 01 3119.
1.04 SUBMITTALS

A. Product Data: Manufacturer's product data for each glass product and glazing material required.

B. Product Certificates: Provide documentation for solar control low-emissivity (low-e) glass, demonstrating that manufacturer of coated glass is certified by coating manufacturer.

C. Samples for Verification Purposes: Minimum of four 12 inch square samples of each type of glass indicated except for clear monolithic glass, and four 12 inch long samples of each color required (except black) for each type of sealant or gasket exposed to view.
   1. Install sealant or gasket sample between two strips of material representative in color of adjoining framing system.

D. Compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealants.
   1. Include sealant manufacturer's interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed for adhesion.

E. Compatibility test report from manufacturer of insulating glass edge sealant indicating that glass edge sealants were tested for compatibility with other glazing materials including sealants, glazing tape, gaskets, setting blocks, and edge blocks.

F. Product test reports for each type of glazing sealant and gasket indicated, evidencing compliance with requirements specified.

G. Maintenance Data: Manufacturer's maintenance data for glass and other glazing materials.

1.05 DEFINITIONS

A. Deterioration of Coated Glass: Defects developed from normal use that are attributed to manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions.
   1. Defects include peeling, cracking, and other indications of deterioration in metallic coating.

B. Deterioration of Insulating Glass: Failure of hermetic seal under normal use due to causes other than glass breakage and improper practices for maintaining, and cleaning insulating glass.
   1. Evidence of failure is obstruction of vision by dust, moisture, or film on interior surfaces of glass.
   2. Improper practices for maintaining and cleaning glass are those that do not comply with manufacturer's directions.
1.06 PROJECT CONDITIONS

A. Environmental Conditions: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing materials manufacturer or when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver glass and glazing materials with manufacturer's labels intact.

B. Protect glazing materials to comply with manufacturer's directions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.08 REGULATORY REQUIREMENTS

A. California Building Code (CBC), Chapter 24.
   1. Comply with wind design requirements of CBC, Chapter 16A, Division II.

B. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1
   1. Subject to compliance with requirements, permanently mark safety glass with certification label of Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.

1.09 WARRANTY

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

B. Manufacturer's Warranty for Coated Glass: Written warranty signed by glass manufacturer agreeing to furnish replacements for those laminated glass units that deteriorate as defined in "Definitions" article, within specified warranty period indicated below.
   1. Warranty covers only deterioration due to normal conditions of use and not to handling, installing, and cleaning practices contrary to glass manufacturer's published instructions.
   2. Warranty Period: Manufacturer's standard but not less than 10 years after date of Substantial Completion.

C. Manufacturer's Warranty on Insulating Glass: Written warranty signed by manufacturer of insulating glass agreeing to furnish replacements for insulating glass units that deteriorate as defined in "Definitions" article, within specified warranty period indicated below.
   1. Warranty covers only deterioration due to normal conditions of use and not to handling, installing, protecting, and maintaining practices contrary to glass manufacturer's published instructions.
   2. Warranty Period: Manufacturer's standard, but not less than 10 years after date of Substantial Completion.
PART 2 – PRODUCTS

2.01 PRIMARY FLOAT GLASS

A. Refer to Schedule of Glass Types in Article 3.06.

B. Clear Float Glass: ASTM C 1036, Type 1 (transparent glass, flat), Class 1 (clear), quality q3 (glazing select) of following thicknesses:
   1. Clear, heat-treated and fully tempered, nominal 3/8 inch thick

C. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1. glass, except laminated glass, shall be fully tempered and comply with CBC, Section 2406.
   1. Subject to compliance with requirements, permanently mark safety glass with certification label of Safety Glazing Certification Council or another certification agency acceptable to Division of the State Architect.
   2. Identification mark shall be etched or ceramic fired on glass and readable from inside of building after installation.

D. Float Glass Manufacturers: Guardian, Pilkington, or PPG Industries.

2.02 TINTED GLASS

A. ASTM C 1036, Type 1 (transparent glass, flat), Class 2 (tinted, heat absorbing and light reducing) quality q3 (glazing select), 1/4 inch thick.
   1. Color: As indicated in Schedule of Glass Types at end of this Section.
   2. Tinted Glass Manufacturers: Guardian, Pilkington, or PPG Industries.

2.03 HEAT TREATED GLASS

A. Fabrication Process: By horizontal process with roll wave distortion parallel to bottom edge of glass as installed.

B. Uncoated, Clear, Heat Treated Float Glass: ASTM C 1048, Condition (uncoated surfaces), Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select), 1/4 inch thick, fully tempered

C. Uncoated, Tinted, Heat Treated Float Glass: ASTM C1048, Condition (uncoated surfaces), Type 1 (transparent glass, flat), Class 2 (tinted heat-absorbing and light reducing), Quality q3 (glazing select), with tint color and performance characteristics for 1/4 inch thick glass matching those indicated for annealed primary tinted float glass.

2.04 SOLAR CONTROL LOW EMISSIVITY (LOW E) COATING GLASS

A. Sputter Coated Glass: ASTM C 1376 float glass with metallic coating deposited by vacuum deposition process after manufacture and heat treatment, and complying with other requirements specified.
   1. Edge delete coating of surfaces in contact with insulating glass edge seals.
2. Basis of Design Product: Low-e coatings by Viracon as follows:
   a. Tinted glass with low-e coating on number 2 surface.
3. Products by one of following may be submitted subject to availability of low-e coating on number 2 surface of tinted light and acceptance by Architect for performance and appearance: Pilkington or PPG.

B. Coated, Solar Control Low-Emissivity Heat Treated Glass: ASTM C 1048, Condition C (other uncoated glass), Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select), 1/4 inch thick, fully tempered.

2.05 CERAMIC FRIT GLASS

A. Comply with requirements of Article 2.01 for clear, tempered glass.
   1. Furnish specified glass with flood coat of ceramic frit applied to Number 3 surface.
   2. Ceramic Frit Type and Color:
      a. Basis-of-Design for obscure/opaque insulating glass units: Satin Etch by PPG, or approved equal.
      b. For insulating glass units at windows where indicated.
      c. Assembly as specified under Article 3.06

2.06 INSULATING GLASS

A. Sealed Insulating Glass Units: Preassembled units consisting of organically sealed lights of glass separated by dehydrated air spaces complying with ASTM E 2190 and with other requirements indicated.

B. For properties of individual glass lights making up units, refer to requirements specified elsewhere in this Section applicable to types, classes, kinds, and conditions of glass products comprising lights of insulating glass units.

C. Provide heat treated glass,(heat strengthened) or fully tempered, unless indicated otherwise.

D. Air Space: Nominal 1/2 inch

E. Sealing System: Dual seal, primary and secondary sealants:
   1. Manufacturer's standard sealants.

F. Spacer Specifications: Manufacturer's standard metal
   1. Desiccant: Either molecular sieve or silica gel or blend of both.
   2. Corner Construction: Manufacturer's standard corner construction.

G. Insulating glass manufacturers:
   1. Viracon, Oldcastle, or approved equal; subject to conformance with specified appearance and performance characteristics.

2.07 GLAZING SEALANTS

A. General: Provide products complying with following requirements:
   1. Compatibility: Select glazing sealants and tapes of proven compatibility with other materials they will contact.
a. Including, but not limited to, 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 sealant and glass manufacturer's recommendations for selecting glazing sealants and tapes that are suitable for applications indicated and conditions existing at time of installation.

3. Colors: Provide color of exposed joint sealants to comply with following:
   a. Provide selections made by Architect from manufacturer's full range of standard colors for products of type indicated.

B. Glazing Sealant: One part silicone rubber glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25.
   1. Provide acid curing type recommended by manufacturer where only nonporous bond surfaces are contacted.
      a. Dow Corning 999-A Silicone Building & Glazing Sealant, or approved equal.
   2. Provide non-acid curing type recommended by manufacturer where one or more porous bond surfaces are contacted.
      a. Dow Corning 795 Silicone Building Sealant, or approve equal.
   3. Low Emitting Materials: Provide glazing sealants and sealant primers for use inside building envelope that comply with specified limits for VOC content when calculated according to California Air Resources Board (CARB) regulations:
      a. Comply with requirements specified in Section 07 9200.

2.08 MISCELLANEOUS GLAZING MATERIALS

A. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.

B. Setting Blocks: Elastomeric material with Shore durometer hardness of 85 plus or minus 5 with proven compatibility with sealants used.

C. Spacers: Elastomeric blocks or continuous extrusions with Shore durometer hardness required by glass manufacturer to maintain glass lights in place for installation indicated.

D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement

2.09 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

A. Fabricate glass and other glazing products in sizes required to glass openings indicated for Project, 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.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine glass framing, with glazier present, for compliance with following:
1. Manufacturing and installation tolerances, including those for size, squareness, offsets at corners.
2. Presence and functioning of weep system.
3. Minimum required face or edge clearances.
4. Effective sealing between joints of glass framing members.

B. Do not proceed with glazing until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean glazing channel, or other framing members to receive glass, immediately before glazing.
   1. Remove coatings which are not firmly bonded to substrate.
   2. Remove lacquer from metal surfaces wherever elastomeric sealants are used.

3.03 GLAZING, GENERAL

A. Watertight and airtight installation of each piece of glass is required, except as otherwise shown.
   1. Each installation must withstand normal temperature changes, wind loading, impact loading (for doors), without failure, including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glazing materials and other defects in Work.

B. Protect glass from edge damage during handling and installation as follows:
   1. Use rolling block in rotating glass units to prevent damage to glass corners.
   2. Do not impact glass with metal framing.
   3. Use suction cups to shift glass units within openings; do not raise or drift glass with pry bar.
   4. Rotate glass lights with flares or bevels on bottom horizontal edges so edges are located at top of opening, unless otherwise indicated by manufacturer's label.
   5. Remove damaged glass from Project site and legally dispose of off site.
      a. Damaged glass is glass with edge damage or other imperfections that, when installed, weaken glass and impair performance and appearance.

C. Glazing channel dimensions as shown are intended to provide for necessary bite on glass, minimum edge clearance, and adequate sealant thicknesses, with reasonable tolerances.
   1. Adjust as required by Project conditions at time of installation.

D. Comply with combined recommendations and technical reports by manufacturers of glass and glazing products as used in each glazing channel, and with recommendations of GANA – Glazing Manual, except where more stringent requirements are indicated.

E. Apply primer or sealer to joint surfaces wherever recommended by sealant manufacturer.

F. Install elastomeric setting blocks in sill rabbets, sized and located to comply with referenced glazing standard, unless otherwise required by glass manufacturer.
   1. Set blocks in thin course of compatible sealant suitable for heel bead.
G. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lights.

H. Provide spacers for glass sizes larger than 50 united inches (length plus height) as follows:
   1. Locate spacers inside, outside, and directly opposite each other.
   2. Install correct size and spacing to preserve required face clearances, except where gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and comply with system performance requirements.
   3. Provide 1/8 inch minimum bite of spacers on glass and use thickness equal to sealant width.
      a. With glazing tape, use thickness slightly less than final compressed thickness of tape.

I. Provide edge blocking to comply with requirements of referenced glazing publications, unless otherwise required by glass manufacturer.

J. Set glass slights in each series with uniform pattern, draw, bow, and similar characteristics.

K. Provide fully tempered safety glass, unless indicated otherwise.

L. Install insulating glass units to comply with recommendations by Insulating Glass Manufacturers Association (IGMA), except as otherwise specifically indicated or recommended by glass and sealant manufacturers.

3.04 GLAZING

A. Cutting and Fitting Glass: Accurately cut and fit glass to opening size.
   1. Provide clearance for expansion.
   2. Cut and set glass to keep wave lines horizontal.
   3. Ensure sharp, clean cut glass edges.

B. Force sealants into channel to eliminate voids and to ensure complete bond of sealants to glass and channel surfaces.

C. Tool exposed surfaces of glazing liquids and compounds to provide wash away from glass.
   1. Install pressurized tapes and gaskets to protrude slightly out of channel, so as to eliminate dirt and moisture pockets.

D. Clean and trim excess glazing materials from glass and stops or frames promptly after installation, and eliminate stains and discolorations.

E. Do not attempt to cut, seam, nip or abrade glass which is tempered, heat strengthened, or coated.

F. Mitered Joints: Seam miter cut edges.
   1. Clean edge of glass to ensure proper adherence of sealant.
   2. Air pockets or voids in joint are not acceptable.
G. Gasket Glazing: Miter cut and bond ends together at corners where gaskets are used for channel glazing, so that gaskets will not pull away from corners and result in voids or leaks in glazing system.

3.05 CURE, PROTECTION, AND CLEANING

A. Cure glazing sealants and compounds in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength, and surface durability.

B. Protect exterior glass from breakage immediately upon installation, by attachment of crossed streamers to framing held away from glass.
   1. Do not apply markers of any type to surfaces of glass.
   2. Remove nonpermanent labels and clean surfaces.

C. Remove and replace glass which is broken, chipped, cracked, abraded or damaged in other ways during construction period, including natural causes, accidents and vandalism.

D. Protect glass from contact with contaminating substances resulting from construction operations including weld splatter.
   1. Should, despite such protection, contaminating substances come into contact with glass, remove them immediately as recommended by glass manufacturer.

E. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once per month, for build up of dirt, scum, alkali deposits, or stains, and remove as recommended by glass manufacturer.

3.06 SCHEDULE OF GLASS TYPES

A. Glass Type G1:
   1. Insulating vision glass unit of nominal 1 inch overall thickness:
      a. Outer Light: Coated, clear, heat treated glass, fully tempered, 1/4 inch nominal thickness with low-emissivity coating on number 2 surface.
      b. Air Space: 1/2 inch
      c. Inner Light: Uncoated, clear, heat treated glass, fully tempered, 1/4 inch nominal thickness.
      d. Nominal Performance Characteristics:
         1) Visible Light Transmittance: 70 percent
         2) Outdoor Visible Reflectance: 11 percent
         3) Shading Coefficient: 0.44
         4) Solar Heat Gain Coefficient: 0.38
         5) Winter Nighttime U Value: 0.29
         6) Summer Daytime U Value: 0.26
      e. Product and Manufacturer: VE1-2M by Viracon.
B.  Glass Type G2:
   1.  Insulating vision glass unit of nominal 1 inch overall thickness:
      a.  Outer Light: Coated, tinted, heat treated glass, fully tempered, 1/4 inch
           nominal thickness with low-emissivity coating on number 2 surface.
      b.  Air Space: 1/2 inch
      c.  Inner Light: Uncoated, clear, heat treated glass, fully tempered, 1/4 inch
           nominal thickness.
      d.  Nominal Performance Characteristics:
           1)  Visible Light Transmittance: 53 percent
           2)  Outdoor Visible Reflectance: 10 percent
           3)  Shading Coefficient: 0.30
           4)  Solar Heat Gain Coefficient: 0.26
           5)  Winter Nighttime U Value: 0.29
           6)  Summer Daytime U Value: 0.26
      e.  Product and Manufacturer: VNE2-63 by Viracon.

C.  Glass Type G3:
   1.  Insulating vision glass unit of nominal 1 inch overall thickness:
      a.  Outer Light: Coated, tinted, heat treated glass, fully tempered, 1/4 inch
           nominal thickness with low-emissivity coating on number 2 surface.
      b.  Air Space: 1/2 inch
      c.  Inner Light: Uncoated, clear, heat treated glass, fully tempered, 1/4 inch
           nominal thickness.
      d.  Nominal Performance Characteristics:
           1)  Visible Light Transmittance: 47 percent
           2)  Outdoor Visible Reflectance: 8 percent
           3)  Shading Coefficient: 0.27
           4)  Solar Heat Gain Coefficient: 0.23
           5)  Winter Nighttime U Value: 0.29
           6)  Summer Daytime U Value: 0.26
      e.  Product and Manufacturer: VNE8-63 by Viracon.

D.  Glass Type G4:
   1.  Insulating vision glass unit of nominal 1 inch overall thickness:
      a.  Outer Light: Coated, tinted, heat treated glass, fully tempered, 1/4 inch
           nominal thickness with low-emissivity coating on number 2 surface.
      b.  Air Space: 1/2 inch
      c.  Inner Light: Uncoated, clear, heat treated glass, fully tempered, 1/4 inch
           nominal thickness with “Subdued Gray” ceramic frit on number 4 surface.
      d.  Product and Manufacturer: VNE2-63 by Viracon.

E.  Glass Type G5:
   1.  Insulating vision glass unit of nominal 1 inch overall thickness:
      a.  Outer Light: Coated, tinted, heat treated glass, fully tempered, 1/4 inch
           nominal thickness with low-emissivity coating on number 2 surface.
      b.  Air Space: 1/2 inch
      c.  Inner Light: Uncoated, clear, heat treated glass, fully tempered, 1/4 inch
           nominal thickness with “Subdued Gray” ceramic frit on number 4 surface.
      d.  Product and Manufacturer: VNE8-63 by Viracon.

END OF SECTION 08 8000
PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Extent of louvers is indicated, including indications of sizes and locations.
      a. Coordinate requirements, quantities and sizes with Mechanical Drawings.
      b. Louvers not shown on Architectural Drawings, but indicated on Mechanical Drawings shall be provided as part of Work of this section.
   2. Types of louvers include following:
      a. Exterior extruded aluminum, sightproof, drainable blade wall louvers.
      b. Fabricated sheet metal, drainable blade wall louvers.
      c. Louvers at locations where HVAC ductwork terminates at exterior walls.

B. Related Sections:
   1. Section 05 0513: Shop-Applied Coatings for Metal; factory finish on aluminum louvers.
   2. Section 07 9200: Joint Sealants
   3. Division 23 Sections for louvers in mechanical Work.

1.02 REFERENCES

A. ASTM International (ASTM):

B. Air Movement and Control Association (AMCA):

C. Sheet Metal and Air Condition Contractors National Association (SMACNA)

D. American Architectural Manufacturer's Association (AAMA):

1.03 QUALITY ASSURANCE

A. Performance Requirements: Where louvers are indicated to comply with specific performance requirements, provide units whose performance ratings have been determined in compliance with Air Movement and Control Association (AMCA) Standard 500.
   1. AMCA Certification: Provide louvers with AMCA Certified Ratings Seal evidencing that product complies with above requirement.
B. Source Limitations: Obtain louvers and vents through one source from single manufacturer where alike in one or more respects regarding type, design, or factory-applied color finish.

C. Comply with SMACNA-"Architectural Sheet Metal Manual" recommendations for fabrication, construction details and installation procedures, except as otherwise indicated.

D. Field Measurements: Verify size, location and placement of louver units prior to fabrication, wherever possible.

E. Shop Assembly: Coordinate field measurements and shop drawings with fabrication and shop assembly to minimize field adjustments, splicing, mechanical joints and field assembly of units.
   1. Preassemble units in shop to greatest extent possible and disassemble as necessary for shipping and handling limitations.
   2. Clearly mark units for reassembly and coordinated installation.

1.04 SUBMITTALS

A. Product Data: Manufacturer's specifications and installation instructions for required products, including finishes.

B. Shop Drawings: For fabrication and erection of louver units and accessories.
   1. Include plans, elevations and details of sections and connections to adjoining Work.
   2. Indicate materials, sizes, thickness, fastenings, profiles, fasteners, joinery and other information to determine compliance with specified requirements
   3. Include anchorages, accessories, and finishes.
   4. Include information necessary for fabrication and installation of louvers.

C. Samples for Verification: Each type of metal finish required, prepared on Samples of same thickness and material indicated for final Work.

D. Quality Assurance Submittals:
   1. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
      a. Certified test results from approved testing laboratory showing that proposed louvers meet specified criteria.
   2. Performance Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria, and physical requirements.

1.05 PROJECT CONDITIONS

A. Field Measurements: Verify actual measurements/openings by field measurements before fabrication.
   1. Show recorded measurements on shop drawings.
   2. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.
1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer’s ordering instructions and lead-time requirements to avoid construction delays.

B. Deliver materials in manufacturer’s original, unopened, undamaged containers with identification labels intact.
   1. Deliver, store, and handle products to avoid distortion or damage due to moisture, physical abuse or other causes.
   2. Louvers shall be free from nicks, scratches and blemishes.
   3. Replace defective or damaged materials with new.

1.07 WARRANTY

A. Manufacturer’s Warranty: Manufacturer’s standard warranty document executed by authorized company official.
   1. Manufacturer’s warranty is in addition to, and not limitation of, other rights Owner may have under General Conditions of the Contract.

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Basis-of-Design: Design for extruded aluminum wall louvers is based on characteristics of model A6177 High Performance Drainable Fixed Mullion Louver as manufactured by Construction Specialties.

B. Subject to compliance with specified requirements, comparable products may be submitted by alternate manufacturers in accordance with requirements for product substitutions specified in Section 016000 and following:
   1. Submit items listed in Article 1.03 and as specified in Section 01 3300, for evaluation of the proposed items.
   2. Complete project shop drawings for similar project may be submitted for evaluation purposes, however shop drawings specific to this Project will be required from successful bidder.

2.02 MATERIALS

A. Aluminum Sheet: ASTM B209 Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer to provide required finish.

B. Aluminum Extrusions: ASTM B221, Alloy and Temper 6063-T52.

C. Fastenings: Use same material as items fastened, unless otherwise indicated.
   1. Fasteners for exterior applications may be stainless steel or aluminum.
   2. Provide types, gauges, and lengths to suit unit installation conditions.
   3. Use Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.

D. Anchors and Inserts: Use non-ferrous metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance.
   1. Use steel or lead expansion bolt devices for drilled-in-place anchors.
F. Isolation Between Dissimilar Materials:
   1. For concealed locations, provide single-component, inert-type non corrosive compound free of asbestos fibers, sulfur components, and other deleterious impurites; VOC compliant.
      a. Elasto-Deck BT as manufactured by Pacific Polymers International, Inc.or equivalent product acceptable to Architect.

2.03 FABRICATION – GENERAL

A. Provide louvers and accessories of design, materials, sizes, depth, arrangement, and metal thicknesses indicated, or as required for optimum performance with respect to airflow; water penetration; strength; durability; and uniform appearance.
   1. Size:
      a. Fabricate louvers in exterior walls to outside dimensions indicated, with allowance of 3/8 inch on each side for sealant joints.
      b. Verify sizes with final HVAC shop drawings, including detail dimensions of ductwork, dampers, or other fittings abutting louvers.

B. Field Measurements: Verify size, location and placement of louver units prior to fabrication.

C. Shop Assembly:
   1. Fabricate frames to minimize field adjustments, splicing, mechanical joints and field assembly of units.
   2. Fabricate frames to suit adjacent construction with tolerances for installation, including application of sealants in joints between louvers and adjoining work.
   3. Preassemble units in shop to greatest extent possible and disassemble as necessary for shipping and handling.
      a. Clearly mark units for reassemble and coordinated installation.
   4. Join frame members to one another and to stationary louver blades by welding,
      a. Maintain equal blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
   5. Include supports, anchorages, and accessories required for complete assembly.

D. Provide insect screens for exterior louvers.

2.04 SIGHTPROOF DRAINABLE BLADE WALL LOUVER

A. Sightproof Drainable Blade Louver: Units designed to collect and drain water to exterior at sill by means of gutters in front edges of blades, and channels in jambs and mullions.
   1. Furnish units with extrusions not less than 0.063 inch thick, of depth, and sizes indicated, complying with following performance requirements:
      a. Free Area: As indicated on Mechanical Drawings.
      b. Static Pressure Loss: Not more than 0.15 inch of water gage at an airflow of 1050 fpm free area velocity in intake direction.
      c. Water Penetration: Not more than 0.05 oz. per sq. ft. of free area at an airflow of 1000 fpm free area velocity.
      d. Coordinate air-handling louvers with duct work.

2.05 LOUVER SCREENS

A. Provide removable screens for exterior louvers where indicated.
1. Fabricate screen frames of same metal and finish as louver units to which secured, unless otherwise indicated.

B. Provide rewireable frames consisting of formed or extruded metal with driven spline or insert for securing screen mesh.

C. Use insect screens where indicated, of 18 by 14 inch mesh, 0.015 inch grey fiberglass.

2.07 METAL FINISHES

A. Aluminum Finish:
   1. High-Performance Coating: Comply with requirements for Metal Finish Type A for extrusions in Section 05 0513.

PART 3 – EXECUTION

3.01 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions and directions for installation of anchorages which are to be embedded in concrete or masonry construction.
   1. Coordinate delivery of such items to Project Site.

3.02 EXAMINATION

A. Site Verification: Verify substrate conditions, previously installed under other sections, are acceptable for product installation in accordance with manufacturer’s instructions.

3.03 INSTALLATION

A. Install louvers in accordance with manufacturers approved shop drawings and as shown.
   1. Locate and place louver units plumb, level and in proper alignment with adjacent Work.
   2. Provide necessary fastenings and anchors required for complete installation.
      a. Use concealed anchorages wherever possible.
      b. Provide neoprene or nylon washers fitted to screws where required to protect metal surfaces.
   3. Form tight joints with exposed connections accurately fitted together.
      a. Fit exposed connections accurately.
      b. Provide reveals and openings for sealants and joint fillers, as indicated.

B. Repair finishes damaged by installation operations required for fitting and jointing.
   1. Restore finishes so there is no evidence of corrective work.
   2. Return items which cannot be refinished in field to shop, make required alterations, and refinish entire unit, or provide new units, at Contractor's option.

C. Protect galvanized and non-ferrous metal surfaces from corrosion or galvanic action by application of heavy coating of Isolation material on surfaces which will be in contact with Portland cement plaster or dissimilar metals.

D. Provide concealed gaskets, flashings, joint fillers, and insulation, and install as Work progresses to make installations weathertight.
3.04 PROTECTION

A. Protect louvers from damage from subsequent building operations.

3.05 CLEANING

A. Remove and legally dispose of debris, rubbish, and waste material off Project Site.

END OF SECTION 08 9000
SECTION 09 2216

NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Metal support systems as indicated.

B. Related Sections:
   1. Section 09 2900: Gypsum Board.

1.02 SYSTEM DESCRIPTION

A. Regulatory Requirements: Comply with 2013 CBC requirements.

B. Design Requirements:
   1. Metal Studs: Studs for interior partitions shall be roll-formed channel or C-shapes.
   2. Track: Stud track for floor and ceiling anchorage shall be channel configuration, sized to fit studs.
      a. Galvanized steel as manufactured for installation with specified metal studs.

1.03 SUBMITTALS

A. Shop Drawings: Showing framing, connection details, accessories and anchorage. Indicate location of assemblies and size and spacing of framing components.

B. Product Data: Manufacturer's catalog data for each item proposed for installation.

C. Certificates: Furnish manufacturer's certification that materials meet or exceed specification requirements.

1.04 QUALITY ASSURANCE

A. Coordinate with related Work to provide blocking for items mounted on finished surfaces and to provide allowances for pipes and other items inside partitions and walls.

B. Comply with following as minimum requirement:
   1. American Welding Society (AWS): Structural Welding Code Steel (D1.1); and Structural Welding Code Sheet Steel (D1.3).
   2. ASTM Standards:
      a. ASTM A 653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
      b. ASTM A 1008 – Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High Strength Low-Alloy and High Strength Low-Alloy with Improved Formability.
e. ASTM C 954 – Standard Specification for Steel Drill Screws for Application of Gypsum Panel Products or Metal Bases to Steel Studs From 0.033 Inch to 0.112 Inch in Thickness.

C. Tolerances: Install walls and partitions on straight lines, plumb, free of twists or other defects, and contacting a 10 foot straightedge for its entire length at any location within a 1/8 inch tolerance. Install horizontal framing level within a tolerance of 1/8 inch in 12 feet in any direction.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Materials shall be delivered in their original unopened packages and stored protected from damage.
   1. Do not store material directly on grade.
   2. Provide adequate support to prevent bowing of material prior to installation.

B. Store welding electrodes in accordance with AWS D12.1.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Light Gage Metal Framing:
   1. Metal framing shall be formed from corrosion resistant-steel conforming to requirements as noted on the structural drawings.

B. Studs: 50 ksi, hot-dipped galvanized or electro-galvanized sheet steel, G-60, C Stud type, unpunched web, C-shaped, sizes required to conform to details and scheduled wall thicknesses. Studs shall be rolled from new steel sheet and shall not be produced from re-rolled steel.
   1. Wall Framing and Furring for Gypsum Board: Studs and tracks shall be 20-gage minimum, unless otherwise indicated on structural drawings.

C. Framing Accessories: Provide standard related accessories including floor and ceiling tracks, clips, web stiffeners, anchors, and similar items, of same manufacture as each type of stud specified, and as required for complete installation.

D. Fasteners: Wafer-head screws, self-drilling type for 20 gage metal and heavier. ASTM C954 self-drilling, self-tapping screws, Type S-12 pan head, 1/2 inch long unless noted otherwise on structural drawings.


F. Steel Backing Plates: Provide a minimum 4 inch wide by 16 gage steel, or sections of studs and stud track welded or fastened to web of studs, except as otherwise indicated. Apply shop coat of metal primer.
PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that overhead or concealed Work is completed, tested, inspected, and finished as required before starting Work of this section.

3.02 INSTALLATION

A. Walls and Partitions: Unless noted otherwise on structural drawings.
   1. Fasten floor runners for interior partitions to concrete slab with required power driven fasteners. Spacing of fasteners not to exceed 24 inches on center. Fasten ceiling runners to structure as indicated.
   2. Space studs not over 16 inch on center unless indicated otherwise. Studs shall be located approximately 2 inches from doorframe jambs, abutting partitions and partition corners.
   4. Furnish and install manufacturer's standard floor track. Fasten track to floor by means of 1/4 inch x 1-1/4 inch Star "Dryvin" hammer drive anchors or 3/16 inch x 1 inch round head, "Rawl-Drives" one-piece expansion bolts spaced not to exceed 3 feet, and installed in drilled holes in slab, as indicated. Track may be fastened to concrete floor slabs with, power-driven fasteners.
   5. Studs shall be seated squarely in track with stud web and flanges abutting track web, plumbed and securely fastened with sheet metal screws, to flanges or web of both floor and top tracks. Provide 4 screws per stud.
   6. Where there is no suspended ceiling, tops of stud walls shall be provided with track and shoes and be fastened as specified for floors. Welding of studs to ceiling track will not be permitted except where bearing studs are installed.
   8. Bridging, or horizontal bracing of 1-1/2 inch, cold-rolled channels shall be fastened in manner to prevent stud rotation. Bridging shall be furnished as follows: walls up to 10 feet high, one row at mid-height; walls exceeding 10 feet high, bridging or bracing rows spaced not to exceed 5 feet on center.

3.03 CONNECTIONS TO DECK

A. Provide pre-molded neoprene filler strips matching flute profile for non-fire-rated walls and partitions covered on one or both sides up to decking.

3.04 CLEANING

A. Remove and legally dispose of debris, rubbish, and waste material off Project Site.

3.03 PROTECTION

A. Protect Work of this section until Substantial Completion.

END OF SECTION 09 2216
SECTION 09 2400
PORTLAND CEMENT PLASTER

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   2. Metal Lath and Accessories.
   3. Weather barrier membrane

B. Related Sections:
   1. Section 07 9200: Joint Sealants
   2. Section 09 2216: Non-Structural Metal Framing

1.02 REFERENCES


B. ASTM International (ASTM):
   2. ASTM C 926 – Standard Specification for Application of Portland Cement-Based Plaster
   4. ASTM D 1784 – Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) and Related PVC and Chlorinated Poly (Vinyl Chloride) (CPVC) Building Products Compounds

1.03 QUALITY ASSURANCE

A. Comply with CBC, Chapter 25.

B. Mockups: Prior to installing plaster work, construct panels for each type of finish and application required to verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution.
   1. Build mockups to comply with following requirements, using materials indicated for final unit of Work.
   2. Locate mockups on-site in location and of size indicated or, when not indicated, as directed by Architect.
   3. Erect mockups 4 by 4 foot by full thickness in presence of Architect using materials, including lath, support system, and control joints, indicated for final Work.
   4. Notify Architect 7 days in advance of dates and times when mockups will be constructed.
   5. Demonstrate proposed range of color aesthetic effects and workmanship expected in completed Work.
a. Show cut-away in panel exposing weather barrier, metal lath and drainage weep of system on perimeter edge of panel.
b. Obtain Architect's acceptance of visual qualities of sample panel.

6. Obtain Architect's acceptance of mockups before start of plaster work.
7. Retain and maintain mockups during construction in undisturbed condition as standard for judging completed Portland cement plaster work.
8. When directed, remove mockups from Project Site.

C. Contact local architectural representative/technical consultant of plaster finish manufacturer to provide consultation with installer for application of finish on samples, mockups and during actual system application.

D. Conduct Pre-Installation meeting one week prior to construction of mockup at Project Site.
   1. Meeting should be attended by Architect, General Contractor, applicator of plaster system, and manufacturer's technical representative.

1.04 SUBMITTALS
A. Product Data: Manufacturer's product data and installation instructions for each product specified.
B. Material Certificates: Producer's certificate for each kind of plaster aggregate indicated evidencing that materials comply with requirements.
C. Samples: Prepare four 18 inch square sample plaques using materials and workmanship indicating proposed range of colors and texture to be expected in completed Work.
   1. Submit to Architect and obtain acceptance of color and texture.
   2. No work is to be commenced before samples are approved.

1.05 PROJECT CONDITIONS
A. Cold-Weather Requirements: Provide heat and protection, temporary or permanent, as required to protect each coat of plaster from freezing for at least 24 hours after application.
   1. Distribute heat uniformly to prevent concentration of heat on plaster near heat sources; provide deflection or protective screens.
B. Warm Weather Requirements: Protect plaster against uneven and excessive evaporation and from strong flows of dry air, both natural and artificial.
   1. Apply and cure plaster as required by climatic and job conditions to prevent dry out during cure period.
   2. Provide suitable coverings, moist curing, barriers to deflect sunlight and wind, or combinations of these, as required.
C. Exterior Plaster Work: Do not apply plaster when ambient temperature is below 40 degrees F.
D. Protect contiguous work from soiling, spattering, moisture deterioration and other harmful effects which might result from plastering.
1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver manufactured materials in original packages, containers or bundles, bearing name of manufacturer and brand.

B. Keep plaster and cementitious materials dry until ready for use.
   1. Keep off ground, under cover and away from damp surfaces.
   2. Protect metal goods against rusting.

PART 2 – PRODUCTS

2.01 WEATHER BARRIER MEMBRANE

A. Basis of Design: High-performance, flash spun-bonded olefin, non-woven, nonperforated, secondary weather barrier is based upon DuPont™ Tyvek® CommercialWrap D and related assembly components
   1. Complying with ASTM E 1677 and as follows:
   2. Air Penetration Resistance, ASTM E 1677: Type 1, <0.04 cfm/ft² @ 1.57 psf.
   3. Water-Vapor Transmission, ASTM E 96, Method B: 30 perms
   4. Water Penetration Resistance, AATCC 127: 235 cm
   5. Basis Weight, TAPPI T-410: 2.4 ounces per square yard
   6. Breaking Strength, ASTM D 882: 33/41 lbs/in
   7. Tear Resistance (trapezoid), ASTM D 1117: 6/9 lbs
   8. Surface Burning Characteristics, ASTM E 84:
      a. Flame Spread Index: 15, Class A
      b. Smoke Developed Index: 25, Class A

B. Accessories:
   1. Seam Tape: Tyvek® Tape, 3 inches wide, as manufactured by DuPont
   2. Fasteners: Tyvek® Wrap Caps – No. 4 nails with large 1 inch plastic cap fasteners
      a. Do not use staples.

C. Flashing:
   2. DuPont™ StraightFlash™: Straight flashing membrane materials for flashing windows and doors and sealing penetrations

2.02 LATH

A. Expanded Metal Lath: Fabricate expanded metal lath from zinc-coated (galvanized) steel sheet to produce lath complying with ASTM C 847 for type, configuration and other characteristics indicated below:
   1. Diamond Mesh Lath: Comply with following requirements
      b. Weight: 3.4 lbs. per square yard.
      c. Do not use paper-backed lath

B. Tie and String Wire: 16-18 gage galvanized.
C. Lath Attachment Devices: Devices of material and type required by referenced standards and recommended by lath manufacturer for secure attachment of lath to framing members and of lath to lath.

2.03 PLASTER ACCESSORIES FOR PORTLAND CEMENT PLASTER

A. General: Comply with material provisions of ASTM C 1063.
   1. Coordinate depth of accessories with thicknesses and number of coats required.
   2. Provide PVC products as manufactured by Plastic Components, Inc., or approved equal.

B. Metal Corner Reinforcement: Expanded large mesh diamond mesh lath fabricated from zinc-alloy or welded wire mesh fabricated from 0.0475 inch diameter zinc-coated wire, specially formed to reinforce external corners of Portland cement plaster on exterior exposures while allowing full plaster encasement.

C. Corner Beads: Small nose corner beads fabricated from PVC, with 2-1/2 inch to 2-3/4 inch flanges of PVC to allow full encasement by plaster.

D. Casing Beads: Square-nose style of PVC, with 1-3/4 inch flange and removable protective tape.

E. Control Joints: Prefabricated of PVC.
   1. One-Piece Type: Folded pair of non-perforated screeds in M-shaped configuration, with 3-3/8 inch flanges.
   2. Two-Piece Type: Pair of casing beads with back flanges formed to provide slip joint action, adjustable for joint widths from 1/8 inch to 5/8 inch.
   3. Cut lath and wire tie at control joints per ASTM C 1063.

F. Soffit Drip Stop:

G. Perforated Soffit Vent: Perforated, 2 inch width.

H. Foundation Weep Screed:
   1. Fabricated from PVC, with weep holes, 3-1/2 inch flange.

2.04 PORTLAND CEMENT PLASTER MATERIALS

A. Portland Cement: ASTM C 150, Type I or Type II, low alkali.
   1. Super Cement as manufactured by Omega Products International, Inc.
   2. Do not use plastic cement.

B. Sand Aggregate: ASTM C 897, clean, free from deleterious amounts of loam, clay, silt, soluble salts, organic matter and graded within following limits:
### 2.05 MISCELLANEOUS MATERIALS

A. Water for Mixing and Finishing Plaster: Drinkable, free of substances capable of affecting plaster set or of damaging plaster, lath or accessories.

B. Bonding Agent for Portland Cement Plaster: ASTM C 932.

C. Miscellaneous Aluminum Moldings and Trim: As manufactured by Fry Reglet Corp., or approved equal:
   1. Style type indicated on Drawings.
   2. Aluminum moldings shall be extruded alloy 6063-T5; provide with end caps.
   3. Finish: Factory applied prime coat.
   4. Install in accordance with manufacturer's recommendations.
   5. Finish paint per Section 09 9100.
      a. Contractor's Option: Provide factory baked enamel finish coating in color as selected by Architect.

### 2.06 PORTLAND CEMENT PLASTER MIXES

A. General: Comply with ASTM C 926 for Portland cement plaster base and finish coat mixes as applicable to plaster bases, materials and other requirements indicated.

B. Portland Cement Plaster Base Coat Mixes and Compositions: Proportion materials for respective base coats in parts by volume for cementitious materials and in parts by volume per sum of cementitious materials for aggregates to comply with following requirements for each method of application and plaster base indicated.
   1. Adjust mix proportions below within limits specified to attain workability.
   2. Two Coat Work Over Metal Lath: Base coats as indicated.
      a. Scratch Coat: Omega Fibered Super Cement, 2-1/2 to 4 parts sand.
      b. Brown Coat: Omega Fibered Super Cement, 3 to 5 parts sand.

C. Provide Portland cement plaster with maximum allowable slump of 2-1/2 inches when tested per ASTM C143.
   1. Take material for slump test from nozzle of plastering machine hose.
   2. Perform one slump test for each day of Portland cement plaster work.

### 2.07 PROPORTIONING AND MIXING

A. Proportion and mix following manufacturer's recommendations.
B. Mechanically mix cementitious and aggregate materials for plasters to comply with applicable referenced application standard and with recommendations of plaster manufacturer.
   1. Mechanically mix at Project Site.
      a. Do not hand mix except where small amounts are needed, using less than one bag of plaster.
   2. Use measuring devices with known volume with successive batches proportions alike.

2.08 ACRYLIC MODIFIED FINISH COAT

A. Acrylic Modified Plaster:
   1. Basis of Design: OmegaFlex System by Omega Products International, Inc.

B. Finish Coat:
   1. Level Coat: OmegaFlex StyroGlue DryBond.
   2. Base Primer: Omega Flex Primer.
   3. Finish Coat: OmegaFlex Fine 100 percent acrylic finish, color and texture to match approved sample.

PART 3 – EXECUTION

3.01 INSTALLATION OF LATH-GENERAL


B. Exterior Cement Plaster over Metal Lath: Prior to installation of metal lath ensure that weather barrier and flashing have been installed.
   1. Exterior Stucco Mesh or Key Mesh (cement plaster): Wire, nails, screws and staples shall be of type, minimum size and maximum spacing along supports.

3.02 METAL LATHING

A. Metal Lath: Install expanded metal lath for following applications where plaster base coats are required.
   1. Provide appropriate type, configuration and weight of metal lath selected from materials indicated which comply with referenced lathing installation standards.
   2. Exterior sheathed wall surfaces; minimum weight of self-furring diamond mesh lath, 3.4 lbs. per square yard
   3. Monolithic surfaces indicated to receive metal lath or not complying with requirements of referenced plaster application standards for characteristics which permit direct bond with plaster.
      a. Provide self-furring metal lath.
   4. Apply metal lath over gypsum sheathing with fasteners extending through the sheathing in to the framing.

3.03 PLASTERING ACCESSORIES

A. General: Comply with referenced lathing and furring installation standards for provision and location of plaster accessories of type indicated.
   1. Miter or cope accessories at corners; install with tight joints and in alignment.
2. Attach accessories securely to plaster bases to hold accessories in place and alignment during plastering.

B. Accessory Attachment: Attach each flange at 18 inches on center maximum, or as necessary to hold plumb, for vertical accessories and to coincide with framing for horizontal accessories.

C. Set accessories plumb, level and true to line, with a tolerance of 1/8 inch in 10 feet.

D. Install metal corner beads at external corners.

E. Install casing beads at terminations of plaster work, except where plaster is indicated to pass through other work and be concealed by lapping work, and except where special screens, bases or frames act as casing beads including interior metal door frames.
   1. For exterior work, set casing beads 1/4 inch from abutting frames and other work, for application of sealant.

F. Control Joints: Install control joints at locations indicated, or if not indicated, at locations complying with following criteria and approved by Architect.
   1. Where expansion or control joint occurs in surface of construction directly behind plaster membrane.
   2. Where distance between control joints in Portland cement plastered surface exceeds 10 feet in either direction.
   3. Where area within Portland cement panels exceed 100 square feet.
   4. Where Portland cement plaster panel sizes or dimensions change. Extend joints full width or height of plaster membrane.
   5. Install prefabricated expansion joints of 2-piece design where shown as "Expansion Joint"; 1/8 inch joint width for exterior work.

G. Separation Screeds: Install at intersections of two types of plaster, plaster and tile, and where indicated.

3.04 PREPARATION FOR PLASTERING

A. Clean plaster bases and substrates for direct application of plaster, removing loose material and substances that may impair Work.

B. Apply bonding agent on concrete and concrete unit masonry surfaces indicated for direct plaster application; comply with manufacturer's written instructions for application.

C. Install temporary grounds and screeds to ensure accurate rodding of plaster to true surfaces; coordinate with scratch-coat work.

D. Surface Conditioning: Immediately before plastering, dampen concrete and concrete unit masonry surfaces that are indicated for direct plaster application, except where bonding agent has been applied.
   1. Determine and apply amount of moisture and degree of saturation that will result in optimum suction for plastering.
3.05 PORTLAND CEMENT PLASTER APPLICATION

A. Portland Cement Plaster Application Standard: Apply Portland cement plaster materials, compositions, and mixes to comply with ASTM C 926.

B. Number of Coats: Apply Portland cement plaster, of composition indicated, to comply with following requirements:
   1. Use two-coat work:
   2. Total Plaster Thickness:
      a. Over Plywood Sheathing and Metal Lath: 7/8 inch thick (3/8 inch scratch; 3/8 inch brown; 1/8 inch acrylic finish)

C. Do not join or lap brown coat over joining or laps in scratch coat.
   1. Do not join or lap finish coat over joining or laps in brown coat.
   2. Joining or lap marks or differences in texture where scaffolding changes occur are not acceptable.

D. Texture of Plaster Finishes:
   1. Except as otherwise indicated, apply finish-coats as follows:

E. Curing: Provide proper continuous moist curing for Portland Cement plaster, including periods that extend over into holidays or weekends.
   1. Do not saturate or soak; use fine fog spray.
      a. Protect each coat from irregular or excessive drying.
      b. Protect plaster from hot dry winds to eliminate "dry-outs" and see that required heat and ventilation are provided as necessary to eliminate "sweat-outs".
   2. Scratch Coat: Moist cure for at least 48 hours.
   3. Brown Coat: Moist cure for 48 hours, then allow to dry for 5 days before applying finish coat.
   4. Cure finish coat per manufacturer’s instructions.

3.06 ACRYLIC MODIFIED FINISH COAT APPLICATION

A. Two Coat Application: 1/16 inch minimum acrylic finish over 1/16 inch minimum basecoat over cured brown coat.
   1. Use primer only if recommended by manufacturer.
   2. Do not apply finish when ambient temperature is less than 40 degrees F and has been above 40 degrees for at least 24 hours prior.
   3. Do not apply finish materials to Portland cement brown coats if sun is directly on wall surface and temperature is 75 degrees or more.
   4. Protect plaster surfaces from precipitation prior to, during application, and through setting/curing period of finish coat.
   5. Mix and apply trowelable aggregated acrylic finish system in strict accordance with manufacturer's printed instructions and recommendations of manufacturer's field representative.
   6. Apply continuously and in one operation to entire wall area.
      a. Maintain wet edge.
   7. Bring finish minimum distance into sealant joints so that sealant material bonds to substrate but still covers edge of finish.
   8. Apply finish so that there are no scaffold lines or other marks due to application.
B. Application:
   1. Apply finish coat following manufacturer’s directions, using stainless steel trowel and textured using conventional wood or plastic float to match approved sample.
   2. Finished base coat surface shall be left smooth and even and allowed to air cure for not less than 24 hours.
   3. Tolerance: Finished wall surface shall be true, straight and plumb to 1/8 inch in 10 feet.
   4. Allow finish to dry at least 24 hours.
      a. Protect from weather, soiling, dust and physical contact until fully dried.

C. Curing:
   1. Cure acrylic finish coat per manufacturer’s instructions.

D. Application of Omega Penetrating Sealer: Spray apply or roll two separate coats.
   1. Allow for each coat to dry to touch before proceeding.

3.07 CUTTING AND PATCHING

A. Cut, patch, point-up and repair plaster as necessary to accommodate other work and to restore cracks, dents and imperfections.
   1. Repair or replace work to eliminate blisters, buckles, excessive crazing and check cracking, dry-outs, efflorescence, sweat-outs and similar defects, and where bond to substrate has failed.

B. Sand smooth troweled finishes lightly to remove trowel marks and arises.

3.08 CLEANING AND PROTECTION

A. Remove temporary protection and enclosure of other work.
   1. Promptly remove plaster from door frames, windows, and other surfaces which are not to be plastered.
   2. Repair surfaces which have been stained, marred or otherwise damaged during plastering work.
   3. When plastering work is complete, remove unused materials, containers and equipment and clean floors of plaster debris.

END OF SECTION 09 2400
SECTION 09 2900
GYPSUM BOARD

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Furnishing materials, labor, and equipment necessary for completion of gypsum board as indicated.
   2. Gypsum board systems and accessory components as indicated.
   3. Shear / sheathing panels.

B. Related Sections:
   1. Section 08 3100: Access Doors and Panels
   2. Section 09 2216: Non-Structural Metal Framing

1.02 REFERENCES


B. ASTM International (ASTM):

B. National Fire protection Association (NFPA):
   1. NFPA or UL requirements for fire-rated assemblies per ASTM E119.

C. UL, LLC (ULI):
   1. Requirements and listings for fire-rated materials and products classification.

D. Gypsum Association (GA):
   1. GA 214 – Recommended Levels of Gypsum Board Finish.
E. American Iron and Steel Institute (AISI):
1. AIS - North American Specifications for the Design of Cold-Formed Steel Structural Members.

F. International Code Council (ICC):

1.03 QUALITY ASSURANCE

A. Qualifications:
1. Installer: Minimum 5 years experience in installing and finishing gypsum board.

B. Finishes: Gypsum wallboard finish shall conform to requirements of GA 214, and as specified herein.
1. Levels used on the project are described as follows:

<table>
<thead>
<tr>
<th>Level</th>
<th>Joints</th>
<th>Interior Angles</th>
<th>Accessories</th>
<th>Fasteners</th>
<th>Surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tape set in compound</td>
<td>Tape set in joint compound</td>
<td></td>
<td></td>
<td>Tool marks and ridges acceptable</td>
</tr>
<tr>
<td>2</td>
<td>Tape set in joint compound and one separate coat of joint compound</td>
<td>Tape embedded in joint compound and wiped to leave a thin coat of compound over tape, and one separate coat</td>
<td>Covered by one separate coat of joint compound</td>
<td>Covered by one separate coat of joint compound</td>
<td>Free from excess joint compound. Tool marks and ridges acceptable.</td>
</tr>
<tr>
<td>3</td>
<td>After taping, cover with two separate coats of joint compound</td>
<td>After taping, cover with one separate coat of joint compound</td>
<td>Covered by 3 separate coats of joint compound</td>
<td>Covered by 3 separate coats of joint compound</td>
<td>Smooth and free of tool marks and ridges *</td>
</tr>
<tr>
<td>4</td>
<td>After taping, cover with 2 separate coats of joint compound</td>
<td>After taping, cover with one separate coat of joint compound</td>
<td>Covered by 3 separate coats of joint compound</td>
<td>Covered by 3 separate coats of joint compound</td>
<td>Smooth and free of tool marks and ridges *</td>
</tr>
<tr>
<td>5</td>
<td>After taping, cover with 2 separate coats of joint compound</td>
<td>After taping, cover with one separate coat of joint compound</td>
<td>Covered by 3 separate coats of joint compound</td>
<td>Covered by 3 separate coats of joint compound</td>
<td>Skim coat of joint compound applied to entire surface. Surface free from tool marks and ridges. **</td>
</tr>
</tbody>
</table>
*At completion of specified taping and finishing, apply one coat of high solids primer as specified hereafter.
**Or use Sheetrock Brand Primer Surfacer “Tuff-Hide” in lieu of skim coat and primer.

C. Shear Panel and Sheathing Annually Inspected/Approved Manufacturing:

1.04 SUBMITTALS

A. Product Data: Manufacturer's catalog data for each product proposed for use.

B. Shop Drawings: Indicating complete suspension system including connections, anchorage and trim features.
   1. Shear wall layout, framing and supports, with dimensions and sections.
   2. Shear wall/Diaphragm load tables using specified panels, fastener size/type and spacing will be attached to designed shear walls that define size of required collector posts for shear, along with required wall framing hardware, size or gage and on center stud spacing for Vertical/Diaphragm and Concentrated loads as well as lateral load resistance that have been engineered.
   3. Details of proprietary or non-proprietary components when included.

C. Material Samples: Minimum 18 inch x 18 inch samples of texture coat of gypsum board panels with edges taped.

1.05 SYSTEM DESCRIPTION

A. Design Requirements: Provide systems capable of deflection as required by 2013 CBC and authorities having jurisdiction.

B. Shear Panel/Sheathing System: As indicated, including basic layout, gypsum, non-combustible sheathing materials to be laminated to steel sheet, fastener type, spacing for attachment of shear panel/sheathing system.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original, factory sealed packages, containers or bundles bearing brand name and name of manufacturer.

B. Materials shall be kept dry. Gypsum board shall be neatly stacked flat; avoid sagging and damage to edges, ends and surfaces.

C. Use means necessary to protect gypsum board systems before, during and after installation.

D. Shear Panel/Sheathing System Materials:
   1. Panels shall be packaged and handled to prevent damage during shipping and unloading.
   2. Cover panels with waterproof material and ventilate to avoid condensation before installation.
   3. Store panels off ground with one end elevated for moisture drainage.
   4. Do not bend sheet steel or break/mar gypsum board sheet while handling.
a. Should damage to panel occur, repair of panel may be approved by manufacturer.

1.07 REGULATORY REQUIREMENTS

A. Comply with 2013 CBC requirements for design and installation.
   1. CBC, Chapter 25.

B. Fire-Resistance Ratings: Comply with fire-resistance ratings as shown and as required by governing authorities and codes.
   1. Provide materials, accessories and application procedures which have been listed by UL or tested according to ASTM E 119 for type of construction shown.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.
   1. Georgia Pacific G-P Gypsum:

B. Shear Panel/Sheathing System:
   1. Sure-Board® Series 200 Structural Panels as manufactured by Intermat, Inc., or approved equal.

2.02 MATERIALS – GYPSUM BOARD

A. Gypsum Board:
   1. Glass-Mat Faced Gypsum Board:
      b. Width: 4 feet.
      c. Length: 8 feet.
      d. Weight: 2570 pounds per M square feet.
      e. Edges: Tapered.
      f. Surfacing: Coated glass mat on face, back and long edges.
      g. Flexural Strength, Parallel (ASTM C473, ASTM C1396): Not less than 100 lbf.
      i. R-Value (ASTM C518): Not less than 0.67.
      o. Surface Burning Characteristics: Flame spread/smoke developed, 10/5.
   2. Tape: 2 inch, glass mesh tape.
B. Fastenings:
1. ASTM C 1002 self-drilling, self-tapping bugle-head drywall screws:
   a. Type W 1-1/4 inch long for wood framing (for single-layer panels).
   b. Screws shall be given corrosion-resistant treatment.

C. Wire: Galvanized and annealed carbon steel wire:
1. Tie Wire: No. 16 SWG.
2. Hanger Wire: No. 8 SWG, annealed and galvanized.

D. Metal Trim: ASTM C 1047, Paper-Face metal trim and cornerbead fabricated from minimum 26 gage galvanized steel,
1. Trim units shall be of size and type to fit gypsum board construction and shall include corner beads, casings, edge trim and other shapes indicated and required.
   a. USG, Beadex, or National Gypsum Company.
   c. Crimp-on type trim is not allowed.

E. Finishing Materials:
1. High solids primer to be SHEETROCK Brand First Coat manufactured by USG or High-build primer by Sherwin Williams.
2. Texture coat finish material shall be manufactured by the U.S. Gypsum, Hamilton, or Highland Stucco and Lime Products, Inc.

F. Tile Backer Board:
1. Cementitious Backer Units: Water-resistant, non-combustible cementitious panels reinforced with fiberglass scrim, complying with ANSI A118.9:
   b. Fasten to wood with 1-1/2 inch galvanized roofing nails or 1-5/8 inch Durock No. 8 wood screws.
   c. Tape joints with Durock glassfiber tape and ANSI A136.1 Type I organic adhesive, or approved equal.
2. Screws for board attachment: ASTM C 1002.

G. Substrate Boards: ASTM C 1177, glass-mat, water-resistant gypsum substrate, Type X, 5/8 inch, factory primed.
1. Subject to compliance with requirements, provide Georgia-Pacific Gypsum LLC; DensDeck.
2. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening substrate board to roof deck.

2.03 MATERIALS – SHEAR PANEL/SHEATHING SYSTEM

A. Galvanized Steel:
1. No. 22 gage (0.027 inch) base-metal thickness minimum per ASTM A 653 CS Grade 33/hot dipped galvanized G40 minimum per ASTM A 924.

B. Wallboard/Fiber Cement Sheathing Compliance:
1. Wallboard complies with ASTM C 1325, C 1369, C 1177, C 1278, C 1288 and C 1186 including MgO Sheathing.
C. Fasteners:
   1. Fasteners used to fasten Sure-Board Series 200 Structural Panels to steel framing are self-drilling/self-tapping pilot point bugle head screws, No. 8 minimum diameter 0.138-inch, with minimum 0.3145-inch head diameter, 1.5-inch long, and 3/8-inch minimum drill tip, complying with SAE J78 and ASTM C 954 and ER 5280 by John Grabber & Associates or approved equal.

D. Adhesives:
   1. Non-structural adhesive used to attach steel to gypsum wallboard or other non-structural sheathing shall be water soluble, non-combustible type adhesive.

E. Finished Sure-Board® Sheet Steel Panels:
   1. Sheet steel is No. 22 gage /0.027 inch minimum base-metal thickness, complying with ASTM A 653 CS, Grade 33, and provided with G40 minimum hot-dipped galvanized coating conforming to ASTM A 924.

2.04 PERFORMANCE

A. Shear Wall Shear Capacity:
   1. Gage for framing and attachment of Sure-Board® Shear panel shall be designed by Structural Engineer to provide panel shear capacity in accordance with ICC-ES evaluation Report ER 5762.
   2. No other similar materials, stated load capacities, or methods of attachment to framing studs/track/plates other than those stated on approvals for Sure-Board products will be acceptable as equal.

B. Fire Rated Use:
   1. Sure-Board Series 200 panels have been fire tested/reported by ITS Intertek Testing Laboratories and Fire-Stance certified to be used on 1 and 2 hour fire rated, load bearing and non-load bearing assemblies for interior and exterior use.

PART 3 – EXECUTION

3.01 INSTALLATION – GYPSUM BOARD

A. Metal Framing: Refer to Section 09 2216.

B. Metal Trim:
   1. Provide following:
      a. Corner beads at outside corners and angles
      b. Metal casing where gypsum board terminates at uncased openings
      c. Metal edge trim where board edges abut horizontal and vertical surfaces of other construction.
   2. Install trim in accordance with manufacturer’s directions and secure to framing with joint compound.
      a. Apply trim in longest practical pieces.

C. Gypsum Board:
   1. Install gypsum board in conformance with ASTM C840 and the manufacturer’s recommendations.
   2. Gypsum board shall be cut by scoring and breaking or by sawing, working from face side.
a. Where board meets projecting surfaces it shall be scribed and neatly cut.
b. Unless conditions require otherwise, board shall be applied first to ceilings, then to walls.
c. End joints shall occur over support.
d. Use panels of maximum practical length so that minimum number of end joints occur.

3. End joints shall be staggered and joints on opposite sides of partition shall be arranged to occur on different studs.
a. Joint layout at openings shall be made so that no end joints will align with edges of openings.

4. Except where specified otherwise, fasteners shall be spaced not less than 3/8 inch from edges and ends of gypsum board.
a. Do not stagger fasteners at adjoining edges and ends.

5. Install gypsum board vertically or horizontally.
a. Attach board with drywall screws spaced not to exceed 8 inches on center around perimeter of boards and 12 inches on center on intermediate studs.
b. Space screws at 8 inches on centers along top and bottom runners.
c. Screws shall be driven to provide screwhead penetration just below gypsum board surface without breaking surface layer.
d. Where electrical outlet and switch boxes are indicated, provide adjustable attachment brackets between studs.
e. Nails will not be acceptable.

6. Install gypsum board to ceiling framing with long dimension at right angles to wood framing members.
a. Attach with specified drywall screws spaced 6 inch to 7 inch on centers across board.
b. Screws shall be not less than 1/2 inch from side joints and 3/8 inch from butt end joints.
c. Abutting end joints shall occur over wood framing and end joints of boards shall be staggered.
d. Support cutouts or openings in ceilings with wood framing.

7. Install access doors, furnished under separate section, in correct location, plumb or level, flush with adjacent construction, and securely attached to framing.

3.02 TOLERANCES
A. Install gypsum board flat within 1/8 inch in 10 feet.

3.03 JOINT TREATMENT AND FINISHING
A. Conform to GA 214-M and following.
B. Apply tape bedding compound, tape, and finishing cement on joints in gypsum board as required for specified levels of finish.
C. Levels 2 through 5:
  1. Apply joint cement and finishing cement over screw heads.
     a. Treat inside corners with joint cement, tape, and finishing cement.
     b. Treat outside corners with corner beads and finishing cement.
  2. Provide metal casing beads at edges of gypsum board which abut ceiling, wall, or column finish, and elsewhere as required.
a. Make exposed joints, trims and attachments non-apparent following application of paint or other finishes.
b. Where joints and fasteners are apparent, correct defects as directed.
3. Seal raw edges of plumbing openings and boards that have been cut to fit with brushed on sealing compound.
4. When entire installation is completed and prior to installation of finish materials by other trades, correct and repair broken, dented, scratched or damaged gypsum board.

D. Levels 3 and 4: Apply one coat of high solids primer over entire surface.

E. Level 5: Apply one coat of skim coat over entire surface, followed by one coat of high solids primer over entire surface.
   1. Contractor’s Option: Use Sheetrock Brand Primer Surfacer, Tuff-Hide in lieu of skim coat and high solids primer.

3.04 REQUIRED LEVELS OF FINISH

A. Unless otherwise indicated or specified, levels of finish required shall be as follows:
   1. Level 1: Plenum areas above ceilings, insides of shafts, and other concealed areas.
   2. Level 2: Substrate for tile.
   3. Level 3: Backing for adhered acoustic tile and where textured finish is indicated.
   4. Level 4: Exposed, painted wallboard in classrooms, utility rooms, and areas receiving vinyl wall covering.
   5. Level 5: Exposed, painted wallboard in restrooms and corridors where semi gloss enamel is used.

3.05 TEXTURE COAT

A. Spray apply texture coat to interior gypsum board surfaces which are scheduled to receive painted finish, except in food preparation areas.

B. Texture coat shall create uniform splatter pattern finish with 80 percent minimum coverage of surface.

C. Interior surfaces of electrical boxes and wiring therein shall be protected from spray.

3.06 INSTALLATION – SHEAR PANEL/SHEATHING SYSTEM

A. Condition of Material Pre-Installation:
   1. Install shear panel/sheathing system when conditions and material are dry.
   2. When panels are not covered or stored in dry location, and get wet due to inclement weather conditions, allow them to air dry before installing.
   3. Follow appropriate manufacturers recommendations for storage, handling, and installation of panels.
   4. Steel sheet is always attached against framing studs to accomplish resistance capacities stated in manufacturers tables for lateral force resistance.

B. Fasteners and Application for Installing Shear Panel/Sheathing System:
   1. Installing panels only requires use of standard electric gypsum screw guns.
3.07 CLEAN-UP

A. Upon completion, repair damage caused by Work and remove debris, surplus materials and tools of Work from Project Site.

B. Leave installation clean and ready for finishing.

3.08 REPAIR OF DAMAGED GYPSUM BOARD

A. Reset protruding or loose fasteners.

B. For each screws in fractured area or protruding screws, replace with specified screw placed in undamaged area near the loose screw.

C. Remove loose gypsum, paper, and joint compound.

D. Refinish to match existing texture.

E. Paint entire wall plane, color to match existing.

3.09 REPAIRS ON FIELD DAMAGED SHEAR PANEL/SHEATHING

A. Comply with panel manufacturer’s recommended repair procedures.

END OF SECTION 09 2900
“L” TOWER BUILDING
SEISMIC AND CODE UPDATES
RIO HONDO COLLEGE

GYPSUM BOARD
09 2900 - 10
SECTION 09 3000

TILE

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Ceramic tile.
   2. Crack isolation and waterproofing membranes for tile.
   4. Thin set beds for floor and wall tile.

B. Related Sections:
   1. Section 03 3000: Cast-In-Place Concrete.
   2. Section 07 9200: Joint Sealants
   4. Section 09 2900: Gypsum Board
   5. Section 09 6500: Resilient Flooring
   6. Section 09 6800: Carpet

1.02 SUBMITTALS

A. Product Data: Manufacturer's data, standard specifications, and other technical information for each product specified.

B. Material Samples: Manufacturer's standard palette, indicating full range of tile colors, textures, and grout colors.

C. Mock-Ups: For each type, color, and texture, minimum 12 inch x 12 inch or three full tile courses, on plywood or hardboard to demonstrate proper bond mortar and coverage; grout color, hardness and depth.

D. Installation Instructions: Manufacturer's preparation and installation instructions.

E. Certificates:
   1. Manufacturer's certification that grout materials being provided are suitable for intended use, meet or exceed referenced standards.
   2. DCOF AcuTest friction test reports for floor tile.


1.03 QUALITY ASSURANCE

A. Comply with applicable parts of the following codes or standards as minimum requirement:
   3. ANSI A137.1, Standard Specifications for Ceramic Tile.
4. ASTM A 185 - Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
5. ASTM C 144 - Aggregate for Masonry Mortar.
7. ASTM C-144 – Sand.
10. ASTM C 645 - Nonstructural Steel Framing Members.
11. ASTM C 1028 - Determining the Static Coefficient of Friction of Ceramic Tile and other like surfaces by the Horizontal Dynamometer Pull-Meter Method.

B. Laboratory Testing: Tile shall be tested for compliance with ASTM C 1028 by a testing laboratory approved by DSA.

C. Source of Materials: Provide materials obtained from one source for each type and color of tile, grout, and setting materials.

D. Comply with all requirements of 2013 California Building Code and ADA.
   1. Ceramic tile flooring demonstrating a coefficient of friction of at least 0.6 per ASTM C1028 will be accepted as meeting the intent of slip resistance. CBC 1124B.1/ADA Standards 4.5.1.

E. Qualifications of Tile Manufacturer: Company specializing in ceramic tile, mosaics, pavers, trim units, and thresholds with five years minimum experience. Obtain tile from a single source with resources to provide products of consistent quality in appearance and physical properties.

F. Qualification of Installation System Manufacturer: Company specializing in installation systems/ mortars, grouts/ adhesives with ten years minimum experience. Obtain products from single source manufacturer to insure consistent quality and compatibility.

G. Qualifications of Installer: Company specializing in installation of ceramic tile, mosaics, pavers, trim units and thresholds with five years experience with installations of similar scope, materials, and design.

H. Pre-Installation Meetings:
   1. Prior to start of Work and after approval of submittals, schedule on-site meeting with Contractor, Owner, Architect, Project Inspector, and representatives of material manufacturer and tile installer:
      a. Review construction conditions and Drawings for conformance with requirements of this specification for each substrate.
   2. Prior to setting tile and after surfaces to receive tile are installed, schedule an on-site meeting with Contractor, Owner, Architect, Project Inspector, and representatives of material manufacturer and tile installer:
      a. Review tile, tile installation materials, and finishing equipment for conformance with requirements of this specification.
1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver tile in sealed containers, with manufacturer's labels intact.
B. Deliver other products in manufacturer's unopened containers.
C. Keep materials clean and dry.

1.05 MAINTENANCE

A. Extra Materials: Provide minimum of 5 percent of each type and color of tile and accessory shapes, from same run or lot as installed tile, in manufacturers' cartons and labeled.

1.06 WARRANTY

A. Manufacturer shall provide 5-year material warranty.
B. Installer shall provide 5-year labor warranty.
C. For crack isolation membrane, manufacturer shall provide a 10-year material warranty for crack isolation membrane installation, tile setting, and grouting materials.

PART 2 - PRODUCTS

2.01 GENERAL

A. Tile: To establish quality, Specification is based on ANSI A137.1 Standard Grade by Dal-Tile Corporation.
   1. Equivalent tile products from the following manufacturers may be provided:
      a. Dal-Tile Corporation
      b. American Olean Company
      c. Monarch Tile Manufacturing, Inc.
   2. Furnish tile complying with "Standard Grade" requirements unless otherwise indicated.
   3. Comply with ANSI standard referenced with products and materials indicated for setting and grouting
   4. Dynamic Coefficient of Friction (DCOF): Provide floor tiles with coefficient of friction equal to or greater than 0.42 when tested in accordance with provisions of ANSI A137.1, Section 9.6 – DCOF AcuTest.
   5. Condition of Surfaces to Receive Tile:
      1. Verify that surfaces to receive mortar setting bed and tile are firm, dry, clean, and free from oily or waxy films and curing compounds.

2.02 TILE

A. Unglazed Ceramic Mosaic Floor Tile:
   1. Size: 2 inch x 2 inch or as indicated.
2. Colors and patterns as selected by Architect from price groups specified.
3. Slip Resistance: Resistant to slipping appropriate to the installed conditions of use, as required by the 2013 California Building Code.
   a. Ceramic tile flooring demonstrating a coefficient of friction of at least 0.6 per ASTM C1028 will be accepted as meeting the intent of slip resistance. CBC 1124B.1/ADA Standards 4.5.1.
   b. For tile in shower and locker areas, incorporate grit into tile to increase slip resistance.

B. Glazed Wall Tile:
   1. Size: 4-1/4 inch x 4-1/4 inch face dimensions x 5/16 inches thick (ceramic mosaic tile may also be used on walls).
   2. Colors and patterns as selected by Architect from price groups specified.

C. Trim:
   1. Integral bullnose at external corners.
   2. Provide bullnose where tile projects from jamb.

2.03 STONE THRESHOLDS (ST-1)

A. Granite Collection by Daltile Natural Stone Collection
   1. Granite Slab: Sizes as indicated.
      a. Thickness: 3/4 inch
      b. Edge Treatment: Beveled on both long edges
   2. Color: As scheduled.

2.04 INSTALLATION MATERIALS

A. Mortar Sand: ASTM C 144.

B. Portland Cement: ASTM C 150, Type I or II.

C. Hydrated Lime: ASTM C 207, Type S; or ASTM C 206.

D. Portland Cement Mortar: ANSI 108.1B

E. Waterproof Membrane:
   1. Cold-applied laminated CPE composite waterproofing membrane for thin-set tile setting application of latex-modified mortar and grout.
   2. Install waterproof membrane over concrete slab in accordance with TCNA Method F122 at upper floor rooms scheduled to have tile.
      a. Liquid products will not be permitted.
      a. Zero VOC

F. Cleavage Membrane:
   1. Sheet membrane product specifically manufactured for use in thin-set tile installations at slab-on-grade conditions as a crack isolation sheet to prevent cracks in concrete slab from telegraphing through to tile.
   2. Install cleavage membrane over cured mortar bed in accordance with TCNA Method F122 at Ground Level (slab-on-grade) rooms scheduled to have tile.
      a. Liquid products will not be permitted.
3. NobleSeal® TS or CIS Membrane by Noble Company, or approved equal.
   a. Zero VOC

G. Latex Portland Cement Mortar: Sand-cement mortar mix gauged with Laticrete 38
   Acrylic Admix or Custom Building Products Acrylic Mortar Admix.

H. Latex Portland Cement Mortar for Shower Areas: Laticrete 226 Thick Bed Mortar Mix
   Gauged with Laticrete 3701 Mortar and Grout Admix.

I. Latex Portland Cement Bond Mortar: Laticrete 317 Floor & Wall Thinset gauged with
   Laticrete 3701 Admix, or Custom Building Products Master Blend mixed with Acrylic
   Mortar Admix.

J. Latex Portland Cement Bond Mortar over Waterproof Membrane: Laticrete 317 Floor
   & Wall Thinset gauged with Laticrete 3701 Admix.

K. Latex Portland Cement Grout: Laticrete Sanded Grout (1500 Series) or Unsanded
   Grout (1600 Series, for joints smaller than 1/8").

L. Epoxy Grout for Floors: Laticrete SP-100 Stainless Epoxy Grout for Floors and Walls
   (Series 700).

M. Separation Material (for all caulked joints including perimeters and quarry-tile fields of
   floor mortar beds): Quality Foam, QF 200 white, 3/8" wide x 5" high.

N. Backer Rod for sealants (for ceramic mosaic fields): Polyethylene foam, closed-cell,
   flexible and compressible, 3/16" diameter.

O. Cleaner and Sealer:
   1. Cleaner and sealer shall be from one manufacturer, acceptable to tile and grout
      manufacturers.
      a. To establish quality, the Specification is based on Aqua Mix Inc. Equivalent
         products from Miracle Sealants Co. or Watco Tile and Brick may be provided.
   2. Cleaner: Aqua Mix Concentrated Tile Cleaner, neutral phosphate-free cleaner, or
      Custom Building Products Tile Lab Concentrated Tile/ Stone Cleaner.
   3. Sealer: Aqua Mix Penetrating Sealer, fungus and bacteria resistant, stain and
      slip-resistant as specified for tile, or Custom Building Products Tile Lab Surface
      Gard.

P. Sealant:
   1. Sealant and primer shall be from one manufacturer, acceptable to tile and grout
      manufacturers.
      a. Refer to Section 07 9200.

PART 3 - EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Examine substrates, areas, and conditions where tile will be installed for compliance
   with requirements for installation tolerances and other conditions affecting
   performance of installed tile.
1. Verify that vents, drains, piping, and other projections through substrate have been installed.
2. Proceed with Work only after conditions are in compliance.

B. Verify that substrates for setting tile are firm; dry, clean and within flatness tolerances required by relevant ANSI A108 tile installation standards.
   1. Prepare surfaces as follows:
      a. Concrete Floors: Allow concrete floors to cure for 28 days minimum before beginning tile and grout installation.
         1) Remove laitance, sand, dust, and loose particles with air blast.
         2) Where coatings remain, including curing compounds and other substances that contain soap, wax, oil, or silicone and are incompatible with tile-setting materials, remove them by using terrazzo or concrete grinder, drum sander, polishing machine equipped with heavy-duty wire brush, or shot-blast system.
      b. Cleavage Membrane:
         1) No. 15 asphalt saturated felt, ASTM D226, Type 1.
         2) Polyethylene film, ASTM D4397, 4.0 mil thickness.

C. Substrates to receive wall tile and base shall be:
   1. Scratch coat of cement plaster, as specified in Section 09 2400.
   2. Cementitious backing panels, as specified in Section 09 2900.

D. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical items of Work, and similar items located in or behind tile have been completed before installing tile.

E. Verify that joints and cracks in tile substrates are coordinated with tile caulked joint locations
   1. Where not coordinated, adjust as required by Architect.

F. Do not install tile until construction in spaces is completed and ambient temperature and humidity conditions are being maintained to comply with referenced standards and manufacturer's written instructions.

G. Protect adjacent surfaces during progress of the Work of this section.

3.02 TILE INSTALLATION, GENERAL

A. Install tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are the same size. Lay out 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.

B. For tile mounted in sheets, install joints between tile sheets the same width as joints within tile sheets so joints between sheets are not apparent in finished Work.

C. Extend Work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions, unless otherwise indicated. Terminate Work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
D. 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 plates, collars, or covers overlap tile.

E. Locate expansion, control, contraction or isolation joints and other sealant-filled joints, directly above joints in concrete substrates, at horizontal and vertical changes in plane, or where indicated during installation of mortar beds. In quarry tile floors, provide at 12 feet on center maximum. Use foam to provide 3/8-inch width. Do not saw-cut joints after installing tiles.

F. Prepare and clean joints to receive sealant, and apply sealants to comply with requirements of Section 07 9200.

G. Conform to manufacturers printed instructions, and applicable requirements of ANSI and TCNA Standards.

3.03 TILE INSTALLATION – FLOOR

A. Install reinforcing and latex Portland-cement mortar setting bed over cured concrete slab or cleavage membrane on concrete floor.
   1. Lap reinforcing at least one full mesh, and support or lift so that it is approximately in the middle of mortar bed. Do not abut against vertical surfaces. Install foam separation material at perimeters and expansion joint locations for caulked joints.

B. Mix setting mortar in accordance with ANSI A.108.1a.2.2.

C. Once begun, mortar installation must continue until room is completely filled. Discard batch not floated and finished within 1/2 hour of mixing. Firmly compact before screeding. Screed to true plane and pitch as indicated. Slope mortar bed sufficiently that water flows to drain and no puddling will occur. Slope mortar down to floor drains for proper installation of waterproof membrane. After screeding, firmly rub down with steel or wood float.

D. Cure mortar bed with light fog spray of water and cover with 6 mil polyethylene for 72 hours.

E. Install tile over properly cured setting bed or waterproof membrane utilizing "thin-set" method with latex Portland cement bond mortar, in accordance with manufacturer's printed instructions and ANSI A108.5. Confirm substrate is completely clean and free of dust. Cut foam at floor perimeters flush with top of mortar bed. Insure that bond coats do not intrude into joints to be caulked.

F. Minimum coverage of bond mortar shall be 80% except 95% in shower areas, for quarry tile, and exterior installations. Place tile into fresh mortar and move and press or beat in tile to insure full contact. Before setting proceeds, set and remove three tiles or sheets of tiles to confirm specified coverage of bond mortar. If coverage is insufficient, utilize a larger toothed trowel or back butter tiles until proper coverage is provided.

G. Install tile on floors with the following joint widths:
   1. Ceramic Mosaic Tile: 1/16 to 1/8 inch.
3.04 TILE INSTALLATION, WALLS

A. Install wall mortar beds before floor mortar beds.

B. On plaster walls, clean scratch coat surface of loose or foreign materials, fog spray with water, and install brown coat mortar bed over scratch coat to a thickness not less than 3/8” and not greater than 3/4 inch. Once started, wall mortar installation must continue until wall is completely floated. Discard any batch not floated and finished within 1/2 hour of mixing. As soon as wall mortar is dried to sufficient hardness but still in a plastic condition, firmly rub down with wood float and scribe all plane interfaces the full depth.

C. Cover cure with 40 weight Kraft paper for 72 hours minimum.

D. Install tile over properly cured setting bed, utilizing "thin-set" method with latex Portland cement bond mortar, in accordance with manufacturer's printed instructions and ANSI A108.5. Confirm substrate is completely clean and free of dust. Insure that bond coats do not intrude into joints to receive sealant.

E. Minimum coverage of bond mortar shall be 80 percent except 95 percent in shower areas or exterior installations. Set and test as specified for floors.

F. Lay out the Work so tiles will be centered on each wall or section of wall in order to minimize tile cuts. Lay out tile wainscots to next full tile beyond dimensions indicated. Spot setting bed with mortared tile, set plumb and true, to accurately indicate plane of finished tile surfaces.

G. Install tile on walls with following joint widths:

H. Horizontal joints shall be level, vertical joints plumb with surfaces true and plumb, edges of tiles flushed.

I. Rub exposed cuts smooth with fine stone; no cut edge shall be set against fixture or adjoining surface without 1/16 inch sealant joint.

J. Install access doors where required, furnished under another section, in correct location, plumb or level, flush with adjacent construction, and securely fastened to framing.

3.05 GROUTING

A. Prior to starting, ensure that all wall and floor tile surfaces are clean and any excessive bond mortar is scraped and vacuumed from joints (approximately 2/3 depth of tile should be open for grouting). Follow manufacturer’s instructions for mixing grout. Once grout Work commences, proceed until complete wall or floor area is finished utilizing one batch of grout.

B. Latex Portland cement grouting: Dampen tile surface and joints with water using sponge, but leaving no puddles in joints.
   1. Force grout into joints using sufficient pressure on rubber float so as to fill joints completely, and scrape excess grout off tile surface with rubber float. Smooth or tool grout to uniform joint finish. Do not over water.
C. Curing latex Portland cement grout: Remove final grout haze with clean soft cloth, and cover with 40-weight Kraft paper to cure. Leave paper in place for protection. Cover wall surfaces with 40-weight Kraft paper for 72 hours.

3.06 CLEANING AND SEALING

A. Where grout scum is not visible on tile surface after curing, clean tile surface with clear water. Remove and replace cracked, broken or defective Work with proper material.

B. When curing membrane is removed and grout scum is visible on tile surface, follow this cleaning method:
   1. Immediately recover floor with paper or felt and allow to continue curing for minimum of 14 days. Uncover floor and maintain entire tile surface saturated with clean cool water for not less than 2 hours.
   2. Utilize neutral cleaner acceptable to manufacturers of tile and grout, and follow manufacturer’s instruction. Do not provide generic acid cleaners.
   3. Wet tile floors and apply cleaning solution to floor surface, then scrub with brush. Rinse area several times with clean water to flush solution off floor surface.

C. Apply penetrating sealer in accordance with manufacturer’s instructions utilizing dense sponge applicator, paint pad, sprayer or brush. Avoid overlapping, puddling, and rundown. Completely wipe surface dry within 3 to 5 minutes using cotton or paper towels. Do not allow sealer to dry on tile. After 2 hours, test surface by applying water droplets to surface. If water is absorbed, apply second coat. Avoid surface traffic for 24 hours.

3.07 SEALANT

A. Insure joints to receive sealant are free and clear of setting and grouting materials and construction debris. Do not permit foot traffic on installed sealant for minimum of 48 hours or protect with hardboard strips.

B. Install in accordance with requirements of Section 07 9200.

3.08 PROTECTION

A. Do not allow traffic where tile is installed until mortar and grout has set for minimum of 72 hours.

B. Protect Work until Substantial Completion.

3.09 CLEAN UP

A. Remove and legally dispose of rubbish, debris, and waste material off Project Site.

END OF SECTION 09 3000
SECTION 09 5100
ACOUSTICAL CEILINGS

PART 1 – GENERAL

1.01 DESCRIPTION

A. Work Included:
   1. Lay-in acoustical ceiling systems.

B. Related Work:
   1. Section 06 1000: Rough Carpentry.
   2. Section 09 2900: Gypsum Board.
   3. Division 23 Sections for HVAC.
   4. Division 26 Sections for Electrical.

1.02 QUALITY ASSURANCE

A. Qualifications of Installer: Minimum 5 years experience in installing acoustical ceiling systems of the types specified.

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

C. Requirements of Regulatory Agencies:
   1. Conform to 2013 CBC requirements and UL - Tunnel Test for Fire Hazard Classification of Building Materials.
   2. CISCA Code of Practices.
   3. Acoustical Materials:

1.03 SUBMITTALS

A. Samples:
   1. Lay-in panels, 6 inch x 6-inch minimum size.
   2. Lay-in Systems: Sample of assembly system to indicate all typical members, connections, splices, wall angle, and colors.

B. Shop Drawings:
   1. Indicate complete plan layouts and installation details.
   2. Indicate related Work of other sections that is installed in, attached to, or penetrates ceiling areas, such as air distribution and electrical devices.
C. Product Data:
   1. Suspension System for Lay-in Ceiling: Printed data for all suspension system components, including load tests.

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

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project site in original sealed packages.

B. Storage: Store materials in building area where they will be installed, in original package. Keep clean and free from damage due to water or deteriorating elements.

C. Handle in manner to prevent damage during storage and installation.

1.05 PROJECT CONDITIONS

A. Environmental Requirements: Maintain temperature in space at 55 degrees F or above for 24 hours before, during and after installation of materials.

B. Scheduling:
   1. Before concealing Work of other sections, verify required tests and inspections have been completed.
   2. Coordinate with related Work of other sections. Coordinate location and symmetrical placement of air distribution devices, electrical devices, and penetrations with related Work section.

1.06 WARRANTY

A. Provide 10-year material warranty.

B. Provide 2-year labor warranty.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Armstrong World Industries.

B. USG Corporation.

C. Approved equal.

2.02 MATERIALS

A. Ceiling systems shall consist of lay-in acoustical ceiling panels and suspension systems manufactured by same company.
B. 24” x 48” Module Ceiling System:
   1. Acoustical Ceiling Panels:
      a. Panel Name: Armstrong Item #1729, Humigard Plus Fine Fissured mineral fiber ceiling board.
      b. Panel Size: 24 by 48 inches
      c. Panel Thickness: 5/8 inch
      d. Edge Detail: Square.
      e. Light Reflectance: 0.85 minimum, complying with ASTM E 1477.
      f. CAC: Minimum 35, UL Classified, complying with ASTM E 1414.
      g. Class: UL Class A, in accordance with ASTM E 1264.
      h. NRC: Minimum 0.50, UL Classified, complying with ASTM C 423.
      i. Color: White.
      j. Recycled Content: Minimum 36 percent.
      k. Mold and Mildew Resistance: Panels and faces shall be treated with biocide paint additive to inhibit mold and mildew or anti-microbial solution.

C. Suspension System:
   1. Suspension System Name: Suprafine XL 9/16 inch by Armstrong.
   2. Fire Class: Class A.

D. Brace Attachment Clip: Manufacturers’ standards to fit system furnished for acoustical panels, as indicated.

E. Vertical Strut: USG Donn Compression Post, or equal, or as indicated; types and designs complying with requirements of authorities having jurisdiction and seismic requirements.

F. Hanger Wire: No. 12 gage (9 gage for pendant fixtures), galvanized carbon steel per ASTM A 641, soft tempered, prestretched.

PART 3 – EXECUTION

3.01 PREPARATION

A. Furnish layouts for inserts, clips or other supports and struts required to be installed by the Work of other trades that depend upon support by the suspended ceiling system.

B. Coordinate related Work to ensure completion prior to installation of clips or fasteners.

C. Lay-In Ceiling Systems: Compare layouts with construction conditions. Tile shall be spaced symmetrically about the centerlines of the room or space, and shall start with a tile or joint line as required to avoid narrow tiles at the finish edges unless indicated otherwise. Joints shall be tight with joint lines straight and aligned with the walls. Ceiling moldings shall be provided where tile abuts wall with matching caulking to eliminate any space.
3.02 INSTALLATION OF SUSPENSION SYSTEMS

A. General:

1. System shall be complete; with joints neatly and tightly joined and securely fastened; suspension members shall be installed in true, flat, level plane.
2. Hanger Wires: 12-gage minimum; larger sizes as indicated or required.
   a. Fasten wires to panel points and structure above per most stringent requirements of fabricator and 2013 CBC and as indicated on Drawings.
   b. Wires exceeding 1:6 out-of-plumb shall be braced with counter-sloping wires.
   c. Maintain wires 6 inches minimum clear of non-braced ducts, pipes, and other items.
   d. Install wire within 6 inches of ends of main runners and cross-tees at ceiling perimeters.
   e. Where obstructions prevent direct suspension, provide trapezes or equivalent devices; 1-1/2 inches minimum cold-rolled channels back to back may be installed for spans to 6 feet max.
   f. Wire to be straight, without extraneous kinks or bends and tolerate 200 pound pull without stretching or shifting suspension clip.
3. Bracing Wires to Resist Seismic Forces: 12 gage minimum, larger sizes as indicated or required.
   a. System for Bracing Ceilings: Lay-In Ceiling Systems: Install one four-wire set of sway-bracing wires and vertical strut for each 144 square feet maximum of ceiling area. Locate wire-sets and struts at 12 feet maximum on center. At ceiling perimeters, wire-sets shall be within 6 feet of walls.
   b. Install four-wire sets and struts within 2 inches of cross-runner intersection with main runner; space wires 90 degrees from each other.
   c. Do not install sway bracing wires at angle greater than 45 degrees with ceiling plane.
   d. Wires shall be tight, without causing ceiling to lift.
   e. Fasten struts in accordance with 2013 CBC requirements.
4. Provide additional wires, 12 gage minimum, necessary to properly support suspension at electrical devices, air distribution devices, vertical soffits, and other concentrated loads.
5. Suspension:
   a. Suspension members shall be fastened to 2 adjacent walls; but shall be 1/2 inch minimum clear of other walls.
   b. Suspension members not fastened to walls shall be interconnected to prevent spreading, near their free end, with horizontal metal strut or 7445 stabilizer bar or 16-gage taut tie wire.
   c. Provide additional tees or sub-tees to frame openings for lights, air distribution devices, electrical devices, and other items penetrating through ceiling, which do not have integral flange to support and conceal cut edges of acoustic panels. Provide cross-bracing necessary to securely support surface mounted fixtures or other items.
6. Attachment of Wires:
   a. To Metal Deck or Steel Framing Members: Install as required by current code.
   b. To Suspension Members: Insert through holes in members or supporting clips.
   c. All wires to be fastened with tight turns; three tight turns minimum for hanger wires; four tight turns minimum for bracing wires. All turns to be made in a 1-1/2 inches maximum distance.

B. Suspension System for 24” x 48”, Lay-in Acoustical Ceilings:
   1. Main Runners: Install main runners 48 inches apart; 12 gage hanger wires space 48 inches on center maximum along runners, and within 6 inches of ends.
   2. Install wall moldings.
   4. Sub-Tees: Install at edges of penetrations.

3.03 INSTALLATION OF ACOUSTICAL PANELS

A. Install panels into suspension system. Partial panels are to be neatly cut and fitted to suspension and around penetrations and/or obstructions. Duplicate edges at partial panels; cuts to be straight. Repaint cut tiles to match color or as directed by manufacturer for Mylar facing at visually exposed conditions or as required by the Architect.

3.04 AIR DISTRIBUTION DEVICES

A. Refer to and coordinate with Division 23.

B. Install air distribution grilles and other devices into suspension system. Install 4 taut wires, each 12-gage minimum, to each device within 3 inches of device corners, to support their weight independent of the suspension system.

3.05 LIGHT FIXTURES

A. Refer to and coordinate with Division 26: Electrical.

B. Fixtures weighing less than 56 Pounds: Install fixtures into suspension systems and fasten earthquake clips to suspension members. Install minimum 2 slack safety wires, each 12-gage minimum, to each fixture at diagonally opposite corners, to support their weight independent of the system.

C. Fixtures weighing more than 56 Pounds: Install fixtures into suspension system and fasten earthquake clips to suspension system members. Install not less than 4 taut 2 gage wires capable of supporting four times the fixture load.

3.06 CLEANING

A. General: After installation of acoustical material has been completed, clean all surfaces of the material, removing any dirt or discolorations.
B. Acoustical Panels: Minor abraded spots and cut edges shall be touched up with the same paint as was used for factory applied finish of the lay-in panels.

3.07 CLEAN UP

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

3.08 PROTECTION

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

END OF SECTION 09 5100
SECTION 09 6500
RESILIENT FLOORING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Vinyl composition tile flooring as indicated.

1.02 REFERENCES


B. ASTM International (ASTM):

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Minimum 5 years experience in successfully installing same or similar flooring materials.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer’s published technical data describing materials, construction and recommended installation directions. Submit technical data and installation instructions for each adhesive material. Submit list and Product Data of recommended finish materials.

B. Maintenance Instructions: Submit manufacturer’s recommendations for maintenance, care, and cleaning of vinyl composition tile.

C. Samples: Submit samples of vinyl composition tile in each available color and pattern. Following color selections, submit full size samples of each selected color and pattern. Submit pint cans of each type of adhesive.

D. Maintenance Materials: Before Substantial Completion, deliver one unopened container of each color and pattern of vinyl composition tile in each color and pattern installed. Label each container indicating locations installed. Include unopened cans of adhesives adequate to install the maintenance materials.

E. Installer’s Experience Qualifications: Submit list of not less than 5 projects, extending over period of not less than 5 years, indicating installer’s experience record. Submit letter from manufacturer indicating manufacturer’s approval for installer of the products.
1.05 DEFINITIONS

A. Pop-Up: Pop-Up is defined as surface deviation or looseness of substrate that is equal to or greater than 1/64 (0.015625) inch above concrete floor level, regardless of size.

1.06 PROJECT CONDITIONS

A. Ventilation and Temperature: Verify areas that are to receive new flooring are ventilated to remove fumes from installation materials, and areas are within temperature range recommended by various material manufacturers for Project Site installation conditions.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Materials shall be delivered to Project Site in original unopened manufacturer’s packaging clearly labeled with manufacturer’s name.

B. Materials shall be stored at not less than 70 degrees F for not less than 48 hours before installation.

1.08 REGULATORY REQUIREMENTS

A. Comply with following as minimum requirement:
   1. Materials shall be ADA compliant.
   2. Resilient flooring shall be stable, firm, and slip resistant per CBC Section 11B-302.1.
   3. ASTM E 84: Class A Flame Spread Rating of 25 or less.

1.09 WARRANTY

A. Manufacturer shall provide 2-year material warranty.

B. Installer shall provide 2-year labor warranty.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Resilient Flooring: Armstrong Commercial Flooring.

B. Approved equal.

2.02 MATERIALS

A. Resilient Flooring: Vinyl Composition Tile conforming to ASTM F 1066, Composition 1, asbestos free, Class 2 (through pattern), 12 inch by 12 inch by minimum 1/8 inch thick, colors and patterns as indicated.
   1. Armstrong 12 inches x 12 inches Standard Excelon, Imperial Texture.
      a. Colors: As selected by Architect.
      b. Accent Colors: Provide random pattern for Architect’s review and approval.
B. Crack Filler and Leveling Compound: Cementitious type, shall be Durabond's Webcrete # 95, Ardex SD-F, Armstrong S-194 or as recommended by flooring manufacturer.

C. Concrete Primer: Non-staining type recommended by manufacturer of vinyl composition tile.

D. Adhesive: Water based, low odor type formulated specially for installation with vinyl composition tile, and recommended by manufacturer

E. Reducer Strips: Tapered rubber not less than one inch wide, and thickness to match tile.

F. Moisture Detection Equipment: Calcium chloride testing system, consisting of pre-packaged anhydrous calcium chloride crystal test kits, and an electronic gram weight scale measurable in 1/10 grams. Equipment shall be manufactured by one of the following:
   1. Sealflex Industries, Inc.,
   2. Vaprecision Professional Emission Testing Systems,

G. Floor Finish: As recommended by vinyl composition tile manufacturer.

2.03 RESILIENT BASE

A. Rubber base: Conform to ASTM F 1861; Group 1, solid (homogeneous); Type TS, thermoset vulcanized rubber; 4-inch high unless otherwise indicated, integral colors as selected, non-shrinking, 1/8 inch thick, with matching molded corners and end stops.
   1. Acceptable Manufacturers:
      a.. Johnsonite
      b.. Burker Flooring
      c.. Roppe
   2. Thickness: 1/8-inch minimum.
   3. Height: As indicated.
   4. Length: Provide in rolls. Pre-cut 4-foot strips are not acceptable.
   5. Style: Standard top set cove base

B. Base Adhesive: Water based, low odor type formulated specially for use with rubber base, and manufactured or recommended by manufacturer of rubber base.

PART 3 – EXECUTION

3.01 COORDINATION

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

3.02 EXAMINATION

A. Field verify dimensions and other conditions affecting this Work before commencing Work.

B. Before Work is commenced, examine surfaces to receive vinyl composition tile and correct deficiencies.
3.03 PREPARATION OF CONCRETE SLABS

A. Do not start preparation until adjacent concrete floor slabs are at least 90 days old.

B. Leveling: Check sub-floors for true to level and plane within tolerance of 1/4 inch in 10 feet.
   1. Test floor areas both ways with a 10 foot straightedge and repair high and low areas exceeding allowable tolerance.
   2. Pop ups shall be hammered out and floor filled with cementitious leveling compound.
   3. Remove high areas by power sanding, stone rubbing or grinding, chipping off and filling with leveling compound, or equivalent method.
   4. Fill low areas with leveling compound.
   5. Repair and level surfaces having abrupt changes in plane, such as trowel marks or ridges, whether or not within allowable tolerance.

C. Cleaning: After leveling, clean areas and substrates where repairs were performed of deleterious substances and foreign matter.

D. Cracks or Depressions: Fill voids with cementitious leveling compound of type recommended by flooring manufacturer for specific Work conditions.

E. Moisture Testing: Test new and old concrete slabs for adequate dryness.
   1. Testing shall conform to ASTM F 1869, and following.
      a. Minimum testing requirements are 3 calcium chloride tests for the first 1,000 square feet of floor area, and one for each additional 1,000 square feet or fraction thereof.
      b. Unless more stringent requirements are recommended by flooring manufacturer, maximum allowable moisture release at time of flooring installation shall be 3 pounds per 24 hours per 1,000 square feet.
   2. Provide report of test as specified above.
   3. For each test, perform the following steps:
      a. Weigh the sealed dish of crystals immediately prior to exposure. Record starting weight, date, and time.
      b. Open kit and set crystal dish on clean concrete surface. Immediately install plastic dome over the dish. Confirm the dome is gasketed to the concrete and is airtight.
      c. Leave test to absorb moisture for 60 to 72 hours. Maintain room temperature above 55 degrees F for duration of test.
      d. After exposure, remove and discard housing. Replace dish lid and tape shut. Weigh the sample within one hour of removal from floor.
      e. Compute the vapor emission in pounds, indicate location of test and vapor emission on report.
      f. Delay application of flooring until sub-floors are sufficiently dry according to flooring manufacturer’s recommendations, or perform remedial measures as recommended by flooring materials manufacturer.

3.04 INSTALLATION OF TILE

A. Color and pattern: Install tiles in the pattern indicated on Drawings.
   1. Where no pattern is indicated, tiles shall be installed in rectangular pattern, in one color.
B. Special Designs/School Logo:
   1. Fabricate of sizes and colors indicated from electronic file provided by Architect.
   2. Precision cut VCT tiles using either computer aided water-jet or laser technologies to tolerance of 0.005 inch.

C. Install vinyl composition floor tile when ambient temperature is 70 degrees F or higher.

D. Install tile adhesive in thin film evenly with notched trowel.
   1. Trowel notches shall be as recommended by flooring manufacturer.
   2. Mix adhesive in accordance with manufacturer’s instructions.
      a. Provide safety precaution during mixing.
   3. Install adhesive only in the area that can be covered by flooring material within adhesive manufacture’s recommended working time.
   4. Remove adhesive that has dried or filmed over.
   5. Adhesive application rate shall be as required to avoid telegraphing trowel lines to surface after maintenance coatings are applied.
      a. Adjust tile runoff during installation if necessary.

E. Provide reducer where floor covering edges are exposed, such as at center of door or where floor coverings terminate.

F. Install vinyl composition tile in accordance with manufacturer’s recommendations.
   1. Tiles shall fit snugly at wall.
   2. Closely trim to pipes, jambs, outlets, and similar conditions.

G. Install tiles symmetrically about centerlines of areas progressing toward walls.
   1. Adjust border tiles as required.
   2. Tiles shall be straight and joints close.
   3. Tile shall be cut to fit snugly at doorframes, and walls.

H. Mechanically cut flooring material to produce square true edges.

I. As floor tile is installed, roll with clean, 150 pound roller in both directions.

3.05 CLEANING

A. Keep flooring surfaces clean as installation progresses.

B. Clean flooring when sufficiently seated and remove foreign substances.

C. Clean adjacent surfaces of adhesive or other materials.
   1. Replace damaged or defective Work to specified condition.

3.06 CLEAN UP

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

3.07 PROTECTION

A. Protect Work until Substantial Completion.

END OF SECTION 09 6500
SECTION 09 6800

CARPET

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Carpet
B. Carpet installation accessories

1.02 RELATED SECTIONS

A. Section 09 6500: Resilient Flooring; rubber wall base and carpet edge guard

1.03 REFERENCES


B. American Society for Testing and Materials (ASTM):
   1. ASTM F 710 -“Standard Practice for Preparing Concrete Floors and Other Monolithic Floors to Receive Resilient Flooring”

1.04 SUBMITTALS

A. Product Data: Manufacturer's product data for each type of carpet material and installation accessory required.
   1. Include written data on physical characteristics, durability, resistance to fading, and flame resistance characteristics.

B. Samples for Verification Purposes: Showing full range of color, texture, and pattern variations expected.
   1. Prepare samples from same material to be used for Project.
   2. Minimum of four 24 by 24 inch samples of each type of carpet.

C. Accessories: Minimum of four 12 inch long sample of carpet edge guard.

D. Certification: Manufacturer's written certification that carpet has passed required flame spread tests and achieved specified flame spread rating.

E. Maintenance Data: Manufacturer's printed recommendations for care, cleaning and maintenance of carpeting in optimum conditions under anticipated traffic and use conditions.

F. Seam Diagram: Submit carpet layout and seaming drawings, clearly indicating carpet directions, locations and methods of joining seams, and locations and types of edge strips.
   1. Indicate columns, doorways, enclosing walls/partitions, built-in cabinets and locations where cut-outs are required in carpet.
2. Revise seam diagrams as required.
3. Do not install carpet until written acceptance of seaming diagram has been received.

G. Reports:
1. Provide test results for concrete moisture vapor emission and pH testing of concrete in chart form listing test dates, start/stop times, start/stop weight, weight gain in grams, moisture vapor emission values, and pH levels
2. Provide test results for concrete in-situ relative humidity and pH testing in chart form listing test dates, time, depth of test well, in-situ temperature, relative humidity, and pH levels
3. List test locations on chart and show same on 8-1/2 by 11 inch site map
   a. Make such map available to testing agency
4. Deliver results to Owner, Architect, Construction Manager, and flooring contractor.

1.05 QUALITY ASSURANCE

A. Manufacturer's Representative: Obtain carpeting materials from only manufacturers who will, when requested, send qualified technical representative to Project Site, to advise installer of proper installation procedures.

B. Work is to be performed by competent mechanics directly employed by Contractor, and fully experienced in first class commercial installation of type required by these specifications.

C. Provide only carpet which has passed following tests:
   2. Critical Radiant Flux (Flame Spread): ASTM E 648 Class 1

D. Substitutions: Carpet submitted for approval as equal to specified carpet must be equal in every respect, including color selection.
   1. Include full range of carpet colors and manufacturer's written specification.

E. Pre-Installation Meeting:
   1. Schedule meeting with Owner, Architect and General Contractor; arrange for attendance by carpet installer and carpet manufacturers' technical representatives.
   2. Meeting to include, but not limited to, following:
      a. Review of calcium chloride and pH test results on floor slabs.
      b. Adhesive application instruction.
      c. Scheduling and procedures for periodic field inspections by carpet manufacturers' technical representatives.
   3. Record minutes of meeting and promptly distribute copies of minutes to attendees and other interested parties as may be necessary.
   4. Record issues resolved during meeting; include copies of Drawings and application instructions used in meeting; record changes on Drawings and application instructions made at meeting.
1.06 PROJECT CONDITIONS

A. Space Enclosure and Environmental Limitations: Do not install carpet until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete, and ambient temperature and humidity conditions are and will be continuously maintained at values near those indicated for final occupancy.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver carpet and accessories until notification is received that buildings or spaces are ready for installation of carpet.

B. Deliver carpeting materials in original mill protective wrapping with mill register numbers and tags attached.
   1. Store inside, in well ventilated area, protected from weather, moisture and soiling.
   2. Lay flat with continuous blocking off ground.
   3. Deliver tags to job inspector along with a sample of carpet cut from each bale.

1.08 REMNANTS

A. Leave usable carpet remnants with Owner.
   1. Tag each piece by size and prepare inventory of materials.
   2. Provide secure vandalproof storage until Owner accepts materials.

1.09 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.
   1. Provide required overrun exclusive of carpet needed for proper installation, waste and usable scraps.
   2. Deliver and store at Owner's direction.
   3. Carpet: Before installation begins, furnish quantity of full size units equal to 5 percent of amount installed, but not less than 10 square yards.

1.10 WARRANTY

A. Provide special project warranty, signed by Contractor, installer and manufacturer (Carpet Mill), agreeing to repair or replace defective materials and workmanship of carpeting work during specified warranty periods following substantial completion; attach copies of product warranties.
   1. 25 year non-prorated limited warranty against excessive surface wear and static delamination, edge ravel, zippering, and backing resiliency loss

B. Adhesive: Provide manufacturer's warranty for pressure sensitive adhesive to be free from manufacturing defects for period of one year from date of substantial completion.
PART 2 – PRODUCTS

2.01 CARPET

A. Carpet Data: Detailed requirements for each required type of carpet is specified in Article 3.08 at end of Section.
   1. Extent of each type of carpet is shown on Drawings and scheduled.
   2. Provide carpet complying with CBC Chapter 11B.

B. Carpet Color/Pattern Texture: Match Architect's samples or match specified manufacturer's stock carpet color, pattern and texture.

C. Dyeing: Yarn to be from same dye lot.

D. Environmental Requirements: Provide carpet that complies with testing and product requirements of Carpet and Rug Institute (CRI) Green Label Plus testing program.

2.02 ACCESSORIES

A. Carpet Edge Guard, Nonmetallic: Comply with requirements in Section 09 6500 and CBC Chapter 11B.

B. Concrete Slab Primer: Henry 366 Floor Primer and Latex Liquid Additive by W.W. Henry Company, or approved equal as recommended by flooring manufacturer.

C. Trowelable Underlayment and Patching Compounds: Latex-modified, Portland cement based formulation
   1. Henry 547 Universal Underlayment with Henry 546 Feather Edge Additive, if required, by W.W. Henry Company, or approved equal as recommended by flooring manufacturer.

D. Adhesives:
   1. Carpet Adhesive: Water resistant, mildew resistant, nonstaining type adhesive as recommended by carpet manufacturer to suit products and subfloor conditions indicated, which complies with flammability requirements for installed carpet.
   2. VOC Content: Provide adhesives with vac content not more than 50 g/L when calculated according to California Air Resources Board (CAR B) regulations dated June, 2008
      a. Include printed statement of VOC content and documentation of compliance with requirements for Carpet and Rug Institute (CRI) Green Label Plus testing program

E. Seaming Cement: Hot-melt seaming adhesive or similar product recommended by carpet manufacturer, for taping seams and buttering cut edges at backing to form secure seams and prevent pile loss at seams.

F. Miscellaneous Materials: Provide types of adhesives and other accessory items recommended by carpet manufacturer and installer for conditions of installation and use, without failure during life of carpet.
PART 3 - EXECUTION

3.01 EXAMINATION AND TESTING

A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance.
   1. Verify that substrates and conditions are satisfactory for carpet installation and comply with requirements specified.
   2. Report to Architect, in writing, prevailing conditions that will adversely affect satisfactory execution of Work.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and following:
   1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond.
   2. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet and adhesive manufacturers.
      a. Do not install carpet if test readings show unacceptable conditions.
   3. Subfloors are free of cracks, ridges, depressions, scale and foreign deposits.

C. Proceed with installation only after unsatisfactory conditions have been corrected.
   1. Starting Work constitutes acceptance of existing conditions.
   2. Correction of unsatisfactory and defective work subsequently encountered will be responsibility of Contractor at his expense.

3.02 PREPARATION – GENERAL

A. Clear away debris and scrape up cementitious deposits from concrete surfaces to receive carpet.

B. Comply with CRI 104, Section 6.2, "Site conditions; Floor Preparation", and carpet manufacturer's written installation instructions for preparing substrates indicated to receive carpet installation.

C. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

D. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents.
   1. Use mechanical methods recommended by carpet adhesive manufacturer.

E. Broom and vacuum clean substrates to be covered immediately before installing carpet.
   1. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust.

F. Sequence carpeting with other work so as to minimize possibility of damage and soiling of carpet during remainder of construction period.
3.03 INSTALLATION – GENERAL

A. Install carpet in following manufacturer's instructions, including manufacturer's instructions and recommendations for seam locations and direction of carpet.
   1. Maintain uniformity of direction and lay of pile.

B. Provide cut-outs where required, and bind cut edges properly where not concealed by protective edge guards or overlapping flanges.

C. Extend carpet into following areas:
   1. Under open-bottomed and raised-bottoms obstructions, and under removable flanges of obstructions.
   2. Into closets and alcoves of rooms indicated to be carpeted, unless another floor finish is indicated for such spaces.
   3. Under movable furniture and equipment, unless otherwise indicated.

D. Install carpet edge guard at every location where edge of carpet is exposed to traffic, except where another device, such as expansion joint cover system or threshold, with integral carpet binder bar, is indicated
   1. Anchor edge guards to substrate.
   2. Comply with requirements in Section 09 6513 and CBC Chapter 11B.

E. Expansion Joints: Do not bridge building expansion joints with continuous carpeting, provide for movement.

F. Piecing: Use full sizes of carpet for applications where use of smaller size would cause an extra seam.
   1. Use of small pieces in areas where larger piece could be used is not permitted.

3.04 GLUED-DOWN INSTALLATION-DIRECT TO FLOOR SLAB

A. Floor Preparation: Allow concrete slabs to age minimum of 90 days and perform moisture test prior to starting Work.
   1. Surfaces to receive carpet shall be dry, free of grease, wax and foreign matter and thoroughly cleaned with commercial vacuum cleaner.
   2. Grind ridges and high spots smooth.
   3. Fill cracks 1/16 inch and wider with latex emulsion filler compatible with adhesive.

B. Fit sections of carpet into each space prior to application of adhesive.
   1. Trim edges and butter cuts with seaming cement.

C. Apply adhesive uniformly to substrate following manufacturer's instructions.
   1. Butt carpet edges tightly together to form seams without gaps.
   2. Roll lightly to eliminate air pockets and ensure uniform bond.
   3. Remove adhesive promptly from face of carpet.

3.07 CLEANING AND PROTECTION

A. Remove debris from installation, carefully sorting pieces to be saved from scraps to be disposed of.

B. Remove adhesive from carpet surface with manufacturer's recommended cleaning
agent.
1. Replace carpet which cannot be cleaned.

C. Vacuum carpet using commercial machine with face-beater element. Remove protruding face yarn.

D. Protect carpet during remainder of construction period, so that carpet will be in undamaged and unsoiled condition at time of acceptance.
1. Use non-staining material for protective cover.

E. Maintenance Materials: Deliver specified overrun and usable scraps of carpet to Owner's designated storage space, properly packaged (paper wrapped) and identified.
1. Usable scraps are defined to include roll ends of less than 9 feet in length, and pieces of more than 3 sq. ft. area and more than 8 inches wide.
2. Dispose of smaller pieces as "construction waste" in accordance with requirements of Section 01 7419

3.08 CARPET DATA

A. Carpet Designation: CPT-1
1. Manufacturer/Quality: Centiva by Tandus US, Inc, or approved equal.
2. Style: Infinity 05849
3. Face Yarn: 100% Antron Legacy Nylon, with Ensure Soil Protection.
4. Construction: Stratatec Patterned Loop
5. Pattern: Texture.
6. Dye Method: 50% Solution Dyed / 50% Yarn Dyed.
7. Color: Aztec Gold 55012
8. Gauge: 5/64inch
9. Stitches: 11.0 per inch
10. Average Pile Height: 0.187 inch
11. Primary Backing: Non-woven synthetic fiber
12. Secondary Backing: Powerbond RS Closed-Cell Vinyl Cushion
   a. Weight: 35.5 oz/yd2
   b. Density: 18.5 lbs/cu. ft.
   c. Thickness: 0.156 inch
   d. Total Weight (RS): 85.0 oz/yd2 ±5 percent
13. Width: 6 feet (Roll)
15. Flame Spread: Critical radiant flux to meet Class I, 0.45 watts/sq. cm. as tested by ASTM E 648 or NFPA 253.

B. Carpet Designation: CPT-2
1. Manufacturer/Quality: Centiva by Tandus US, Inc, or approved equal.
2. Style: Plexus Colour IV 02875
3. Face Yarn: 100% Antron Legacy Nylon, with Ensure Soil Protection.
4. Construction: Stratatec Patterned Loop
5. Pattern: Texture.
6. Dye Method: 50% Solution Dyed / 50% Yarn Dyed.
7. Color: Earth 18563
8. Gauge: 5/64inch
9. Stitches: 11.0 per inch
10. Average Pile Height: 0.187 inch
11. Primary Backing: Non-woven synthetic fiber
12. Secondary Backing: Powerbond RS Closed-Cell Vinyl Cushion
   a. Weight: 35.5 oz/yd2
   b. Density: 18.5 lbs/cu. ft.
   c. Thickness: 0.156 inch
   d. Total Weight (RS): 85.0 oz/yd2 ±5 percent
13. Width: 6 feet (Roll)
15. Flame Spread: Critical radiant flux to meet Class I, 0.45 watts/sq. cm. as tested by ASTM E 648 or NFPA 253.

END OF SECTION 09 6800
SECTION 09 9100

PAINTING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Surface preparation and field painting of following:
      a. Exposed exterior items and surfaces.
      b. Exposed interior items and surfaces.
      c. Surface preparation, priming, and finish coats specified in this Section are in
         addition to shop priming and surface treatment specified in other Sections.

B. Related Sections:
   1. Section 05 0513: Shop-Applied Coatings for Metal
   2. Section 07 9200: Joint Sealants
   3. Section 08 1113: Hollow Metal Doors and Frames
   4. Section 08 3100: Access Doors and Panels
   5. Section 09 2900: Gypsum Board
   6. Section 09 9600: High Performance Coatings

1.02 REFERENCES

A. South Coast Air Quality Management District (SCAQMD):
   1. SCAQMD Rule 1113 – Architectural Coatings
   2. SCAQMD Rule 1168 – Adhesive and Sealant Applications

1.03 QUALITY ASSURANCE

A. Approved Equal: Provide materials or products specified by trade name as specified.
   1. Interpret references to brand names as establishing standard of quality.
      a. Such interpretation is not to be construed as limiting competition.
   2. Presume brand names, where used in specifications, to be followed by words “or
      approved equal”.
   3. Such approval will be granted only as set forth in Contract Documents and with
      certification that materials are equal or superior to brand named in specifications
      in construction, efficiency, and utility.
      a. In making submittals for approval as equal, include manufacturer’s product
         data sheet for each product indicating composition and percent by weight.

1.04 SUBMITTALS

A. Product Data: For each paint system specified; include primers.
      a. Indicate each material and cross-reference specific coating, finish system,
         and application.
      b. Identify each material by catalog number and general classification.
c. Include manufacturer’s name, product name and number; including primers, thinners, and coloring agents, together with manufacturers’ catalog data fully describing each material as to content, recommended installation, and preparation methods. Identify surfaces to receive various paint materials.

2. Manufacturer’s Information: Provide manufacturer’s technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.

3. Certification by manufacturer that products supplied comply with local regulations controlling use of Volatile Organic Compounds (VOC).

B. Samples for Verification: After receipt of Architect’s Color Schedule, submit following for Architect’s review for color and texture only:

1. Stepped Samples: Defining each separate coat, including primers.
   a. Use representative colors when preparing samples for review.
   b. Resubmit until required sheen, color, and texture are achieved.

2. Provide list of materials and applications for each coat of each sample.
   a. Label each sample for location and application.

3. Provide minimum of four 8-1/2 by 11 inch painted samples of each color and material, with texture to simulate actual conditions.
   a. On Metal – Provide minimum of four 4 by 8 inch samples for each type of finish and color, defining prime and finish coat.
   b. Do not proceed with painting work until color samples have been accepted.

C. Field Sample: When and as directed by Architect, apply one complete coating system for each color, gloss and texture required.

   1. When approved, sample panel areas will be deemed incorporated into Work and will serve as standards by which subsequent Work of this Section will be judged.

D. Provide list of solid volume factors for each type of material if so requested by Architect.

1.05 DEFINITIONS

A. “Paint” as used in this Section means coating systems materials, including primers, emulsions, enamels, stains, sealers, and other applied materials whether used as prime, intermediate, or finish coats.

1.06 SYSTEM DESCRIPTION

A. Paint exposed surfaces except where material is obviously intended and specifically noted as surface not to be painted:

   1. Where items or surfaces are not specifically mentioned, paint item or surface same as adjacent similar materials or surfaces whether or not schedules indicate colors.
      a. When system, color, or finish is not designated, Architect will select from standard colors and finishes available.
      b. Refer to Finish Schedules and notations on Drawings.
      c. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work (unless scheduled to receive high performance coating), conduit, and metal surfaces of mechanical and electrical equipment as indicated.
B. Work Not to be Painted: In general, following items will not require finishing unless specifically specified, scheduled, or indicated:
   1. Flexible conduit connections to equipment, miscellaneous nameplates, stamping, and instruction labels and manufacturer’s data.
   2. Do not paint moving parts of operating units, including, but not limited to:
      a. Mechanical and electrical parts, such as valves and damper operators, linkages, sensing devices, motor and fan shafts.
   3. Do not paint code required labels, such as Underwriters’ Laboratories and Factory Mutual, or equipment identification, performance rating, name, and nomenclature plates.
   4. Concealed Surfaces: Painting is not required on wall or ceiling surfaces in concealed and inaccessible areas such as pipe spaces and duct shafts, as applicable to Project.
   5. Paint exposed piping, ductwork, equipment, and other such items as designated or required.
   6. Finish Hardware, except prime coated items.
   7. Exterior and interior metal stairs and walking surfaces scheduled to receive high performance coatings specified in Section 09 9600.

C. Shop Priming: Unless otherwise specified, shop priming of ferrous metal items is included under various sections for metal fabrications, hollow metal work and similar items.

1.07 PROJECT CONDITIONS

A. Apply primers and paints only when temperature of surfaces to be painted and surrounding air temperatures are within range permitted by paint manufacturer’s printed instructions.

B. Do not apply paint in rain, fog, mist or to damp or wet surfaces; or when relative humidity exceeds 85 percent, unless otherwise specified by paint manufacturer.

C. Do not apply paint, interior, or exterior, when temperature is below 50 degrees F or above 90 degrees F, or when dust conditions are unfavorable for application.

D. Painting may be continued during inclement weather if areas and surfaces to be painted are enclosed and heated within temperature ranges specified by paint manufacturer during application and drying periods.

E. Painting Work by Other Trades: Examine Drawings and Specifications, including requirements specified in other sections for painting work by other trades.
   1. Notify Architect in writing of conflicts between Work of this Section and that of other trades and sections, and errors, omissions, or impractical requirements.
   2. Paint or finish surfaces that are left unfinished by requirements of their specification as Work of this Section.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project Site in original, new, and unopened packages and containers bearing manufacturer’s name and label, and following information:
   1. Name or title of material.
   2. Product Description (Generic Classification or Binder Type).
   3. Federal Specification number, if applicable.
4. Manufacturer’s stock number and date of manufacture.
5. Manufacturer’s name
6. Contents by volume, for major pigment and vehicle constituents.
7. Thinning instructions.
8. Application instructions.
9. Color name and number.
10. VOC Content
11. Concurrently provide local representative of approved paint products with copies of invoices of purchased materials.

B. Storage and Mixing of Materials: Store and mix paint materials in single suitable place in compliance with health and fire regulations.
1. Open and mix ingredients on premises in presence of Project Inspector.
2. Maintain such storage spaces clean and neat.
3. Remove oily rags, waste, and like materials from building each night and take every precaution to avoid danger of fire.

1.09 REGULATORY REQUIREMENTS

A. Codes and Standards: Conform work and materials to regulations of State Fire Marshal, Safety Color Coding in conformance with OSHA, and local or State Ordinances having jurisdiction.
1. Conform to most stringent requirements and authorities having jurisdiction.

B. Comply with applicable codes and regulations of governmental agencies having jurisdiction including those having jurisdiction over airborne emissions and industrial waste disposal.
1. Where those requirements conflict with this Specification, comply with more stringent provisions.
2. Regulatory changes may affect formulation, availability, or use of specified coatings.
   a. Confirm availability of coatings to be used prior to Project bid and before start of painting on Project.
3. Comply with current applicable regulations of California Air Resources Board (CARB), South Coast Air Quality Management District (SCAQMD), and Environmental Protection Agency (EPA), as applicable.

1.10 MAINTENANCE STOCK

A. Upon completion of Work of this Section, deliver to owner, extra stock consisting of one gallon of each color, type, and gloss of finish (topcoat) paint used in Work.
1. Tightly seal each container and clearly label contents and location where used.

PART 2 – PRODUCTS

2.01 MATERIAL QUALITY

A. Provide best quality commercial grade of various types of coatings as regularly manufactured by acceptable paint materials manufacturers.
1. Materials not displaying manufacturer’s identification as standard, best grade product will not be acceptable.
B. Furnish products of only one paint manufacturer unless otherwise specified or approved.
   1. Provide primers, thinners, coloring agents, and catalysts for each painting system as approved for use by manufacturer of paint, except for materials furnished with shop prime coat by other trades.
   2. Use approved thinners only within recommended limits.

C. Factory mix paint materials to correct color, gloss, and consistency for installation to maximum extent feasible.

D. Do not use paints in Work which have been packaged longer than six months, except when such products are known to have long package stability when unopened and only when guaranteed by manufacturer.

2.02 MANUFACTURERS

A. Manufacturer’s catalog names and numbers are used to aid in establishing kind and quality of material required and are not used as indication of color desired.

   1. Equivalent opaque finish products manufactured by one of following will be acceptable, subject to conformance with specified requirements:
      a. Pittsburgh Paints, by PPG Architectural Coatings, div. of PPG Industries
      b. Sherwin-Williams Company
      c. Vista Paint Corporation

C. Stain (Softwoods): Softwood stains, semi-transparent and heavy-bodied, manufactured by one of following will be acceptable, subject to conformance with specified requirements:
   2. Samuel Cabot Incorporated
   3. Sherwin-Williams Company

2.03 COLORS AND FINISHES

A. Surface treatments and finishes are shown on Drawings and indicated in Schedules on Drawings. Paint colors are shown on Architect’s Color Schedule.

B. Colors required or listed by Architect are not necessarily stock colors available in one particular manufacturer’s range.
   1. Non-availability of colors selected by Architect will be sufficient reason to disqualify manufacturer not capable of providing such colors.

C. Paint Coordination: Provide finish coats which are compatible with prime paints used.
   1. Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates.
   2. Upon request from other subcontractors, furnish information on characteristic of specified finish materials, to ensure that compatible prime coats are used.
   3. Provide barrier coats over incompatible primers or remove and reprime as required.

2.04 PAINTABLE CAULK

A. Acrylic latex, one-part, non-sag, mildew resistant, non-bleeding and non-staining, acrylic emulsion component compound conforming to ASTM C 834, Type OP, Grade NS, formulated to be paintable.
   1. For use as interior caulk in nonworking joints only.
   2. Must be able to accommodate joint movement of not more than 5 percent in both extension and compression for total of 10 percent.
   3. Backup and Bond Breaker: Products recommended by caulking manufacturer.
   4. Provide one of following products:
      a. AC-20: Pecora Corporation.
      c. GE RCS20: Momentive Performance Materials.
   5. VOC compliant per SCAQMD Rule 1168.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions under which painting will be performed for compliance with requirements for application of paint.
   1. Do not begin paint application until unsatisfactory conditions have been corrected and surfaces scheduled to receive paint are thoroughly dry.

B. Starting of painting will be construed as applicator’s acceptance of surfaces and conditions within particular area.

3.02 SURFACE PREPARATION

A. Clean and prepare surfaces to be painted following paint manufacturer's written instructions and as specified, for each particular substrate condition.

B. Clean surfaces to be painted before applying paint or surface treatments.
   1. Remove oil and grease prior to mechanical cleaning.
   2. Program cleaning and painting so contaminants from cleaning process will not fall onto wet, newly painted surfaces.
   3. Cover surfaces and equipment as necessary to prevent contaminants from cleaning process from falling onto equipment.

C. Clean floors and surfaces in room being painted of loose dirt and dust before painting is started.

D. Moisture Content: Measure moisture content of surfaces using electronic moisture meter.
   1. Do not apply finishes unless moisture content of surfaces are below maximum levels specified, or as otherwise recommended by manufacturer.
E. Remove hardware, hardware accessories, switch and receptacle plates, surface-mounted lighting fixtures, escutcheons and plates, surface-mounted equipment, free-standing equipment blocking access to painted surfaces, and other items as required prior to surface preparation and painting operations.
   1. Following completion of painting of each space or area, reinstall removed items.

F. Provide barrier coats over incompatible primers or remove and reprime.

G. Gypsum Board: Remove dust, loose particles or other matter that would prevent proper paint adhesion.
   1. Check to see that joints and screw heads have been properly covered with joint compound and sanded smooth and flush with adjacent surfaces.
   2. Before finishing untextured smooth gypsum board, use damp sponge along edge of joints where nap of paper has been raised by sanding.

H. Ferrous Metals: Clean ungalvanized ferrous metal surfaces that have not been shop coated or are not otherwise specified to receive high performance coatings.
   1. Remove oil, grease, dirt, loose mill scale, and other foreign substances.
   2. Use solvent (SSPC SP1) or mechanical cleaning methods (SSPC SP2 and SP3) that comply with The Society for Protective Coatings (SSPC) recommendations.
   3. Where rust or scale is present, wire brush and sandpaper clean.
   4. Clean field welds and abraded portions of field welded and erected ferrous metal components.

I. Galvanized Surfaces: Clean galvanized surfaces with non-petroleum-based solvents (SSPC SP1) so surface is free of oil and surface contaminants.
   1. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
   2. Spot prime field connections, welds, soldered joints, and burned and abraded portions.
   3. Factory finished surfaces indicated to be repainted shall be sanded or etched to increase adherence of finish coats.

J. Paintable Caulk Installation:
   1. Comply with general sealant installation requirements in Section 09 9200.
   2. Use only for caulking of followings joints in dry areas:
      a. Perimeter caulking of interior door frames.
   3. Joint Design: Width of joint should be approximately 12 times anticipated movement and fall within range of 1/4 inch to 3/4 inch

3.03 MATERIAL PREPARATION

A. Mix and prepare painting materials in field following manufacturer's directions.

B. Store materials not in actual use in tightly covered containers.
   1. Maintain containers used in storage, mixing and application of paint in clean condition, free of foreign materials and residue.

C. Stir materials before application to produce mixture of uniform density, stir as required during application.
   1. Do not stir surface film into material.
   2. Remove film and, if necessary, strain material before using.
3.04 APPLICATION

A. Apply paint following manufacturer’s directions.
   1. Use applicators and techniques best suited for substrate and type of material being applied.
   2. Mix to proper consistency.
   3. On brush-applied work brush out smooth leaving minimum of brush marks, with paint uniformly flowed on.

B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, and conditions otherwise detrimental to formation of durable paint film.

C. Apply paint to clean, dry, prepared surfaces only.
   1. Apply paint material evenly, smoothly flowed on without runs, sags, or holidays.

D. Provide finish coats compatible with primes used.

E. Minimum Coating Thickness: Apply each material at not less than manufacturer’s recommended spreading rate, to provide a total dry film thickness of not less than 5.0 mils for entire coating system of prime and finish coats for 3 coat work.
   1. Provide total dry film thickness of not less than 3.5 mils for entire coating system of prime and finish coat for 2 coat work.

F. Number of coats and film thickness required is same regardless of application method.
   1. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer.
   2. Sand between applications where sanding is required to produce even smooth surface following manufacturer’s directions.

G. Apply additional coats when undercoats, stains or other conditions show through final coat of paint, until paint film is of uniform finish, color and appearance.
   1. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive dry film thickness equivalent to that of flat surfaces.
   2. Number of coats specified herein are minimum to be applied.
      a. Apply additional coats in event full coverage is not obtained or required total thickness of paint does not comply with mil thickness recommended by paint manufacturer.

H. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces.

I. Included Work: Finish tops, bottoms, and edges of doors same as balance of door.
   1. Where walls are specified to be painted, include columns, arrises, reveals, soffits, returns, and like surfaces.

J. Priming: Where shop coats and touch-up painting are specified under other sections of Work, omit prime coat.

K. Completed Work: Match approved samples for color, texture, and coverage.
   1. Remove, refinish, or repaint work not in compliance with specified requirements.
3.05 CLEANING AND PROTECTION

A. Cleanup: At end of each work day, remove empty cans, rags, rubbish, and other discarded paint materials from Project Site.
   1. Remove paint, varnish and brush marks from glazing material
   2. Upon completion of painting work, wash and polish glazing material both sides.
      a. Glazing material, which is damaged, shall be removed and replaced with new material.

B. Protection: Protect work of other trades, whether to be painted or not, against damage by painting.
   1. Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.

C. Protect floors and adjacent surfaces from paint smears, spatters and droppings.
   1. Use dropcloths to protect floors.
   2. Cover fixtures and mask off areas where required.

D. Provide “Wet Paint” signs and barricades to protect newly painted finishes.
   1. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.

E. At completion of work of other trades, touch-up and restore damaged and defaced painted surfaces.

3.06 PAINT SYSTEM SCHEDULES – GENERAL

A. Provide following paint systems for substrate indicated.
   1. Products must meet or exceed current applicable regulations of agencies listed in Regulatory Requirements Article.

3.07 SCHEDULE OF EXTERIOR PAINT SYSTEMS

A. Paint System Type 1:
   1. Type and Gloss: Waterborne Acrylic; Eggshell
   2. Use: Exterior concrete walls
      a. Spot Prime: FLEX-TEX Elastomeric Coating Smooth FTXS10
      b. 2nd Coat: ACRI-HUES Exterior Eggshell ACHS30
      c. 3rd Coat: ACRI-HUES Exterior Eggshell ACHS30

B. Paint System Type 2:
   1. Type and Gloss: Water-based Acrylic Urethane; Semi-Gloss
   2. Use: Exterior Metal doors and frames, except where otherwise specified.
      a. Primer: ULTRA-GRIP Interior/Exterior Flat UGPR00-1
      b. 2nd Coat: ULTRASHIELD DTM Semi-Gloss ULDM 50
      c. 3rd Coat: ULTRASHIELD DTM Semi-Gloss ULDM 50

3.08 SCHEDULE OF INTERIOR PAINT SYSTEMS

A. Paint System Type 3:
   1. Type and Gloss: Water-based Acrylic Urethane; Semi-Gloss
   2. Use: Interior concrete walls and other surfaces indicated.
      a. Primer: ULTRA-GRIP Interior/Exterior Flat UGPR00-1
b. 2nd Coat: ULTRASHIELD DTM Semi-Gloss ULDM 50
   c. 3rd Coat: ULTRASHIELD DTM Semi-Gloss ULDM 50

B. Paint System Type 4:
   1. Type and Gloss: Latex Dry Fall; Low Sheen
   2. Use: Interior metal deck ceilings.
      a. Primer: ULTRA-GRIP Interior/Exterior Flat UGPR00-1
      b. 2nd Coat: ULTRASHIELD Low Sheen AQUA40
      c. 3rd Coat: ULTRASHIELD Low Sheen AQUA40

C. Paint System Type 5:
   1. Type and Gloss: Water-based Acrylic Urethane; Semi-Gloss
   2. Use: Interior ferrous metal surfaces indicated, including structural steel, doors, frames, window trim and other metal surfaces indicated.
      a. Primer: ULTRA-GRIP Interior/Exterior Flat UGPR00-1
      b. 2nd Coat: ULTRASHIELD DTM Semi-Gloss ULDM 50
      c. 3rd Coat: ULTRASHIELD DTM Semi-Gloss ULDM 50

3.09 SPECIAL TREATMENT OF SPECIFIC SURFACES

A. Mechanical and Electrical Work:
   1. Paint exposed surfaces of, but not limited to following:
      a. Exterior and interior plumbing, HVAC, and electrical, factory-primed equipment, apparatus, pipes and fittings, vents, ducts, miscellaneous supports and hangers, electrical conduit, fittings, pull boxes, outlet boxes, and other unfinished surfaces of mechanical and electrical Work, miscellaneous factory-primed metal cabinets, panels, and access doors and panels.

B. Paint System Type 30 (FB):
   1. Type and Gloss: Flat Black
   2. Use:
      a. Ducts visible through grilles and registers
      b. Reveals at ceiling edges
      c. Structure visible through glass above ceiling line, unless indicated otherwise
   3. Pretreatment: UGPROO Ultra-Grip Premium
   4. 1st Coat: W601 Ecoshield Flat or SPMA 10 Suprema Interior Flat

END OF SECTION 09 9100
SECTION 09 9600
HIGH PERFORMANCE COATINGS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:
   1. Preparation, priming, and application of high performance field applied coatings, including but not limited to, following:
      a. Exterior steel handrails and guardrails.

1.02 RELATED SECTIONS

A. Section 05 0513: Metal Finishes; factory applied high performance finishes on aluminum
B. Section 05 5000: Metal Fabrications; shop cleaning and priming of Miscellaneous metal specified to receive high performance coatings
C. Section 09 9100: Painting; ferrous metal not specified to be galvanized, fireproofed, or to receive high performance coating.

1.03 PERFORMANCE REQUIREMENTS

A. Provide coating systems suitable for application to steel.

B. Conform to applicable performance standards of following where referenced in specification:
   1. National Association of Architectural Metal Manufacturers (NAAMM):
      a. "Metal Finishes Manual"

1.04 SUBMITTALS

A. Product Data: For each coating system specified; including primers.
      a. Indicate each material and cross-reference specific coating, finish system, and application.
      b. Identify each material by manufacturer's catalog number and coating material proposed for use.
   2. Manufacturer's Information: Provide manufacturer's technical information, including instructions for handling, storing and applying each coating material proposed for use.
   3. Certification by manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOC's).

B. Samples:
   1. Applied finishes on steel and aluminum, for color and finish.
   2. Provide minimum of four 4 by 8 inch pieces, and 8 inch lengths of larger sizes
as required to show finished Work.

C. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience.
   1. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.05 QUALITY ASSURANCE

A. Applicator Qualifications: Engage experienced applicator who has completed high performance coating system applications similar in material and extent to that indicated for this Project with record of successful in-service performance.

B. Source Limitations: Obtain primers for each coating system from same manufacturer as finish coats.

C. Coating manufacturer’s technical representative will perform following:
   1. Conduct periodic inspections of surface preparation and coating operations as required to obtain warranty.
   2. Coating contractor is responsible for contacting coating manufacturer’s technical representative to arrange for required inspections.
   3. Notify Architect if Contractor fails to meet any portion of specification.

1.06 WARRANTIES

A. Special Finish Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period.
   1. Warranty does not include normal weathering.
   2. Warranty Period:
      a. 5 years from date of Substantial Completion for Type B coatings.

B. Completed high performance coatings shall be jointly warranted by respective coating manufacturer and coating applicator to meet weathering tests and performance requirements as specified.
   1. Coating applicator must apply for coating warranty at time of application.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Products-High Performance Coatings on steel are based on following systems as manufactured by Carboline Company:
   1. Type B: Organic Zinc-Rich EpoxylWaterborne Acrylic Polyurethane System

B. Alternate Basis-of-Design Products-High Performance Coatings on steel are based on following systems as manufactured by Tnemec Company:
   1. Type B: Zinc-Rich Aromatic UrethanelWaterborne Acrylic Polyurethane System
C. Subject to compliance with specified requirements, comparable products may be submitted by alternate manufacturers in accordance with requirements for product substitutions specified in Section 016000 and following:
1. Submit items listed in Article 1.04 and as specified in Section 01 3300, for evaluation of proposed system.
2. Tests shall have been made for identical systems within ranges of specified performance standards and criteria for application to specified substrates.
3. Acceptance is also subject to availability of acceptable color matching specified color.

2.02 COATING MATERIALS- GENERAL

A. Material Compatibility: Provide primers and finish coat materials that are compatible with one another and substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's highest grade of various high performance coatings specified; of uniform color throughout and color-fast.
1. Materials not displaying manufacturer's product identification are not acceptable.

C. Coating manufacturers and coating applicators shall develop jointly methods and procedures for surface preparation, priming, and finish coating of materials.

2.03 HIGH PERFORMANCE FIELD APPLIED COATING SYSTEMS

A. High Performance Coating System Type B:
1. High performance pigmented two component shop applied system consisting of organic zinc-rich epoxy primer and aliphatic acrylic polyurethane finish coat, as manufactured by Carboline Company, which meets or exceeds following performance provisions:
   a. Resistant to abrasion, corrosion, and chemical exposure.
   b. Repel surface dirt and contaminates.
2. Provide two coat system consisting of:
   a. Primer Coat: Carbozinc 859 VOC Organic Zinc-Rich Epoxy Primer at 3.0 to 5.0 mils dry film thickness.
   b. Finish Coat: Carbothane 133 MC Aliphatic Acrylic Polyurethane at 3.0 to 5.0 mils dry film thickness.

B. Alternate High Performance Coating System Type B:
1. High performance pigmented two component shop applied system consisting of aromatic zinc-rich urethane primer and aliphatic acrylic polyurethane finish coat, as manufactured by Tnemec Company, which meets or exceeds following performance provisions:
   a. Resistant to abrasion, corrosion, and chemical exposure.
   b. Repel surface dirt and contaminates.
2. Provide two coat system consisting of:
   a. Primer Coat: Tnemec Hydro-Zinc Series 94-h20 Zinc-Rich Aromatic Urethane Primer at 2.5 to 3.5 mils dry film thickness.
   b. Finish Coat: Tnemec Endura-Shield Series 1081 Waterborne Acrylic Polyurethane at 2.5 to 4.0 mils dry film thickness.
1) Color: As scheduled.

PART 3 – EXECUTION

3.01 GENERAL REQUIREMENTS

A. Finish visible surfaces of exposed work; defined as surfaces which will be exposed to view from exterior and in interior of completed building.

B. Perform finishing after fabrication, forming, fitting, and welding have been completed.

C. Finishes on exposed work shall be uniform in appearance; members are to match each other exactly throughout installed work.

D. Specified finishes establish type and quality required; finishes are subject to Architect's acceptance.

3.02 SHOP CLEANING AND PRIMING OF EXPOSED STEEL

A. Comply with requirements of Sections 051200, 055000, and following:
   1. Clean surfaces just prior to painting in accordance with SSPC-SP1 "Solvent Cleaning" to remove dirt and contaminants, followed by dry-blast cleaning in accordance with SSPC-SP6 "Commercial Blast Cleaning".
   2. Fill small pit marks in otherwise smooth, sound surfaces with metallic compound, finish flush and smooth.
   3. Apply one coat of organic zinc-rich epoxy primer specified in Article 2.03, after fabrication and cleaning.
      a. Apply two coats to surfaces that will be inaccessible after fabrication or after installation.

3.03 FIELD PAINTING OF EXPOSED STEEL

A. Clean surfaces in accordance with SSPC-SP 2 or SP 3 as required and touch up primer as necessary.

B. Field apply one coat of Type B high performance finish specified in Article 2.03, to exposed surfaces of exterior steel handrails and guardrails, in accordance with coating manufacturer's recommendations and instructions.

3.04 CLEANING

A. Comply with Section 01 7423 and following:
   1. Clean in accordance with coating manufacturer's recommendations.
   2. Do not use materials or methods which may damage finishes or surrounding construction.

3.05 PROTECTION

A. Protect finished surfaces from damage until acceptance by Owner.

END OF SECTION 09 9600
PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Furnishing materials, labor, and equipment necessary for completion of signage as indicated on Drawings and as specified.
   2. Types of signage include, but is not limited to following:
      a. Interior room signs and directional signs
      b. Geometric restrooms signs
      c. Evacuation plans
      d. Exterior regulation and directional signage.
      e. Exterior building signs.

B. Related Sections:
   1. Section 32 1732: Pavement Markings; accessible parking striping
   2. Division 26 Sections for illuminated exit signs.

1.02 REFERENCES


1.03 QUALITY ASSURANCE

A. Uniformity of Manufacturer: For each separate type of sign required, obtain signs from one source from single manufacturer.

B. Accessibility:
   1. Comply with CBC, Chapter 11B.
   2. Provide tactile exit signage complying with CBC Section 1003.2.8.6.

1.04 SUBMITTALS

A. Product Data: Manufacturer's technical data and installation instructions for each type of sign required.

B. Samples: Each sign form and material showing finishes, colors, surface textures and qualities of manufacturer and design of each sign component including graphics.
   1. Full-size sample units, if requested by Architect.
   2. Acceptable units may be installed as part of Work.

C. Shop Drawings: For fabrication and erection of signs.
   1. Include plans, elevations, and large scale details of sign wording and lettering layout.
   2. Show anchorages and accessory items.
3. Furnish location template drawings for items supported or anchored to permanent construction.


1.05 DEFINITIONS

A. Accessible Route: Continuous unobstructed path that complies with 2013 California Building Code (CBC).

B. Characters: Letters, numbers, punctuation marks, and typographic symbols.

C. Circulation Path: Exterior or interior way of passage from one place to another for pedestrians, including, but not limited to, walks, hallways, courtyards, stairways, and stair landings.

D. Common Use: Interior and exterior rooms, spaces, or elements made available for occupancy by students, staff, or others visiting or utilizing facilities.

E. Facility: Portions of buildings, structures, site improvements, complexes, equipment, roads, walks, passageways, parking lots, or other real or property located on Project Site.

F. ISA: International Symbol of Accessibility

G. Pictogram: Pictorial symbol, which is recognized as representing activities, facilities, or concepts.

H. Sign: Architectural element composed of displayed text, symbolic, tactile or pictorial information.

I. Space: Definable area, such as room, toilet room, hall, assembly area, entrance, storage room, alcove, courtyard, or lobby.

J. Tactile: Object that can be perceived through sense of touch.

1.06 SYSTEM DESCRIPTION

A. Comply with most stringent requirements of 2013 CBC, Chapter 11B for following:

1. Tactile character type and size.

2. Finish and contrast.

3. Raised and visual characters.

4. Visual character and line spacing height and installation height.

5. Braille: California (Contracted) Grade 2 Braille shall be used wherever Braille is required.

6. Tactile sign installation height and location.

7. Parking lot entrance signs and accessible parking space identification signs.

8. Circulation path signs leading from public right of ways, public transportation, and parking lots.

9. Accessible building entrances shall be identified with ISA per CBC Section 11B-216.6.

10. Each permanent room and space identified by sign shall have sign installed adjacent to door it identifies, with raised characters and Braille.

11. Tactile exit signs shall be required per CBC Section 1011.3
12. Directional signs for inaccessible restrooms shall be installed at decision points directing disabled people to accessible restrooms.

13. Signs indicating provision of special equipment for hearing impaired (i.e. TTY phone, volume control phones, and Assistive Listening Systems).

PART 2 – PRODUCTS

2.01 GENERAL

A. Letter Style: Helvetica Medium, unless indicated otherwise.
   1. Uppercase Letters.

2.02 CAST METAL PLAQUES

A. Manufacturer: One of following or approved equal:
   1. Gemini, Inc.
   2. La Haye Bronze
   3. Metal Arts; Div. of L & H Mfg.
   4. Mills Manufacturing, Inc.
   5. Southwell Co.

B. Type: Cast bronze plaques using leaded red brass.

C. Fabricate cast metal plaques of size, shape and thickness shown.
   1. Provide units free of pits, scale, and sand holes or other defects, with required raised letters, numbers, and characters.
   2. Hand tool and buff to provide clean, sharp figures with bright finish.
   3. Protect exposed surfaces with 2 coats of clear, non-yellowing lacquer.
   4. Letters raised 1/8 inch.
   5. Background Texture: Dark pebbled texture.
   7. Size: 16 by 20 inches.

D. Provide rosette covers and expansion bolts for mounting.

E. Provide plaque with following text; verify exact wordage.
   1. Building Name.
   2. District Board of Trustees Names.
   3. Architect's Name.
   4. Contractor's Name.
   5. Date of Dedication.

2.03 PLASTIC SIGNS

A. Basis-of-Design: Design for interior plastic room signs is based on Best Sign Systems standard HC 300 ADA System plaque signs and accessories as manufactured by Best Manufacturing Co., Montrose, CO.

B. Subject to compliance with specified requirements, provide named product or comparable product by one of following manufacturers:
   1. Mohawk Sign Systems, Schenectady, NY
   2. Karman, Ltd., Canoga Park, CA
C. Subject to compliance with specified requirements, comparable products may be submitted by alternate manufacturers in accordance with requirements for product substitutions specified in Section 01 6000 and following:
1. Submit items listed in “Submittals” Article and as specified in Section 01 3300, for evaluation of proposed system.
2. Complete project shop drawings for similar project may be submitted for evaluation purposes, however shop drawings specific to this Project will be required from successful bidder.
3. Copy of manufacturer's finish and material warranty.

D. Material: Plaque stock of laminated phenolic and melamine plastic (MP) for interior signs and fiberglass (FP) for exterior signs suited for graphic sandblast process.
1. Sign stock with face and core plies suited for integral raised profile of text and braille, in finishes and color combinations indicated or, if not indicated, as selected from manufacturer's standards.
2. NEMA rated self-extinguishing.
3. Thickness: 1/4 inch.
4. Edges: Square cut.
5. Corners: As indicated on Drawings.

E. Finish and Contrast: Matte finish with color of characters and symbols contrasting with background by minimum of 70 percent, and have non-glare finish per CBC Sections 11B-703.5.1, 11B-703.6.2, and 11B-703.7.1
1. Colors as selected by Architect.

F. Raised (Tactile) and Visual Characters:
1. Provide raised characters minimum of 5/8 inch and maximum of 2 inches high, based on height of uppercase letter "I", complying with CBC Sections 11B-703.2 and 11B-703.2.5
   a. Accompanied by California Contracted Grade 2 Braille complying with CBC Section 11B-703.2.
2. Proportions: Characters shall be selected from fonts where width of uppercase letter "O" is 60 percent minimum and 110 percent maximum of height of uppercase letter "I" per CBC Sections 11 B-703.2 and 11 B-703.5
3. Format: Text shall be in horizontal Format per CBC Sections 11 B-703.2 and 11 B-703.5
4. Stroke Thickness: Stroke thickness of uppercase letter "I" shall be 15 percent maximum of height of character per CBC Section 11 B-703.2
5. Raised Character and Line Spacing: Character spacing shall be measured between two closest points of adjacent raised characters within message, excluding word spaces.
   a. Where characters have rectangular cross sections, spacing between individual raised characters shall be 1/8 inch minimum and 4 times raised character stroke width maximum.
   b. Where characters have other cross sections, spacing between individual raised characters shall be 1/16 inch minimum and 4 times raised character stroke width maximum at base of cross sections, and 1/8 inch minimum and 4 times raised character stroke width maximum at top of cross sections.
   c. Characters shall be separated from raised borders and decorative elements 3/8 inch minimum.
d. Spacing between baselines of separate lines of raised message shall be 135 percent minimum and 170 percent maximum of raised character height per CBC Section 11B-703.2

6. Visual Character and Line Spacing: Visual character spacing on sign shall be measured between two closest points of adjacent characters, excluding word spaces.
   a. Spacing between individual characters shall be 10 percent minimum and 35 percent maximum of character height.
   b. Spacing between the baselines of separate lines of characters within message shall be 135 percent minimum and 170 percent maximum of character height per CBC Section 11B-703.5

7. Visual Character Height and Installation Height: Minimum character height shall comply with CBC Table 11B-703.5.5

8. Viewing distance shall be measured as horizontal distance between character and obstruction preventing further approach towards sign.

9. Character height shall be based on uppercase letter "I".
   a. Visual characters shall be installed at 40 inches minimum above finish floor or ground except for elevator car controls, floor-level exit signs and emergency procedures information per CBC Section 11B-703.5.

10. Visual Character Case and Style: Visual characters on sign shall be uppercase or lowercase or combination of both and conventional in form.
    a. Characters shall not be italic, oblique, script, highly decorative, or of other unusual forms per CBC Section 11B-703.5

11. Visual Character Stroke Thickness: Stroke thickness of uppercase letter "I" shall be 10 percent maximum of height of character per CBC Section 11B-703.5

G. Braille: California (Contracted) Grade 2 Braille shall be used wherever Braille is required.
   1. Dots shall be 0.100 inch on center in each cell with 0.300 inch space between cells, measured from second column of dots in first cell to first column of dots in second cell.
   2. Dots shall be raised minimum of 0.025 inch above background.
   3. Braille dots shall be domed or rounded per CBC Sections 11B-703.3 and 11B-703.3.1
   4. Braille shall be positioned below corresponding text in horizontal format, flush left or centered.
   5. Multi-lined text, Braille shall be placed below entire text.
   6. Braille shall be separated 3/8 inch minimum and 1/2 inch maximum from other tactile characters, and 3/8 inch minimum from raised borders and decorative elements. per CBC Section 11B-793.3

H. Applied copy not acceptable.

I. Geometric Toilet Room Signs:
   1. Comply with CBC Section 11B-703.7.2.6
   2. Fabricated of 1/4 inch thick, non-glare material which shall contrast with restroom door (light to dark, or dark to light).
   3. Boys/Mens Rooms: Triangular with equal sides, 12 inches in length.
   5. When restroom or other sanitary facility is accessible, ISA shall be placed in center of geometric sign.
   6. Non-tactile text, such as "Staff Only", may be added to sign.
7. Signs shall be installed on door leading into restroom or other sanitary facility, centered on door, and with center of sign 60 inches from finished floor.

J. Provide Plastic Signs as indicated in schedule and details.

**2.04 PARKING LOT ENTRANCE AND ACCESSIBLE PARKING SPACE IDENTIFICATION SIGNS**

A. Sign Requirements:
1. Parking Lot Entrance Signs:
   a. Comply with CBC Chapter 11B, warning that cars parked in parking spaces reserved for people with disabilities will be towed.

2. Parking spaces reserved for people with disabilities shall be identified with reflective sign featuring ISA, which shall comply with CBC, Chapter 11B.
   a. Van accessible spaces shall be identified by including term "Van Accessible" below pictogram on same sign, or separate sign with words shall be installed below ISA sign. per CBC Section 11B-502.6

B. Sign Fabrication:
1. Fabricate signs of 3M Scotchlite Brand reflective sheeting laminated to 18 gage galvanized heavy-duty steel.
2. Size: Minimum 17 inches x 22 inches.
3. White reflective graphics on dark blue reflective background.
4. Character styles and proportions shall be minimum of one inch high.
5. Provide with ISA, minimum 8 inches high.
6. Posts: Provide 0.050 inch thick aluminum, or 14 gage galvanized steel, square tube, 2-1/4 inches square, punched.
   a. Furnish with corrosion and tamper resistant fasteners.

C. Sign Installation and Mounting:
1. Install Parking Lot Entrance Signs on wall or pole in conspicuous place at each entrance to off-street parking facilities, or immediately adjacent to, and visible from each accessible stall or space.
2. Install Parking Space Signs as follows:
   a. On wall or pole at head of each accessible parking space.
   b. In public way, with bottom edge of sign minimum of 80 inches above pavement or ground.
   c. In planting area, parking strip, or on wall, with bottom edge of sign minimum of 60 inches above pavement or ground.

D. Painting and Striping:
1. Reserved parking spaces shall be identified by ISA at foot of space in compliance with CBC, Chapter 11B.
   a. Access aisles shall be striped as required.
2. Perform painting and striping in accordance with requirements in Section 32 1723.

**2.05 ACCESSIBLE PATH OF TRAVEL SIGNS**

A. Accessible Path of Travel Signs:
1. Circulation paths of travel with stairs or other obstacles leading from public right of ways, public transportation, and parking lots, that are not accessible, or do not lead to accessible entrances to building.
a. Locate accessible route signage at decision points compliant with CBC Chapter 11B directing people with disabilities to accessible routes or entrances.
b. Locate and install signs so steps will not have to be retraced.

2. Graphics: White on dark blue background; non-glare, high contrast signs.
a. Conform to requirements of CBC Chapter 11B
b. ISA minimum 4-1/2 inches high.

3. Installation Location and Mounting:
a. Mount sign on post or wall with lower edge of sign between 48 inches and 60 inches above ground or surface.

2.06 INFORMATIONAL SIGNS

A. Building Entrance Signs:
1. Building entrances shall have sign stating: “No Smoking in Building”, in accordance with California statute prohibiting smoking in public buildings.
2. When functional spaces have individual entrances from exterior of building, or from courtyard, and such entrances are accessible, one sign can be placed on each exterior elevation stating “All Rooms Have Accessible Entrances.”
a. Include ISA on such signs, and include phrase: “No smoking in Building”.

B. Room Identification Signs:
1. Each permanent room and space identified by sign shall have sign installed adjacent to the it identifies, with raised characters and Braille.
a. This includes entrances to rooms and spaces, which are entered by exterior entrance or by door off interior corridor or courtyard, per CBC Chapter 11B.
2. Toilet Room identification signs shall include gender pictogram in 6 inch high field.
a. Pictogram field shall be located above raised character and Braille text on tactile sign, which is to be located adjacent to latch side of the door, per CBC Chapter 11B.
b. Where there is not adequate space for sign immediately adjacent to door, and door opens inward, gender pictogram, ISA, and raised characters and Braille can be included on geometric sign installed on door.

PART 3 – EXECUTION

3.01 INSTALLATION

A. General: Locate sign units and accessories where shown, scheduled, or directed by Architect.
1. Use mounting methods shown or selected by Architect.
2. Comply with manufacturer's instructions, and CCR, Title 24, Part 2, CBC Chapter 11 B.

B. Install level, plumb, and at proper height with sign surfaces free from distortion or other defects in appearance.
1. Cooperate with other trades for installation to finish surfaces.
2. Repair or replace damaged units as directed by Architect.

C. Cast Metal Plaques: Mount plaques using standard method recommended by manufacturer for type of wall surface indicated.
1. Concealed Mounting: Mount plaques by inserting threaded studs into tapped lugs on back of plaque. Set in predrilled holes filled with quick-setting cement.
   
2. Face Mounting: Mount plaques using exposed fasteners with rosettes attached through face of plaque into wall.

D. Tactile Sign Installation Height and Location:
1. Tactile characters on signs shall be located minimum 48 inches above finish floor or ground surface, measured from baseline of lowest Braille cells and 60 inches maximum above finish floor or ground surface, measured from baseline of highest line of raised characters.
   a. Where tactile sign is provided at door, sign shall be located alongside door at latch side.
   b. When at double doors with one active leaf, sign shall be located on inactive leaf.
   c. When at double doors with two active leaves, sign shall be located to right of right hand door.
   d. Where there is no wall space at latch side of single door or at right side of double doors, signs shall be located on nearest adjacent wall.
   e. Signs containing tactile characters shall be located so that clear floor space of 18 inches minimum by 18 inches minimum, centered on tactile characters, is provided beyond arc of door swing between closed position and 45 degree open position per CBC Section 11 B-703.4

E. Plastic Signs: Mount sign with aluminum T-type bracket, finish to match adjacent surface or adhesive mount with adhesive recommended by sign manufacturer for application to substrate.
1. Locate signs so that person may approach within 3 inches of sign without encountering protruding objects or standing within swing of door per CBC Chapter 11B.

3.02 CLEANING AND PROTECTION

A. At completion of installation, clean soiled sign surfaces in accordance with manufacturer's instructions.
1. Protect units from damage until acceptance by Owner.

END OF SECTION 10 1400
SECTION 10 2113
TOILET COMPARTMENTS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Solid Phenolic Toilet Compartments
   1. Hardware and accessories

1.02 RELATED SECTIONS

A. Section 10 2813: Toilet Accessories.

1.03 SUBMITTALS

A. Product Data: Manufacturer’s detailed technical data for materials, fabrication, color selection and installation, including catalog cuts of anchors, hardware, fastenings, and accessories.

B. Shop Drawings: Showing fabrication and erection of toilet compartment assemblies which are not fully described in manufacturer’s data; include anchorage and accessory items.
   1. Setting drawings, templates, and instructions for installation of anchorage devices built into other work.
   2. Locations of reinforcement and cutouts for compartment-mounted toilet accessories.

C. Samples for Verification: Minimum of four for each compartment or screen color and finish required, prepared on 6-inch square Samples of same thickness and material indicated for Work.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements:

B. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication where possible, to ensure proper fitting of Work.
   1. Allow for adjustments within specified tolerances wherever taking of field measurements before fabrication might delay Work.

C. Coordination: Furnish inserts and anchorages which must be built into other work for installation of toilet compartments and related work; coordinate delivery with other work to avoid delay.

D. Mock-Up: Upon request of Architect, submit minimum 1/4 scale mock-up of toilet partition; include door, pilasters, divider panels, shoes, and specified door and mounting hardware.
PART 2 – PRODUCTS

2.01 TYPE/MANUFACTURER

A. Type of Toilet Compartment:
   1. Solid Phenolic, Floor Anchored/Overhead Braced

B. Basis-of-Design: Design for Solid Phenolic Toilet Compartments is based on performance characteristics of Floor Anchored Color-Thru Phenolic Partitions, as manufactured by Accurate Partitions Corp.

C. Subject to compliance with specified requirements, comparable products may be submitted by alternate manufacturers in accordance with requirements for product substitutions specified in Section 01 6000 and following:
   1. Submit items listed in Article 1.02 and as specified in Section 01 3300, for evaluation of proposed system.
   2. Complete project shop drawings for similar project may be submitted for evaluation purposes, however shop drawings specific to this Project will be required from successful bidder.
   3. Approval is subject to availability of acceptable color.

2.02 MATERIALS

A. General: Provide materials which have been selected for surface flatness and smoothness.
   1. Exposed surfaces which exhibit pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections on finished units are not acceptable.

B. Material: Solid color-thru phenolic material with facing on both sides, fused to substrate during panel manufacturing process; without visible glue line or seam, with eased edges, with doors and pilasters minimum 3/4 inch finished thickness; and divider panels minimum 1/2 inch finished thickness.
   1. Color and Pattern: As scheduled.
   2. Core Color: Same as face laminate

C. Pilaster Shoes: ASTM A 167, Type 302/304 stainless steel, not less than 3 inches high, 22 gauge, finished to match hardware.

D. Hardware-General:
   1. Hardware to be 18-8, Type 304 stainless steel with satin finish.
   2. Screws: Vandal resistant one-way mounting screws throughout installed into threaded inserts ..
   3. Hardware of stainless steel or chrome plated. "Zamac" is unacceptable.
   4. Through bolting of hardware is unacceptable.

E. Door Latch: Sliding door latch, complying with CBC Chapter 11B, requiring less than 5 lb. force to operate; pinching or twisting latch operation is not acceptable.
   1. Center opening hardware between 30 and 44 inches above finish floor.
   2. Door Latch: 14 gage stainless steel latch with shock resistant nylon track sliding on one-piece 11 gage stainless steel keeper.
   3. Attach latch to door and stile by theft resistant one-way stainless steel machine screws into factory installed threaded metal inserts.
4. Provide latch handle with rubber bumper to act as door stop.
5. Metal to metal connection shall withstand direct pull of over 1000 lbs. per screw.
6. Provide loop-type vinyl coated aluminum pull immediately below latch on both sides of doors to accessible compartments.

F. Door Stops: Two 11 gage PVC coated steel stops, each attached with 2 stainless steel one-way machine screws.

G. Hinges: Surface mounted stainless steel gravity hinges attached to door and pilaster by theft resistant one-way stainless steel machine screws into factory installed metal inserts.
   1. Metal to metal connection shall withstand direct pull over 1,000 lbs. per screw.
   2. Fasten hinge to door by factory installed threaded metal inserts.
      a. Fasteners secured directly into core are not acceptable.
   3. Equip outswinging doors and doors to accessible compartments with self-closing hinge per CBC Chapter 11B.
   4. Manufacturer's standard vault-type hinge, subject to Architect's review.

H. Mounting Brackets: 18 gage stainless steel channel for attaching panels to walls and pilasters.
   1. Attach bracket to pilasters and panels with stainless steel screws, theft resistant where exposed, into factory installed metal inserts.
   2. Provide wall mounted urinal screen brackets of 11 gage double thickness.

I. Coat Hook: Combination stainless steel hook and rubber-tipped bumper, sized to prevent door hitting mounted accessories.
   1. Install maximum 48 inches above finish floor.

J. Leveling Device: 3/8 inch x 1 inch steel bar, chromate treated and double zinc plated; bolted to base of solid phenolic stile.

K. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, chromium-plated steel, or brass finished to match hardware, with theft-resistant type heads and nuts.
   1. For concealed anchors, use hot-dip galvanized, cadmium plated, or other rust-resistant protective-coated steel.

2.03 FABRICATION

A. General: Provide standard doors, panels, screens, and pilasters fabricated for compartment system, unless otherwise indicated.
   1. Furnish units with cutouts, drilled holes, and internal reinforcement to receive partition-mounted hardware, accessories, and grab bars, as indicated.

B. Door Swing: Unless otherwise indicated, furnish inswinging doors for standard toilet compartments and outswinging doors at accessible compartments.

C. Door Dimensions: Dimensions are for clear, unobstructed opening widths with door at 90 degree angle from closed position per CBC Chapter 11B.
   2. End Opening Accessible Compartments: 32 inches wide.
3. Side Opening Accessible Compartments: 34 inches wide.

D. Floor Mounted Partitions: Furnish galvanized steel supports and leveling bolts at pilasters, as recommended by manufacturer to suit floor conditions.
   1. Furnish shoe at each pilaster to conceal supports and leveling mechanism.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Comply with manufacturer's written installation instructions.
   1. Install units rigid, straight, plumb and level.
   2. Provide clearances of not more than 1/2 inch between pilasters and panels, and not more than 1 inch between panels and walls.
   3. Secure units in position with manufacturer's recommended anchoring devices.

B. Anchor through walls to wood blocking or metal backing plates furnished and installed under other sections.

C. Conceal evidence of drilling, cutting and fitting of wall, floor and ceiling finish.
   1. Maintain uniform clearance at vertical edge of doors from top to bottom, not exceeding 1/4 inch.
   2. Locate wall brackets so holes for wall anchorages occur in masonry or tile.

D. Floor mounted Partitions: Secure pilaster to floor with specified anchorage device.
   1. Level, plumb, and tighten installation with leveling device.

E. Screens: Attach with heavy duty concealed anchoring devices, recommended by manufacturer to suit supporting structure.
   1. Set units following manufacturer's instructions to provide support and to resist lateral impact.

3.02 ADJUST AND CLEAN

A. Hardware Adjustment: Adjust and lubricate hardware for proper operation.
   1. Set hinges on inswinging doors to hold open approximately 30 degrees from closed position when unlatched.
   2. Set hinges on outswinging doors (and entrance swing doors) and doors to accessible compartments to return to fully closed position.

B. Perform final adjustments to pilaster leveling devices, door hardware, and other operating parts of compartment assembly just prior to final inspection.

C. Clean exposed surfaces of compartments, hardware, fittings and accessories, and touch up minor scratches and other finish imperfections using materials and methods recommended by manufacturer.

D. Replace damaged units which cannot be satisfactorily field repaired, as directed by Architect.

END OF SECTION 10 2113
SECTION 10 2813
TOILET ACCESSORIES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Toilet accessories.
   2. Warm-air dryers.

B. Related Sections:
   1. Section 07 9200: Joint Sealants
   2. Section 09 2900: Gypsum Board
   3. Section 09 3000: Tile; mounting on tile walls.
   4. Section 10 2113: Toilet Compartments; accessories mounted on compartment walls.

C. Division 22 Sections for related plumbing fixtures and installation.

D. Schedule of Toilet Accessories: Each type of toilet accessory required is specified in schedule at end of this Section.

E. Refer to Drawings for location of Owner Furnished Contractor Installed (O.F.C.I.) accessories.

1.02 REFERENCES


B. ASTM International (ASTM):
   1. ASTM 153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
   2. ASTM A167 – Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
   3. ASTM A 653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
   4. ASTM A 666 – Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
   5. ASTM A 1008 – Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
   6. ASTM B 16 – Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines
   7. ASTM B 19 – Standard Specification for Cartridge Brass Sheet, Strip, Plate, Bar, and Disks
   8. ASTM B 30 – Standard Specification for Copper Alloys in Ingot Form
   9. ASTM F 446 – Standard Consumer Safety Specification for Grab Bars and
Accessories Installed in the Bathing Area


C. Federal Specifications (FS):

1.03 QUALITY ASSURANCE

A. Accessory requirements, including those for materials, finishes, dimensions, capacities, and performance, are established by specified products indicated in Toilet Accessory Schedule.
   1. Do not modify aesthetic effects, as judged solely by Architect, except with Architect's approval.
   2. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.

1.04 SUBMITTALS

A. Product Data: Include construction details, material descriptions, thicknesses, dimensions, profiles, fastening, and mounting methods, specified options, and finishes for each type of accessory specified.

B. Samples: Full-size samples of units, upon request, to Architect for review of design and operation.
   1. Acceptable samples will be returned and may be used in Work.
   2. Compliance with other requirements is exclusive responsibility of Contractor.

C. Matrix: Provide matrix indicating name of each room to receive accessories and type and quantity of each accessory to be provided in each room.

D. Setting Drawings: For cutouts required in other Work.
   1. Include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.

E. Operation and Maintenance Data:
   1. Maintenance data, operating instructions and keys required for each type of equipment and lock or accessories to include in maintenance manuals specified in Division 01.
   2. Provide lists of replacement parts and service recommendations.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver items in manufacturer's original unopened protective packaging.

B. Store materials in original protective packaging to prevent soiling, physical damage, or wetting.

C. Handle so as to prevent damage to finished surfaces.

D. Maintain protective covers on units until installation is complete.
   1. Remove covers at final clean up of installation.
1.06 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying Work.

1.07 WARRANTY

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

B. Manufacturer's Mirror Warranty: Written warranty, executed by mirror manufacturer agreeing to replace mirrors that develop visible silver spoilage defects within minimum warranty period indicated.
   1. Minimum Warranty Period: 15 years from date of Substantial Completion.

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Basis-of-Design: Model numbers specified for toilet Accessories are based on products as manufactured by Bobrick Washroom Equipment Co.
   1. Unless indicated otherwise, listed products are District Standard items and substitutions are not permitted.

2.02 MATERIALS – GENERAL

A. Stainless Steel: ASTM A 666, Type 304, with No.4 finish, 22 gage minimum, unless otherwise indicated.

B. Brass: ASTM B19, leaded and unleaded, flat products, ASTM B16; Rods, shapes, forgings, and flat products with finished edges; ASTM B 30 castings.

C. Sheet Steel: ASTM A 1008 cold-rolled, commercial quality 20 gage minimum, unless otherwise indicated.
   1. Surface preparation and metal pretreatment as required for applied finish.

D. Galvanized Steel Sheet: ASTM A 653, G60.

E. Chromium Plating: Nickel and chromium electro-deposited on base metal, ASTM B 456, Type SC 2.

F. Mirror Glass: ASTM C1036, Type I, Class 1, Quality q2, 1/4 inch thick, with silver coating, electroplated-copper protective coating, and nonmetallic paint coating comply with FS A-A-3002.

H. Fasteners: Screws, bolts, and other devices of same material as accessory unit tamper and theft resistant when exposed, galvanized steel where concealed.

2.03 FABRICATION

A. General: Stamped names or labels on exposed faces of toilet accessory units are not permitted, except where otherwise indicated
   1. Unobtrusive labels on surfaces not exposed to view are acceptable.

B. Surface-Mounted Toilet Accessories, General: Except where otherwise indicated, fabricate units with tight seams and joints, exposed edges rolled.
   1. Hang doors or access panels with continuous stainless steel piano hinge.
   2. Provide concealed anchorage wherever possible.

C. Recessed Toilet Accessories – Except where otherwise indicated, fabricate units of welded construction, without mitered corners.
   1. Hang doors or access panels with full-length stainless steel piano hinge.
   2. Provide anchorage which is fully concealed when unit is closed.

D. Mirrors: Provide mirror backing and support system which will permit rigid, tamperproof glass installation and prevent accumulation of moisture, as follows:
   1. Fabricate mirror frames with channel shapes of not less than 20 gage, with square corners carefully mitered to hairline joints and mechanically interlocked.

E. Grab Bars: Stainless steel type with wall thickness not less than 18 gage and as follows:
   1. Mounting: Concealed, manufacturer's standard flanges and anchorages.
   2. Gripping Surfaces: Smooth, satin finish, with manufacturer's standard non-slip texture on gripping surface.
   3. Heavy-Duty Size: Outside diameter of 1-1/4 inch.

F. Keys: Provide universal keys for internal access to accessories for servicing and resupplying.
   1. Where locks are required for particular type of toilet accessory, provide keyed-alike throughout Project.
   2. Furnish two keys for each lock and minimum of six keys to Owner's representative.

PART 3 – EXECUTION

3.01 INSPECTION

A. Check wall opening 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.

D. Do not begin installation of washroom accessories until openings and surfaces are acceptable to Contractor and Architect.
3.02 INSTALLATION

A. Install toilet accessory units following manufacturer's instructions, using fasteners appropriate to substrate and recommended by unit manufacturer.
   1. Mount toilet accessories required to be accessible in locations and at heights complying with CBC Sections 11B-602 through 11B-612.

B. Install units plumb, level, and firmly anchored in locations and at heights indicated.
   1. Use concealed fastenings wherever possible.
   2. Provide anchors, bolts and other necessary anchorages.
   3. Install concealed mounting devices and fasteners fabricated of same material as accessories, or of galvanized steel, as recommended by manufacturer.
   4. Install exposed mounting devices and fasteners finished to match accessories.
   5. Provide theft-resistant fasteners for accessory mountings.
      a. Finish of exposed fasteners to match items secured.
   6. Fit flanges of accessories snug to wall surfaces.
      a. Provide sealant in gaps between 90 degree return flanges and finish wall surface after accessories are installed.
      b. Comply with requirements of Section 07 9200 for mildew-resistant silicone sealant
         1) Do not use acrylic sealant

C. Secure mirrors to walls in concealed, tamperproof manner with special hangers or screws.
   1. Set unit plumbs, level, and square at locations indicated, following manufacturer's instructions for type of substrate indicated.

D. Grab Bars in Toilet Facilities:
   1. Install grab bars to withstand a downward load of at least 250 lb, when tested according to method in ASTM F 446.
   2. Comply with CBC Section 11B-609.
   3. Grab bars and wall or other surfaces adjacent to grab bars shall be free of sharp or abrasive elements and shall have rounded edges.
   4. Clearances:
      a. 1-1/2 inch clearance between wall surface and inside face of bar.
      b. 1-1/2 inch minimum between grab bar and projecting objects below and at ends.
      c. 12 inches minimum between grab bar and projecting objects above point of grab bar.
   5. Toilet paper and feminine napkin disposals when located on grab bar side of accessible toilet room or stall shall not project more than 3 inches from finished wall surface nor be located closer than 1-1/2 inches clear of tangent point of grab bar.
      a. Do not install surface mounted accessories above grab bar where they will restrict usability.

E. Conceal evidence of drilling, cutting and fitting on adjacent finishes.
3.03 ADJUSTING AND CLEANING

A. Adjust accessories for proper operation and verify that mechanisms function smoothly.
   1. Replace damaged or defective items.

B. Clean and polish exposed surfaces following manufacturer's recommendations after removing temporary labels and protective coatings.

3.04 CLOSE OUT

A. Deliver accessories schedule, keys, and parts manual as part of Project Closeout Documents.

B. For owner's permanent records, provide two sets of following items of manufacturer's literature:
   1. Technical data sheets of each item installed on Project.
   2. Service and parts manuals.
   3. Name and local representative to be contacted in event of need for field service or consultation.

3.05 SCHEDULE OF TOILET ACCESSORIES

A. Unless noted otherwise, provide toilet accessories equal to Bobrick Model Numbers listed below
   1. Stainless Steel Framed Mirror: B-290 series with 1/4 inch select float plate glass mirror with 15 year silver spoilage warranty.
      a. Frame shall be 3/4 inch welded seamless stainless steel beveled to glass.
      b. Size as indicated.
      a. Surface-mounted at each non-accessible stall.
   3. Dual Roll, Recessed Toilet Tissue Dispenser: B-3888 with theft-resistant spindles, stainless steel, at each accessible stall in toilet rooms.
  11. Warm-air Hand Dryer, automatic no-touch operation, surface mounted, maximum 4 inch projection: Model No. 0199 by American Specialties, Inc. ASI)

END OF SECTION 10 2813
SECTION 10 4400
FIRE PROTECTION SPECIALTIES

PART 1 – GENERAL

1.01 SECTION INCLUDES
A. Fire extinguishers
B. Fire extinguisher cabinets

1.02 REFERENCES
A. California Code of Regulations:
   1. Title 19 – Public Safety
   2. Title 24, 2013 edition:
      b. Part 9 – California Fire Code (CFC).

B. National Fire Protection Association (NFPA):

1.03 QUALITY ASSURANCE
A. Provide portable fire extinguishers, cabinets and accessories by one manufacturer, unless otherwise acceptable to Architect.
B. UL-Listed Products: Provide new portable fire extinguishers which are UL Listed and bear UL "Listing Mark" for type, rating, and classification of extinguisher indicated.
C. Provide fire extinguishers as required by CCR, Title 19 and NFPA 10.

1.04 SUBMITTALS
A. Product Data: Manufacturer's technical data and installation instructions for portable fire extinguishers required.
   1. For fire extinguisher cabinets include roughing-in dimensions, and details showing mounting methods, relationships to surrounding construction, door hardware, cabinet type and materials, trim style and door construction, style and materials.
   2. Where color selection by Architect is required include color charts showing full range of manufacturer's standard colors and designs available.

B. Samples: Minimum of four, 6 inch square, of each required finish.
   1. Prepare samples on metal of same gage as metal to be used in Work.
PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with specified requirements, provide products of one of following:
   1. JL Industries.
   2. Larsen's Mfg. Co. (Basis-of-Design)
   3. Potter-Roemer Inc.
   4. Standard Fire-West

2.02 FIRE EXTINGUISHERS (FE)

A. General: Provide fire extinguishers for each extinguisher cabinet and other locations indicated, in colors and finishes selected by Architect from manufacturer's standard which comply with requirements of governing authorities.

B. Multi-Purpose Dry Chemical Type: UL-rated 2-A:10-B:C, 5 lb. nominal capacity, in enameled steel container, for Class A, Class B and Class C fires.

2.03 FIRE EXTINGUISHER CABINETS (FEC)

A. General: Provide fire extinguisher cabinets where indicated, of suitable size for housing fire extinguishers of types and capacities indicated.
   1. Comply with CBC Chapters 11B-205 and 11B-403.5.1

B. Construction: Manufacturer's standard enameled steel box, with trim, frame, door and hardware to suit cabinet type, trim style, and door style indicated.
   1. Weld joints and grind smooth.
   2. Miter and weld perimeter door frames.

C. Cabinet Type: Suitable for mounting conditions indicated, of following types:
   1. Recessed: Cabinet box (tub) fully recessed in walls of sufficient depth to suit style of trim indicated.

D. Trim Style: Fabricate trim in one piece with corners mitered, welded and ground smooth.
   1. Exposed Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
      a. Flat Trim: Square edges with backbend of 5/16

E. Door Material and Construction: Manufacturer's standard door construction, of material indicated, coordinated with cabinet types and trim styles selected.
   1. Stainless Steel: Manufacturer's standard stainless steel door construction.

F. Door Style: Manufacturer's standard design as indicated below and on Drawings.
   1. Duo-Panel: Float glass, 1/8 inch thick, unless otherwise indicated.

G. Door Hardware: Provide manufacturer's standard door operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
   1. Provide surface mounted door pull with Larsen-Loc.
2. Provide concealed or continuous type hinge permitting door to open 180 degrees.

   1. Model No. 2409-R1 for non-rated cabinets.

2.04 FACTORY FINISHING OF FIRE EXTINGUISHER CABINETS

A. General: Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations except as otherwise indicated.
   1. Apply finishes in factory after products are assembled.
   2. Protect cabinets with plastic or paper covering, prior to shipment.

B. Painted Finish for Box:
   1. Preparation: Clean surfaces of dirt, grease, and loose rust or mill scale.
      a. Apply finish to surfaces of fabricated and assembled units, whether exposed or concealed when installed, except those surfaces specified to receive another finish.
   2. Baked Enamel Finish: Immediately after cleaning and pretreatment, apply manufacturer's standard baked enamel coating.
      a. Provide manufacturer's standard white color.

C. Stainless Steel Finish for Doors and Trim: No.4 polished finish.
   1. Furnish with paper masking to protect finish.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets are to be installed.

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

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

3.02 INSTALLATION

A. Comply with manufacturer's written instructions for installing fire extinguishers and cabinets.

B. Install in locations and at mounting heights indicated, or if not indicated, at heights to comply with applicable regulations of governing authorities.
   1. Mount fire extinguishers with handles 48 inches above finished floor.
   2. Prepare recesses for cabinets as required by type and size of cabinet and style of trim and to comply with manufacturer's instructions.
   3. Fasten cabinets to structure, square and plumb.
3.03 IDENTIFICATION

A. Identify fire extinguisher in cabinet with vertical die-cut lettering spelling "FIRE EXTINGUISHER".
   1. Provide lettering on door as indicated.
   2. Letter Color: Black

END OF SECTION 10 4400
SECTION 12 2413
ROLLER SHADES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Manually operated, chain drive, single roller sunscreen shades at exterior
      window openings where indicated on Drawings.

B. Related Sections:
   1. Section 06 1000: Rough Carpentry; blocking for support of window
      shade bracket assemblies.
   2. Section 08 4113: Aluminum Entrances and Storefronts.
   3. Section 09 2500: Gypsum Board; substrate for window shade systems
      and installation of accessories supplied under this Section.

1.02 REFERENCES

A. California Code of Regulations (CCR), Title 24, Part 2, California Building Code

B. ASTM International (ASTM):
   1. ASTM E 84 – Standard Test Method for Surface Burning Characteristics of
      Building Materials
   2. ASTM G 21 – Standard Practice for Determining Resistance of Synthetic
      Polymeric Materials to Fungi

C. National Fire Protection Association (NFPA):
      and Films.

1.03 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer: 20 years minimum experience manufacturing products
      comparable to those specified in this section.
   2. Installer: 5 years minimum experience installing products comparable to those
      specified in this section.

B. Field Samples: Install large size sample of selected fabric for final verification of
   color, weave and density, in opening as directed by Architect.

C. Do not fabricate shades without obtaining field dimensions for each opening.
   1. Coordinate construction of surrounding conditions to allow for timely field
      dimension verification.

D. Pre-installation Meetings: Conduct in accordance with requirements of Division 01
   and following:
1. Review access requirements for material delivery.
2. Review storage and security requirements.
3. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
4. Review structural loading limitations.
5. Review coordination with other installers whose work interfaces with or affects roller shades.
6. Review and finalize construction schedule and verify availability of materials, installer's personnel, and facilities needed to make progress and avoid delays.

1.04 SUBMITTALS

A. Product Data: Manufacturer's product data sheets, performance data, and installation instructions for each item required.

B. Shop Drawings:
   1. Interior Elevations at 3/8 inch equals 1 foot – 0 inch scale minimum, indicating shade layout, seam/batten locations and coordination with surrounding conditions.
   2. Floor plans or reflected ceiling plans showing overall arrangement of shades and control locations.
   3. Head, jamb, and sill details as necessary to coordinate Work with surrounding conditions and construction.
   4. Shade Schedule coordinating room number, window type, opening size, shade type, quantities, and key to details.

C. Samples:
   1. Verification Samples:
      a. One fully operational window shade sample of each type required 30 inch by 30 inch complete with selected shade cloth including sample of seam/batten when applicable.
         1) Disassemble sample to demonstrating compliance with Part 2.
      b. One complete set of shade components, unassembled, demonstrating compliance with Part 2.
   2. Design Data, Test Reports, and Certificates: Current reports from independent testing laboratories demonstrating compliance with Performance Article
   3. Manufacturer's Instructions: Manufacturer's standard installation instructions.

D. Maintenance Data: For roller shades to include in maintenance manuals.
   1. Include following:
      a. Methods for maintaining roller shades and finishes.
      b. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
      c. Operating hardware.

1.05 PROJECT CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at levels indicated for Project when occupied for its intended use.
B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicated measurements on Shop Drawings.
1. Allow clearances for operable glazed units’ operation hardware throughout entire operating range.
3. Coordinate fabrication schedule with construction progress to avoid delaying Work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection:
1. Do not deliver items to Project until concrete, masonry, painting, and other wet work has been completed and is dry.
2. Deliver shades to Project in labeled protective packaging.
   a. Uniquely labeled to identify each shade for each opening.
   b. Schedule delivery to prevent delays to completion of Work but to minimize on site storage time.
3. Store materials in dry secure place.
   a. Protect from weather, surface contaminants, corrosion, construction traffic and other potential damage.

1.07 WARRANTY

A. Special Warranty:
   a. Warranty period to be Lifetime Limited Warranty to original purchaser and contain provisions that installation is to remain operational without fault for warranty period and include operating parts, including shade cloth and mounting brackets.
   b. Lifetime Limited Warranty is defined to be life of Project for which it was originally purchased, not to exceed 25 years from date of Substantial Completion.
2. In event of warranted product failure, shade contractor will, at no cost to Owner, facilitate acquisition and delivery of necessary components to Owner.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design: To establish standard of quality, design, and function desired, design of roller shades is based on products by MechoShade Systems, Inc.

B. Subject to compliance with specified requirements, provide named product or comparable product by following, or approved equal:
   1. Draper, Inc.

2.02 COMPONENTS

A. Shade Bands: Construction of shade band includes fabric, hem bar and hem pocket, and attachment of shade band to roller tube:
   a. Dense Basket Weave: 1300 Series, 5 percent open, 2 x 2 dense basket-weave pattern.
   b. Color: As scheduled.

3. Hem Bars and Hem Pockets:
   a. Fabric hem pocket with RF-welded seams (including welded ends) and concealed hem weights.
      1) Provide hem weights of appropriate size and weight for shade band, continuous inside sealed hem pocket.
      2) Match hem pocket construction for shades in same rooms.

B. Manually Operated Hardware and Shade Brackets:
   1. Provide for regular and offset drive capacity (chain fall at front or rear of bracket) on shade drive end brackets.
   2. Provide shade hardware system that allows for following:
      a. Removal of shade roller tube from brackets without removing hardware from opening.
      b. Operation of multiple shade bands by single chain (Multi-banded shades) operator subject to manufacturer's design criteria.
      c. Multi-banded manually operated shades to be capable of smooth operation when offset maximum of 6 degrees on each side of plane perpendicular to radial line of curve (12 degrees total offset).
   3. Provide positive mechanical engagement of drive mechanism to shade roller tube.
      a. Do not rely on friction fit connections for drive mechanism to shade roller tube.
   4. Provide shade hardware constructed of minimum 1/8 inch thick cadmium plated steel or heavier as required to support 150 percent of full weight of each shade.
   5. Use only Delrin engineered plastics for plastic components of shade hardware.
      a. Styrene based plastics are not acceptable.

2.03 FABRICATION

A. Fabricate units to completely fill existing openings from head to sill and jamb-to-jamb, unless specifically indicated otherwise.
   1. Comply with Manufacturer's edge clearance standards and recommendations.

B. Fabricate shade cloth to hang flat without buckling or distortion.
   1. Fabricate with heat-sealed trimmed edges to hang straight without curling or raveling.
   2. Fabricate unguided shade cloth to roll true and straight without shifting sideways more than 1/8 inch in either direction per 8 feet of shade height due to warp distortion or weave design.

C. Provide battens in non-railroaded shades as required by manufacturer to assure proper tracking and uniform rolling of shade bands.
D. For railroaded shade bands, provide seams or battens in railroaded multi-width shade bands as required by Manufacturer to meet Width/Height ratios and size requirements.
   1. Unless specified elsewhere, manufacturer's standard seam/batten placements are acceptable to Architect.
   2. When custom placement of seams/battens are required, coordinate these locations with design requirements.

E. Provide batten pockets utilizing self-colored fabric front and back, RF welded into shade cloth.
   1. Provide self-colored opaque liner front and back to eliminate see through of batten pocket that shall not exceed 1-1/2 inches high and be totally opaque.
      a. See-through moire effect, which occurs with multiple layers of transparent fabrics, is not acceptable.
   2. Reinforce batten pockets using coil coated, roll formed spring steel to insure flatness of shade bands in accordance with manufacturer's standards.
   3. Design formed profile of batten stiffeners to be compatible with diameter of shade roller tube.

2.04 FINISHES

A. Aluminum Components:
   1. Manufacturer's standard finish on concealed aluminum components.
   2. Finish on exposed aluminum components shall match that of aluminum storefront components.

B. Steel Components: Cadmium-plated, satin-finished, or bonderized prior to painting with specified finish per Section 09 9100.
   1. Color: As scheduled.

C. Provide finishes on surfaces exposed to view to match finish/color of adjacent surfaces.

2.05 PERFORMANCE REQUIREMENTS

A. Fire Resistance: Provide shade fabrics tested in accordance with following:
   1. NFPA 701-Vertical Burn Test, small and large, and rated "Pass".
   2. ASTM E 84:
      a. Flame Spread Index: 17
      b. Smoke Developed Index: 118

B. Toxicity: Provide shade fabrics tested in accordance with University of Pittsburgh Toxicity Protocol including LC50 analysis and toxicity characteristics.

C. Anti-microbial: Comply with requirements of ASTM G 21 indicating minimum 0.197 Inch, "No Growth Contact Area".

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrate and conditions for installation.
   1. Do not commence installation until conditions are satisfactory.
2. Notify Architect upon inspection when Project conditions are unacceptable for shade installation.
3. Commencement of installation indicates acceptance of Site conditions by Contractor.

3.02 INSTALLATION

A. Install units to comply with manufacturer’s instructions for type of mounting and operation required.
   1. Provide units plumb, true, and securely anchored in place with recommended hardware and accessories to provide smooth operation without binding.

B. Install units within following tolerances:
   1. Maximum variation of gap at window opening perimeter: 1/4 inch, per 8 feet (±1/8 inch) of shade height.
   2. Maximum offset from level: 1/16 inch per 5 feet of shade width.

3.03 ADJUSTING

A. Adjust drive/brake mechanism of units for smooth operation.
   1. Adjust shade and shade cloth to hang flat without buckling or distortion.
   2. Replace units or components, which do not hang properly or operate smoothly.

3.04 CLEANING

A. Touch up damaged finishes and repair minor damage in order to eliminate evidence of repair.
   1. Remove and replace Work that cannot be satisfactorily repaired.

B. Clean exposed surfaces, including metal and shade cloth, using non-abrasive materials and methods recommended by shade cloth manufacturer.
   1. Remove and replace Work, which cannot be satisfactorily cleaned.

3.05 DEMONSTRATION

A. Demonstrate operation method and instruct Owner’s personnel in proper operation and maintenance of window shade systems.

END OF SECTION 12 2413
SECTION 14 2123

ELECTRIC TRACTION ELEVATORS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Removal of existing electric traction elevators, machines, platforms, car
      enclosures and related equipment.
   2. Installation of two new electric traction elevators in existing hoistways.
   3. Installation of new equipment in existing machine rooms.
   4. Installation of new elevators cabs and controls.
   5. Operational verification of equipment.

B. Related Sections:
   1. Section 05 5000: Metal Fabrications; pit ladder, supports for entrances,
      rails and hoisting beam at top of elevator hoistways.
   2. Section 07 1616: Crystalline Waterproofing; waterproofing of elevator pits.
   3. Section 10 1400: Signage; required elevator signage.

C. Refer to Division 23, 26, 27, and 28 Sections for related HVAC, electrical, and
   communications work related to elevator installation.

1.02 REFERENCES

A. California Code of Regulations (CCR), Title 24:
      a. Chapter 11B – Accessibility to Public Buildings, Public Accommodations,
         Commercial Buildings, and Public Housing.

B. California Department of Industrial Relations:
   1. Chapter 4 – Division of Industrial Safety:
      a. Subchapter 6 – Elevator Safety Orders

C. American National Standards Institute (ANSI).

D. National Fire Protection Association (NFPA):

E. American Society of Mechanical Engineers (ASME):

F. UL, LLC (UL):
   1. UL 10B – Standard for Fire Tests of Door Assemblies

1.03 QUALITY ASSURANCE

A. Manufacturer: Elevator manufacturer shall be ISO 9001 certified.
B. Installer: Elevators shall be installed by manufacturer or an authorized factory-trained installer.

C. Permits, Inspections and Certificates:
   1. Elevator contractor shall obtain and pay for necessary Municipal or State Inspections and permits required by elevator inspection authority
   2. Make tests as called for by regulations or authorities.
      a. Tests shall be made in presence of authorities or their authorized representatives.

1.04 SUBMITTALS

A. Product Data: Manufacturer’s product data for each system proposed for use as follows:
   1. Signal and operating fixtures, operating panels and indicators.
   2. Cab design, dimensions and layout.
   3. Hoistway-door and frame details.
   4. Electrical characteristics and connection requirements.
   5. Expected heat dissipation of elevator equipment in hoistway (BTU).
   6. Color selection chart for Cab and Entrances.

B. Shop Drawings: Approval layout drawings, indicating following:
   1. Car, guide rails, buffers and other components in hoistway.
   3. Maximum loads imposed on guide rails requiring load transfer to building structure.
   4. Clearances and travel of car.
   5. Clear inside hoistway and pit dimensions.
   6. Location and sizes of access doors, hoistway entrances and frames.


1.05 SYSTEM DESCRIPTION

A. Equipment Description: Manufacturer’s standard electric traction elevators with separate machine rooms conforming to following:
   1. Equipment Control: Manufacturer’s Standard Control System.
   2. Drive: Manufacturer’s Standard
   3. Quantity of Elevators: Two
   4. Stops: Six, including basement.
   5. Openings: In line.
   6. Travel (maximum): 90 feet
   8. Rated Speed: 150 fpm.
   9. Platform Size: 7 feet 7-1/2 inches W x 5 feet 11 inches D.
   10. Clear Inside Dimensions: 6 feet 9-1/2 inches W x 5 feet 7 inches D.
   11. Cab Height: 8 feet 7 inches
   12. Clear Cab Height: 7 feet 11 inches.
   13. Entrance Type and Width: Two speed doors at 42 inches.
   14. Entrance Height: 7 feet 0 inches – field verify.
   15. Main Power Supply: Refer to electrical drawings.
17. Machine Location: Inside existing machine rooms.
18. Signal Fixtures: Manufacturer’s standard complying with California accessibility requirements.
20. Performance:
   a. Car Speed: Plus 3 percent of contract speed under any loading condition or direction of travel.
   b. Car Capacity: Safely lower, stop and hold up to 120 percent of rated load as required by code.
   c. Ride Quality:
      1) Vertical Vibration (maximum): 20 milli-g
      2) Horizontal Vibration (maximum): 12 milli-g
      3) Vertical Jerk (maximum): 4.59 plus or minus 1.0 ft./sec³
      4) Acceleration/Deceleration (maximum): 2.62 ft./sec²
      5) In Car Noise: 55 – 60 dB(A)
      6) Stopping Accuracy: Plus or minus 0.375 inch maximum, typical.
      7) Re-leveling Distance: Plus or minus 0.5 inch.
21. Operation:
   b. In the absence of system activity, one car can be made to park at pre-selected main landing, with other (free) car remaining at last landing served.
      1) Only one car shall respond to hall call.
      2) When either car is removed from service, other car shall immediately answer all hall calls, as well as its own car calls.
22. Operating Features – Standard
   a. Full Collective Operation
   b. Anti-nuisance.
   c. Fan and Light Protection.
   d. Load Weighing Bypass.
   e. Independent Service.
   f. Full Collective Operation.
   g. Firefighters' Service Phase I and Phase II.
   h. Top of Car Inspection.
   i. Zoned Car Parking.
   j. Relative System Response Dispatching.
23. Door Control Features:
   a. Door control to open doors automatically when car arrives at landing in response to normal hall or car call.
   b. Elevator doors shall be provided with reopening device that will stop and reopen car doors and hoistway doors automatically should doors become obstructed by object or person.
      1) Door protection shall consist of two dimensional, multi-beam array projecting across car door opening.
   c. Door nudging operation to occur when doors are prevented from closing for adjustable period of time.
24. Provide equipment according to Seismic Zone 4.

1.06 PROJECT CONDITIONS

A. Project consists of installation of two new elevators in existing elevator hoistway shafts and pits.
B. Field Measurement:
1. Elevator contractor shall verify by field measurements existing dimensions of hoistways, pits, and machine rooms to ensure adequate space will be available for new installation.
2. Indicate field measurements on shop drawings.
3. Advise, Contractor, Owner, and Architect of conflicts or issues that may arise with elevator installation after field measurement verification.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Should Building or Project Site not be prepared to receive elevator equipment at agreed upon date, Contractor will be responsible to provide proper and suitable storage area on or off premises.

B. Should storage area be off-site and equipment not yet delivered, elevator contractor, upon notification from Contractor, will divert elevator equipment to storage area.
   1. Where equipment has already been delivered to Project Site, Contractor shall transport elevator equipment to storage area.
   2. Cost of elevator equipment taken to storage by either party, storage, and redeliver to Project Site shall be at expense of Contractor.

1.08 REGULATORY REQUIREMENTS

A. Applicable Codes: Comply with applicable building and elevator codes referenced in this Section, at Project Site.

1.09 WARRANTY

A. Elevator contractor’s acceptance is conditional on understanding that their warranty covers defective material and workmanship.
   1. Warranty period shall not extend longer than one year from date of Substantial completion or acceptance by beneficial use, whichever is earlier, of each elevator.
   2. Warranty excludes: ordinary wear and tear, improper use, vandalism, abuse, misuse, or neglect or other causes beyond control of elevator contractor.
   3. This express warranty is in lieu of other warranties, express or implied, including warranty of merchantability or fitness for particular purpose.

1.10 MAINTENANCE AND SERVICE

A. Maintenance service consisting of regular examinations and adjustments of elevator equipment shall be provided by elevator contractor for period of twelve months after elevator has been turned over for Owner’s use.
   1. Service shall not be subcontracted but shall be performed by elevator contractor.
   2. Work shall be performed by competent employees during regular working hours of regular working days.
   3. Service shall not cover adjustments, repairs or replacement of parts due to negligence, misuse, abuse or accidents caused by persons other than elevator contractor.
   4. Only genuine parts and supplies as used in manufacture and installation of original equipment shall be provided.
B. Periodic lubrication of elevator components shall not be required, including:
   1. Sheaves, Rails, Belts, Ropes, Car and CWT guides.

C. Elevator control system must:
   1. Provide in controller necessary devices to run elevator on inspection operation.
   2. Provide on top of car necessary devices to run elevator in inspection operation.
   3. Provide in controller emergency stop switch.
      1) Emergency stop switch when opened disconnects power from brake and
         prevents motor from running.
   4. Provide, in event of power outage, means from controller to electrically lift and
      control elevator brake to safely bring elevator to nearest available landing.
   5. Provide means from controller to reset governor over speed switch and also
      trip governor.
   6. Provide means from controller to reset emergency brake when set because of
      unintended car movement or ascending car over speed.
   7. Optional: Provide means from controller to reset elevator earthquake operation.

D. Provide system capabilities to enable remote expert to create live, interactive
   connection with elevator system to enable following functions:
   1. Remotely diagnose elevator issues with remote team of experts
   2. Remotely return elevator to service
   3. Provide real-time status updates via email
   4. Remotely make changes to selected elevator functions including:
      a. Control Building Traffic: Restrict floor access, remove car from group
         operation, shut down elevator, select up peak/down peak mode, activate
         independent service
      b. Conserve Energy: Activate cab light energy save mode, activate fan
         energy save mode, shut down cars
      c. Improve Passenger Experience: Extend door open times, change parking
         floor, activate auto car full, activate anti-nuisance, advance door opening,
         door nudging, extend specific floor extended opening time, release
         trapped passengers

PART 2 – PRODUCTS

2.01 DESIGN AND SPECIFICATIONS

A. Provide electric traction passenger elevators.
   1. Control system and car design based on materials and systems manufactured
      by one of following or approved equal:
      a. Mitsubishi Electric US, Inc.
      b. Otis Elevator Company
      c. Schindler Elevator

B. Specifically, system shall consist of following components:
   1. Controller located inside machine room
   2. Polyurethane Coated-Steel Belts for elevator hoisting purposes.
   3. LED lighting standard in ceiling lights and elevator fixtures.
   4. Sleep mode operation for LED ceiling lights and car fan.

C. Approved Installer: Elevator manufacturer or factory-trained installation company.
2.02 EQUIPMENT – CONTROLLER COMPONENTS

A. Controller: Microcomputer based control system shall be provided to perform functions of safe elevator operation.
   1. System shall also perform car and group operational control.
   2. High voltage (110V or above) contact points inside controller shall be protected from accidental contact when controller doors are open.
   3. Controller shall be separated into two distinct halves:
      a. Motor Drive side and Control side.
      b. High voltage motor power conductors shall be routed so as to be physically segregated from rest of controller.
   4. Field conductor terminations points shall be segregated:
      a. High voltage, greater than 30 volts DC and 110 VAC.
      b. Low voltage, less than 30 volts DC.
   5. Controllers shall be designed and tested for Electromagnetic Interference (EMI) immunity according to EN 12016 - EMC Product Family Standards for lifts, escalators, and passenger conveyors Part 2 – Immunity.
   6. Controller shall be located inside machine room.

B. Drive: Variable Voltage Variable Frequency AC drive system shall be provided.
   1. Drive shall be set up for regeneration of AC power back to building grid.

2.03 EQUIPMENT – MACHINE AND GOVERNOR

A. Machine: AC gearless machine, with a synchronous permanent-magnet motor, dual solenoid service and emergency disc brakes, mounted elevator machine room.

B. Governor: Governor shall be tension type car-mounted governor.

C. Buffers, Car and Counterweight: Polyurethane type buffers shall be used.

D. Hoistway Operating Devices:
   1. Emergency stop switch in pit
   2. Terminal stopping switches.

E. Positioning System: Consists of encoder, reader box, and door zone vanes.

F. Guide Rails and Attachments: Guide rails shall be Tee-section steel rails with brackets and fasteners.
   1. Side counterweight arrangements shall have dual-purpose bracket that combines both counterweight guide rails, and one of car guide rails to building fastening.

G. Coated-Steel Belts: Polyurethane coated belts with high-tensile-grade, zinc-plated steel cords and flat profile on running surface and backside of belt.
   1. Driving sheaves and deflector sheaves should have crowned profile to ensure center tracking of belts.
   2. Continuous 24/7 monitoring system using resistance based technology has to be installed to continuously monitor the integrity of the coated steel belts and provide advanced notice of belt wear.

H. Governor Rope: Governor rope shall be steel and shall consist of at least eight strands wound about sisal core center.
I. Fascia: Galvanized sheet steel shall be provided at front of hoistway.

J. Hoistway Entrances:
   1. Frames: Entrance frames shall be of bolted construction for complete one-piece unit assembly.
      a. Frames shall be securely fastened to fixing angles mounted in hoistway and shall be of UL fire rated steel.
   2. Sills shall be extruded aluminum.
   3. Doors: Entrance doors shall be of metal construction with vertical channel reinforcements.
   4. Fire Rating: Entrance and doors shall be UL fire rated for 1-1/2 hour.
   5. Entrance Finish: To be determined.
   6. Entrance Marking Plates: Entrance jambs shall be marked with 4 inch x 4 inch plates having raised floor markings with Braille located adjacent to floor marking.
      a. Marking plates shall be provided on both sides of entrance.
      b. Raised lettering and Braille shall conform to California Contracted Grade 2 as specified in Section 10 1400.
   7. Sight Guards: Sight guards will be furnished painted to match painted doors.

2.04 EQUIPMENT – CAR COMPONENTS

A. Car frame and Safety: Car frame fabricated from formed or structural steel members shall be provided with adequate bracing to support platform and car enclosures.
   1. Car safety shall be integral to car frame and shall be Type "B", flexible guide clamp type.

B. Cab:
   1. Cab Options: Steel Shell Cab with painted vertical removable panels
      a. Paints to be selected from manufacturer’s standard line

C. Car Front Finish: Satin Stainless Steel.

D. Car Door Finish: Satin Stainless Steel.

E. Ceiling Type: To be determined.

F. Emergency Car Lighting: Emergency power unit employing 6-volt sealed rechargeable battery and totally static circuits shall be provided to illuminate elevator car in event of building power failure.

G. Fan: Single speed 120 VAC fan will be mounted to ceiling to facilitate in-car air circulation, meeting ASME A17.1 code requirements.
   1. Fan shall be rubber mounted to prevent transmission of structural vibration and will include baffle to diffuse audible noise.
   2. Switch shall be provided in car-operating panel to control fan.

H. Handrail: Handrails shall be provided on rear wall of car enclosure.
   1. Handrails shall be 1-1/2 inch diameter round bar handrail with satin stainless Finish.

I. Threshold: Extruded Aluminum.
J. Emergency Exit Contact: Electrical contact shall be provided on car-top exit.

K. Guides: Car shall have 3 inch diameter roller guides at top and bottom and counterweight shall have slide type guides at top and bottom.

L. Platform: Car platform shall be constructed of metal.
   1. Load weighing device shall be mounted on belts at top of hoistway.


N. LED ceiling lights and fan should automatically shut off when system is not in use and be powered back up after passenger calls elevator and pushes hall button.

2.05 EQUIPMENT – SIGNAL DEVICES AND FIXTURES

A. Car Operating Panel: Car operating panel shall be provided which contains push buttons, key switches, and message indicators for elevator operation.
   1. Car operating panel shall have satin stainless steel finish.
   2. Car operating panel shall be furnished containing bank of round stainless steel mechanical LED illuminated buttons.
   3. Flush mounted to panel and marked to correspond to landings served.
      a. Buttons to have raised numerals and Braille markings with:
         1) Lexan 1/8 inch projecting fully illuminated button with white LED
   4. Car operating panel shall be equipped with following features:
      a. Raised markings and Braille to the left hand side of each push-button.
      b. Car Position Indicator at top of and integral to car operating panel.
      c. Door open and door close buttons.
      d. Inspection key-switch.
      e. Elevator Data Plate marked with elevator capacity and car number.
      f. Help Button: Help button shall initiate two-way communication between car and location inside building, switching over to another location when call is unanswered, where personnel are available who can take appropriate action.
         1) Visual indicators are provided for call initiation and call acknowledgement.
      g. Landing Passing Signal: Chime bell shall sound in car to signal that car is either stopping at or passing floor served by elevator.
      h. In-car stop switch (toggle or key complying with local code)
      i. Firefighter’s hat.
      j. Firefighter’s Phase II Key-switch.
      k. Call Cancel Button
   5. Car Position Indicator: Digital, LED car position indicator shall be integral to car operating panel.

B. Hall Fixtures: Hall fixtures shall be provided with necessary push buttons and key switches for elevator operation.
   1. Integral Hall fixtures shall feature round stainless steel, mechanical buttons marked to correspond to landings.
   2. Hall fixtures to be located in entrance frame face or wall.
      a. Buttons shall be in vertically mounted fixture.
      b. Fixture shall be satin stainless steel finish.
3. Buttons:
   a. Lexan 1/8 inch projecting fully illuminated button with white LED.

C. Car Lantern and Chime: Directional lantern visible from corridor shall be provided in car entrance.
   1. When car stops and doors are opening, lantern shall indicate direction in which car is to travel and chime will sound.

D. Access key-switch at lowest floor in entrance jamb.

E. Emergency (Standby) Power Key-Switch: Manual selection of each elevator in normal operation after automatic return in standby power operation has been initiated.

PART 3 – EXECUTION

3.01 PREPARATION

A. Take field dimensions and examine conditions of substrates, supports, and other conditions under which Work is to be performed.
   1. Do not proceed with Work until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Installation of elevator components except as specifically provided for elsewhere.

3.03 DEMONSTRATION

A. Elevator contractor shall make final check of each elevator operation with Owner or Owner’s Project Inspector present prior to turning each elevator over for use.
   1. Elevator contractor shall determine that control systems and operating devices are functioning properly.

END OF SECTION 14 2123
SECTION 21 1300
AUTOMATIC FIRE SPRINKLERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This Section specifies automatic sprinkler systems and stand pipe and hose systems for buildings and structures. Materials and equipment specified in this Section include:
   1. Pipe, fittings, valves, and specialties.
   2. Sprinklers.

B. Products furnished but not installed include sprinkler head cabinet with spare sprinkler heads. Furnish to the District's maintenance personnel.

1.02 RELATED SECTIONS

A. The following Sections contain requirements that relate to this Section:
   1. Division 33, Section "Water Distribution Systems"
   2. Division 33, Section "Private Fire Service Mains" for fire protection piping from fire service mains to and including water meter and backflow preventer.
   3. Division 22, Section "Mechanical Identification" for labeling and identification of fire protection piping systems and components.

1.03 DEFINITIONS

A. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).

B. Other definitions for fire protection systems are listed in NFPA Standards 13, 14, and 24.

C. Working Plans as used in this Section means those documents (including drawings and calculations) prepared pursuant to the requirements contained in NFPA 13 for obtaining approval from Division of the State Architect (DSA).

1.04 SYSTEM DESCRIPTION

A. FIRE PROTECTION SYSTEM is a "Wet-Pipe" system per Design criteria set forth in NFPA 13, 2013 Edition, employing automatic sprinklers attached to a piping system containing water and connected to a water supply so that water discharges immediately from sprinklers opened by fire.

1.05 SUBMITTALS

A. Product Data for each type sprinkler head, valve, piping specialty, fire protection specialty, and fire department connection specified. Attach current listings.
B. Shop Drawings prepared in accordance with NFPA 13 (2013 Edition) identified as "Working Plans," including hydraulic calculations where applicable, and which have been approved, by the authority having jurisdiction. Shop drawings shall include riser diagram, for each building, spacing between transverse bracing and lateral bracing. Identify reason for areas not protected. Standard heads shall be used, unless prohibited. Use symbol list, show rigid and flexible connections, hanger, rise or drop. A & B shall be submitted together, including hydraulic calculation, data on private fire main and hydrant test.

C. Maintenance Data for each type sprinkler head, valve, piping, specialty, fire protection specialty, fire department connection, hose and rack, and hose cabinet specified, for inclusion in operating and maintenance manual specified in Division 01 and Division 22, Section "Basic Mechanical Requirements." Shall be used in Owner training.

D. Welder's qualification certificates.


1.06 QUALITY ASSURANCE

A. Installer Qualifications: Installation and alterations of fire protection piping, equipment, specialties, and accessories, and repair and servicing of equipment shall be performed only by a qualified installer. The term qualified means experienced in such work (experienced shall mean having a minimum of 5 previous projects similar in size and scope to this project), familiar with all precautions required, and has complied with all the requirements of the authority having jurisdiction. Upon request, submit evidence of such qualifications to the Architect. Refer to Division 01 Section, "Definitions and Standards" for definitions for "Installers." Installer shall have valid State of California Contractor's License.

B. Qualifications for Welding Processes and Operators: Comply with the requirements of AWS D10.9, Specifications for Qualifications of Welding Procedures and Welders for Piping and Tubing, Level AR-3.

C. Regulatory Requirements: Comply with the requirements of the following codes:
   2. NFPA 1963 Screw Threads and Gaskets for Fire Hose Connections.
   3. UL and FM Compliance: Fire Protection system materials and components shall be Underwriter's Laboratories listed and labeled, and Factory Mutual approved for the application anticipated.
      a. DSA – California State Fire Marshal Listing.

1.07 SEQUENCING AND SCHEDULING

A. Schedule rough-in installations with installations of other building components.
1.08 EXTRA MATERIALS

A. Valve Wrenches: Furnish to District, 2 valve wrenches for each type of sprinkler head installed.

B. Sprinkler Heads and Cabinets: Furnish six extra sprinkler heads of each style included in the project. Furnish each style with its own sprinkler head cabinet and special wrenches as specified in this Section.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Manufacturer: Subject to compliance with requirements, provide fire protection system products from one of the following:

B. Gate Valves:
   a. Fairbanks
   b. Jenkins
   c. Kennedy Valve, Div. of ITT
   d. Stockham
   e. Mueller

C. Swing Check Valves:
   a. Fairbanks
   b. Jenkins
   c. Kennedy Valve, Div. of ITT
   d. Star Sprinkler Corp.
   e. Stockham
   f. Mueller

D. Grooved Mechanical Couplings:
   a. Stockham
   b. Victaulic Company of America
   c. Anvil International, Gruvlok

E. Water Flow Indicators:
   a. Reliable Automatic Sprinkler Co., Inc.
   b. Star Sprinkler Corp.
   c. Victaulic Company of America
   d. Viking Corp.

2.02 PIPE AND TUBING MATERIALS

A. General: Refer to Part 3 Article "Pipe Applications" for identification of systems where the below specified pipe and fitting materials are used.

B. Steel Pipe: ASTM A53, Schedule 40, seamless, black steel pipe, plain ends. Piping shall be of domestic manufacture.
C. Steel Pipe: ASTM A53, Schedule 10, seamless, black steel pipe, plain ends, for rolled groove or welded connection. Piping shall be of domestic manufacture.

D. Manufacturer’s thin wall pipe will not be acceptable. All pipe and fittings shall be of domestic manufacture.

2.03 FITTINGS


C. Steel Fittings: ASTM A234, seamless or welded, for welded joints. Fittings of domestic manufacture.

D. Grooved Mechanical Fittings: ASTM A536, Grade 65-45-12 ductile iron; ASTM A47 Grade 32510 malleable iron; or ASTM A53, Type F or Types E or S, Grade B fabricated steel fittings with grooves or shoulders designed to accept grooved end couplings.

E. Grooved Mechanical Couplings: Consist of ductile or malleable iron housing, a synthetic rubber gasket of a central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure roll-grooved pipe and fittings. Grooved mechanical couplings including gaskets used on dry-pipe systems shall be listed for dry-pipe service. Couplings of domestic manufacture.

F. Cast-Iron Threaded Flanges: ANSI B16.1, Class 250; raised ground face, bolt holes spot faced. Flanges of domestic manufacture.

2.04 JOINING MATERIALS

A. Welding Materials: Comply, with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.

B. Gasket Materials: Thickness, material, and type suitable for fluid or gas to be handled, and design temperature and pressures.

2.05 GENERAL DUTY VALVES

A. Gate Valves - 2 Inch and Smaller: Body and bonnet of cast bronze, 175 pound cold water working pressure - non-shock, threaded ends, solid wedge, outside screw and yoke, rising stem, screw-in bonnet, and malleable iron hand-wheel. Valves shall be capable of being repacked under pressure, with valve wide open.

B. Gate Valves - 2-1/2 Inch and Larger: Iron body; bronze mounted, 175 pound cold water working pressure - non-shock.
Valves shall be solid taper wedge; outside screw and yoke, rising stem; flanged bonnet, with body and bonnet conforming to ASTM A126 Class B; replaceable bronze wedge facing rings; flanged ends; and a packing assembly consisting of a cast iron gland flange, brass gland, packing, bonnet, and bronze bonnet bushing. Valves shall be capable of being repacked under pressure, with valve wide open. Butterfly valves shall not be used.

C. Swing Check Valves: MSS SP-71; Class 175, cast iron body and bolted cap conforming to ASTM A126, Class B; horizontal swing, with a bronze disc or cast iron disc with bronze disc ring, and flanged ends. Valve shall be capable of being refitted while the valve remains in the line.

2.06 SPECIALTY VALVES

A. Hose Gate Valves: 300 psig working pressure, cast brass valve with non-rising stem, red hand-wheel, female N.P.T. and male hose outlet. Brass solid wedge disk and tapered seat. Hose thread per requirements of authorities having jurisdiction.

B. Alarm check valve: 175 psig working pressure, designed for vertical installations, and have cast iron, flanged inlet and outlet, bronze grooved seat with "O" ring seals, single hinge pin and latch design. Provide trim sets for bypass, drain, electric sprinkler alarm switch, pressure gages, precision retarding chamber, drip cup assembly piped without valves separate from main drain line, and fill line attachment with strainer. Check shall have bolted access plate. Valve shall be capable of being refitted with valve remaining in line.

2.07 AUTOMATIC SPRINKLERS

A. Sprinkler Heads: Fusible link type, and style as indicated or required by the application. Unless otherwise indicated, provide heads with nominal ½” discharge orifice, for "ordinary" temperature range. Head shall be standard type unless prohibited by code. The following types of sprinkler heads may be used based on the space environment:

1. Upright Sprinkler head
2. Pendant type
3. Sidewall sprinklers
4. Concealed type
5. Flush / Recessed type of Sprinkler head.

B. Sprinkler Head Finishes: Provide heads with the following finishes:

1. Upright, Pendant, and Sidewall Styles: Chrome plated in finish spaces, exposed to view; rough bronze finish for heads in unfinished spaces and not exposed to view. Heads shall be wax-coated where installed exposed to acids, chemicals, or other corrosive fumes. On all exposed heads, install approved wire mesh head guard.

2. In all areas of building with finished ceilings, install concealed type fire sprinkler heads.
   a. Concealed Style: Rough brass, with painted white cover plate.
   b. Flush Style: Bright chrome, with painted white escutcheon plate.
C. Sprinkler Head Cabinet and Wrench: Finish steel cabinet, suitable for wall mounting, with hinged cover and space for 6 spare sprinkler heads plus sprinkler head wrench. Provide a separate cabinet for each style sprinkler head on the project.

2.02 ALARM DEVICES

A. General: Types and sizes shall mate and match piping and equipment connections.

B. Water Flow Indicators: Vane type water-flow detector, rated to 250 psig, designed for horizontal or vertical installation; have 2-SPDT circuit switches to provide isolated alarm and auxiliary contacts, 7 ampere 125 volts AC and 0.25 ampere 24 Volts DC; complete with factory-set, field-adjustable retard element to prevent false signals, and tamper-proof cover which sends a signal when cover is removed and fully equipped and enabled to send an alarm signal to the FACP within 90 seconds.

C. Supervisory Switches: SPST, normally closed contacts, designed to signal valve in other than full open position.

PART 3 - EXECUTION

3.01 PIPE APPLICATIONS

A. Install Schedule 40 steel pipe with threaded joints and fittings for 2 inch and smaller, and with welded joints 2-1/2 inch and larger. At contractor’s option, install Schedule 10 steel pipe with roll-grooved ends and grooved mechanical couplings. T-Drill is not acceptable. Show on shop drawings where off site welds shall be done.

3.02 PIPING INSTALLATIONS

A. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. So far as practical, install piping as indicated.

B. Deviations from approved "Working Plans" for sprinkler piping require written approval of the authority having jurisdiction. Written approval shall be on file with the Architect prior to deviating for the approved "Working Plans."

C. Install sprinkler piping to provide for system drainage in accordance with NFPA 13.

D. Use approved fittings to make all changes in direction, bronze takeoffs from mains, and reductions in pipe sizes.

E. Install unions in pipes 2 inch and smaller, adjacent to each valve. Unions are not required on flanged devices or in piping installations using grooved mechanical couplings.
F. Install flanges or flange adapters on valves, apparatus, and equipment having 2 1/2 inch and larger connections.

G. Hangers and Supports: Comply with the requirements of NFPA 13 and NFPA 14. Hanger and support spacing and locations for piping joined with grooved mechanical couplings shall be in accordance with the grooved mechanical coupling manufacturer's written instructions, for rigid systems. Provide coupling manufacturer's written instructions, for rigid systems. Provide protection from damage where subject to earthquake in accordance with NFPA 13. This School is in Hazard Level A, and per DSA requires Level 2 Protection.

H. Make connections between underground and above-ground piping using an approved transition piece strapped or fastened to prevent separation, at flanged fitting.

I. Install mechanical sleeve seal at pipe penetrations in foundation walls.

J. Install test connections sized and located in accordance with NFPA 13 complete with shutoff valve. Test connections may also serve as drain pipes.

K. Install pressure gage on the riser or feed main at or near each test connection. Provide gage with a connection not less than 1/4 inch and having a soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal.

3.03 PIPE JOINT CONSTRUCTION

A. Welded Joints: AWS D10.9, Level AR-3.

B. Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads. Joint pipe, fittings, and valves as follows:

1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
2. Align threads at point of assembly.
3. Apply appropriate tape or thread compound to the external pipe threads.
4. Assemble joint to appropriate thread depth. When using a wrench on valves place the wrench on the valve end into which the pipe is being threaded.
5. Damaged Threads: Do not use pipe with threads which are corroded or damaged. If a weld opens during cutting or threading operations, that portion of a pipe shall not be used.

C. Flanged Joints: Align flanges surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly to appropriate torque specified by the bolt manufacturer.

D. Mechanical Grooved Joints: Roll grooves on pipe ends dimensionally compatible with the couplings. Couplings shall be standard. Light weight, light duty, are not acceptable.
E. End Treatment: After cutting pipe lengths, remove burrs and fins from pipe ends.

3.04 VALVE INSTALLATIONS

A. General: General install fire protection specialty valves, fittings, and specialties in accordance with the manufacturer's written instructions, NFPA 13 and authority having jurisdiction.

B. Gate Valves: Install supervised-open gate valves so located to control all sources of water supply except fire department connections. Where there is more than one control valve, provide permanently marked identification signs indicating the portion of the system controlled by each valve. Refer to Division 22, Section "Mechanical Identification" for valve tags and signs.

C. Install check valves in each water supply connection.

D. Alarm Check Valves: Install valves in the vertical position, in proper direction of flow including the bypass check valve and retard chamber drain line connection. Install valve trim in accordance with the valve manufacturer's appropriate trim diagrams. Test valve for proper operation.

3.05 SPRINKLER HEAD INSTALLATIONS

A. Use proper tools to prevent damage during installations.

B. Where heads are subject to damage, such as in storage rooms, mechanical rooms, custodian rooms, gymnasiums, shower and locker rooms, etc., install approved type protective metal basket head guards.

C. In all removable or modular patterned ceilings, install all sprinkler heads centered on the modular ceiling panels.

D. Where pipe shall be exposed, submit detailed plan to Architect for review and approval.

3.06 FIELD QUALITY CONTROL

A. Flush, test, and inspect sprinkler piping systems in accordance with NFPA 13.

B. Replacing piping system components which do not pass the test procedures specified, and retest repaired portion of the system.

3.07 CORROSION PROTECTION

A. All below ground metallic fittings, valves, flanges, bolts, etc., installed under this Section of the Specifications, shall be protected against corrosion.

B. Refer to Division 22, Section "Earthwork for Mechanical Systems".
3.08 COORDINATION WITH OTHER TRADES

A. The Contractor shall review the fire sprinkler design and coordinate the shop drawings, identified as "Working Plans", with other parts of the work, prior to submission to Architect for review. Provide coordination drawings.

B. Architect/Engineer will review for concept only. Contractor/Installer shall review for possible conflict with other portions of the work.

3.09 HYDROSTATIC TESTS

A. All new systems including yard piping shall be hydrostatically tested at not less than 200 psi pressure for 2 hours, or at 50 psi in excess of the maximum pressure, when the maximum pressure to be maintained in the system is in excess of 150 psi, with no loss in pressure.

B. Provide the NFPA certificate to the District, the Architect and the Division of the State Architect for Above ground and Underground piping.

END OF SECTION 21 1300
SECTION 22 0510
BASIC PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Project Specification, apply to this and the other sections of Division 22.

B. This Division is an integrated whole comprising interrelated and interdependent Section and shall be considered in its entirety in determining requirements of the Work.

C. Refer to other sections of this Division for additional requirements or information regarding the subjects of this Section.

1.02 SECTION INCLUDES

A. This Section includes general administrative and procedural requirements for plumbing installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:

1. Submittals.
2. Coordination drawings.
3. Record documents.
5. Rough-ins.
6. Mechanical installations.
7. Cutting and patching.

1.03 SUBMITTALS

A. General: Follow the procedures specified in Division 01.

B. Plumbing submittals shall include shop drawings, product data, and samples per requirements of each section of specification

C. Plumbing Submittals and Product Data: Assemble “submittals” and “product data” into tabbed brochures according to main areas of work.

   1. Assemble each brochure with tabbed separators for each Specification Section where products are noted to be submitted, with separate tabs for each product listed.
   2. Temperature "control shop drawings" may be submitted separately after preparations for review.
   3. For items such as valves, hangers and accessories, indicate specific items and where they are to be used.
   4. Contractor need only to submit for review those items specified to be submitted, unless requested by the Architect for special review.

D. All submittals shall be submitted in hard copy, electronic submittals are not acceptable.

E. Increase the number of plumbing related submittals including; shop drawings, product data, and samples submitted to allow for required distribution by one additional copy, which will be retained by the Mechanical Consulting Engineer.
F. Submit for review, only the specific items required in this Section or other Sections of Division 22.

G. Additional submittals shall include, but not limited:
   1. Equipment data record drawings.
   2. Certification of completion of testing.
   3. Certification of completion of operation instructions.
   4. Operating instruction brochure.
   5. Maintenance instruction brochures.
   7. 1/4" = 1'-0" or larger scale layouts of "Equivalent" equipment or "Or Approved Equal" equipment.
   8. Coordination Drawings, where requested or required.

H. Submittal materials will be reviewed for substantial conformity with the intent of the contract plans and specifications only. Such review does not indicate approval of dimensions, quantities, coordination with other trades, or work methods of the contractor, which are indicated thereon.

I. Additional copies may be required by individual sections of these specifications.

1.04 COORDINATION

A. The Contractor shall be totally responsible for coordinating the layout of all building elements to avoid conflict of the work of the structural, mechanical, electrical systems, and architectural features of the building.

B. The cost of any extra work of any kind caused by a conflict due to this lack of coordination shall be borne by the Contractor.

1.05 COORDINATION OF DRAWINGS

A. Prepare coordination drawings in accordance with requirements of Project Specification to a scale of 1/4" = 1'-0" or larger; detailing major elements, components, required clearances, and systems of plumbing equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of the installations are of importance to the efficient flow of the Work, including but not necessarily limited to the following:

   1. Indicate the proposed locations of piping, fixtures, equipment, and materials. Include the following:
      a. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
      b. Equipment for connections and support details.
   2. Prepare reflected ceiling plans to coordinate and integrate installations with other systems and components, such as, ductwork, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling-mounted items.

B. Submittal of "Or Equal" substitutions of equipment will not be reviewed unless accompanied by coordination drawings.
1.06 RECORD DOCUMENTS

A. Prepare record documents in accordance with the requirements of project specification. In addition to the requirements of project specification, indicate the following installed conditions:
   1. Record drawings of all installed systems as specified in project specification including the locations and invert elevations of underground installations.

1.07 MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with project specification and Division 22 Section "Supplementary Plumbing Requirements".

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, mill certification, and other information needed for identification.

1.09 EQUIVALENT EQUIPMENT

A. In these specification and drawings, whenever more than one (1) manufacturer’s product is specified, the manufacturer specified on the drawings and the first named product in these specifications is the basis of design and the use of alternate-named manufacturer’s product or substitutes may require modification in the design work and agency approvals. If such alternatives or substitutions are proposed by the contractor, contractor shall adhere to the following requirements;
   1. Contractor shall clearly identify all proposed alternatives or substitutions in the submittal package.
   2. The Contractor shall assume all costs required to make all necessary revisions and modifications of the contract documents resulting from the substitution or selection of an alternate manufacturer’s product, including all professional fees and the cost of DSA approval.
   3. The Contractor shall assume all costs required for any additional modification to building structure, electrical and all other related construction costs resulting from the substitution or selection of an alternate manufacturer’s product

B. These specifications and/or drawings, names and specifies certain equipment in detail which are the basis of design and are explained in paragraph 1.09-A above. It also names alternate equipment by manufacturer, which is not considered to be a "substitution".

C. Submit equivalent equipment to the Architect for review per the requirements of Division 01, and Section "Basic Plumbing Requirements."

D. Equipment of Manufacturers named in Division 22 will be considered equivalent to that specified in detail and/or named on the drawings if:
   1. The proposed equipment is of equivalent quality, capacity.
   2. Equipment is as fully equipped, fits the space allotted, and has physical configuration and weight similar to the equipment specified in detail.
E. A complete lay out of an equipment room or area must be submitted for equivalent equipment. Notice space limitations. Layouts to include plans and section views at a scale of not less than 1/4” = 1 ft.

F. The Architect shall determine the acceptability of "Equivalent Equipment."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

3.02 MECHANICAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of plumbing systems, materials, and equipment. Comply with the following requirements:

1. Coordinate plumbing systems, equipment, and materials installation with other building components.
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 plumbing 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 plumbing 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 heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible as required by California Building Code.
7. Coordinate connection of plumbing system 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 shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect prior to commencement of installation.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components.
10. Install all plumbing equipment to facilitate servicing, maintenance, and repair or replacement of equipment components in full compliance with California Building Code and the equipment manufacturer's recommendations. If the drawings or the manufacturer does not provide a specific space requirement for servicing equipment, provide as a minimum, horizontal distance of 36" from face of equipment to opposite vertical surface.
11. Install access panels or doors for all equipment and components which require access for adjustment and maintenance, where units are concealed behind finished surfaces.
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
13. Any equipment located above a ceiling that has any component, which is serviceable shall be installed within 12" of the top of the ceiling.

3.03 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with project specification. In addition to the requirements specified in project specification, the following requirements apply:
   1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

B. Perform cutting, fitting, and patching of plumbing equipment and materials required to:
   1. Uncover Work to provide for installation of ill-timed Work.
   2. Remove and replace defective work.
   3. Remove and replace Work not conforming to requirements of the Contract Documents.
   4. Remove samples of installed Work as specified for testing.
   5. Install equipment and materials in existing structures.
   6. Upon written instructions from the Architect, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.

C. Cut, remove and legally dispose of selected plumbing equipment, components, and materials as indicated, including but not limited to removal of plumbing piping, gas lines, heating units, plumbing fixtures and trim, and other plumbing 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.
   1. Patch existing finished surfaces and building components using experienced installers and new materials matching existing materials. For installer’s qualifications refer to the materials and methods required for the surface and building components being patched.

END OF SECTION 22 0510
PART 1 - GENERAL

1.01 SECTION INCLUDES
A. This Section specifies supplementary requirements for plumbing installations and includes requirements common to more than one section of Division 22. It expands and supplements the requirements specified in Section 220510 "Basic Plumbing Requirements."

1.02 DESCRIPTION
A. Provide a complete and operable installation, including all labor, supervision, materials, equipment, tools, apparatus, transportation, warehousing, rigging, scaffolding and other equipment and services necessary to accomplish the work in accordance with the intent and meaning of these drawings and specifications.

1.03 COORDINATION
A. Coordination of the work is the responsibility of the Contractor.
B. Contractor shall designate an individual competent and versed in the plumbing trades to coordinate the plumbing work with the work of other trades.

1.04 DEFINITIONS (AS USED ON DIVISION 22 DRAWINGS AND HEREIN)
A. "Provide" means furnish, install and connect unless otherwise described in specific instances.
B. "Piping" means pipes, fittings, valves and all like pipe accessories connected thereto.
C. "Extend", "Submit", "Repair" and similar words mean that the Contractor (or his designated subcontractor) shall accomplish the action described.
D. "Codes" or "Code" means all codes, laws, statutes, rules, regulations, ordinances, orders, decrees, and other requirements of all legally constituted authorities and public utility franchise holders having jurisdiction.
E. "Products", "Materials" and "Equipment" are used interchangeably and mean materials, fixtures, equipment, accessories, etc.
F. "Utility Areas" are defined as mechanical, electrical, janitorial, and similar rooms or spaces which are normally used or occupied only by custodial or maintenance personnel. "Public Areas" are defined as the rooms or spaces, which are not included in the utility areas definition.
G. "Building Boundary" includes concrete walkways immediately adjacent to the building structure.
H. "Below Grade" means buried in the ground.
I. "Substantial Completion" means all components of all systems are functioning but lacking in final adjustment.
J. Pressure rating specified (such as for valves and the like) means design working pressure for and with references to the fluid, which the device will serve.

1.05 RELATED WORK

A. Coordination: Refer to Architectural, HVAC, Plumbing, Civil, Structural, and Electrical Drawings for the construction details and coordinate the work of this Division with that of other Divisions. Order the work of this Division so that progress will harmonize with that of other Divisions and all work will proceed expeditiously. The work of this Division shall include direct responsibility for the correct placing and connection of Plumbing work in relation to the work of other Divisions.

B. Examine other Divisions for work related to the Work of this Division, especially Divisions 23 & 26.

1.06 EXISTING CONDITIONS

A. Visit the site prior to bidding and investigate the existing conditions, which affect or will be affected by the work of this Division. Become thoroughly familiar with the working conditions and take into account any special or unusual features peculiar to this job. By the act of submitting a Bid, the Contractor will be deemed to have complied with the foregoing, to have accepted such conditions, and to have made allowance therefore in preparing his Bid.

B. The locations of existing concealed utility lines are shown in accordance with reference data received by the Architect. The Architect does not guarantee the accuracy of such data. The points of connection are therefore approximate and the Bidder shall include adequate funds in his Bid to cover costs of connection regardless of their exact location.

C. Exercise extreme caution during trenching operations. Repair the damage caused by such operations to existing utility lines at no cost to the Owner, whether the lines are shown on drawings or not.

1.07 DRAWINGS AND SPECIFICATIONS

A. These drawings and specification do not include necessary components for construction safety.

B. All provisions shall be deemed mandatory except as expressly indicated as optional by the word "may" or "option".

C. Except where dimensioned, the drawings relating to this division are a diagrammatic presentation of the design concept, which indicates the general area where piping is to be run. The drawings do not necessarily indicate any and all offsets and configurations required for coordination with other trades. The contractor is responsible for the correct placing of his work, and the proper location and connection of his work in relation to the work or other trades.

1.08 WATER (DOMESTIC AND FIRE), SANITARY SEWERS AND NATURAL GAS SERVICES

A. Within 5 days after award of Contract, notify the serving utilities that the project is under construction and apply for permanent service in the name of the Owner. Furnish pertinent load and location information to them including the required dates for
permanent service. Verify service locations and conform to utility company requirements.

B. Contractor shall pay charges for permanent service connections levied by the utilities for which he will be reimbursed by the Owner. The reimbursement shall be limited to the actual amount of the utility service charges and a copy of the billing from the utility company shall accompany the Contractor's invoice.

1.09 PERMITS AND INSPECTIONS

A. Obtain, schedule and pay for permits, licenses, approvals, tests, and inspections required by legally constituted authorities and public utility franchise holders having jurisdiction over the work.

B. Afford the Architect's representative every facility for evaluating the skill and competence of the mechanics and to examine the materials. Concealed work shall be reopened when so directed during his periodic visits.

1.10 CODES AND REGULATIONS

A. By submitting a Bid, Contractor is deemed to represent himself as competent to accomplish the work of this Division in conformance with applicable Codes. In case of conflict between the Contract Documents and Code requirements, the Codes shall take precedence. Should such conflicts appear, cease work on the parts of the contract affected and immediately notify the Architect in writing. It shall be the Contractor's responsibility to correct, at no cost to the Owner, any work he executes in violation of Code requirements. Specific references to codes elsewhere in this Division are either to aid the Contractor in locating applicable information or to deny him permission to use options, which are permitted by Codes.

B. Applicable Codes: (Current editions unless otherwise noted)
   1. All local codes; city and/or county as applicable.
   2. OSHA requirements
   3. Uniform Building Code
   4. California Code of Regulations (CCR) Titles (as applicable)
   5. Fire Marshal Regulations
   6. State, County, City Health Department Ordinances and Regulations
   7. Regulations of all other authorities having jurisdiction.

C. Where conflict or variation exists amongst Codes, the most stringent shall govern.

1.11 RECORD AND DOCUMENTATION

A. Accumulate the following and deliver to the Owner's representative prior to final acceptance of the work.
   1. Record (As-Built) Drawings:
      a. Maintain in good order in the field office a complete set of prints for all work being done under Division 22. Update the drawings daily with neat and legible annotations in red ink showing the work as actually installed.
      b. The actual size, location and elevation of all buried lines, valve boxes, manholes, monuments, and stubouts shall be accurately located and dimensioned from building walls or other permanent landmarks.
c. Furnish the original marked up AS-Built drawings and an electronic copy in AutoCAD-14 format.

2. Operation and Maintenance Manual: Furnish an operation and maintenance manual covering the stipulated Plumbing systems and equipment. Seven copies of the manual, bond in hardback binders or an approved equivalent shall be provided to the Architect.

3. Furnish one complete manual prior to the time that system or equipment tests are performed.

4. Furnish the remaining manuals before the contract is completed.

5. The following identification shall be inscribed on the cover:
   a. OPERATION AND MAINTENANCE MANUAL
   b. PROJECT TITLE . . . . . . . . . . . .
   c. CONTRACTOR NAME & CONTACT INFORMATION

6. Provide a table of contents.
   a. Insert tab sheets to identify discrete subjects.
   b. Instruction sheets shall be legible and easily understood, with large sheets of drawings folded in.
   c. The manual shall be complete in all respects for all materials, piping, valves, devices and equipment, controls, accessories and appurtenances stipulated. Include as a minimum the following:
      1) Updated approved materials lists, shop drawings and catalog information of all items of HVAC system equipment.
      2) System layout showing piping, valves and controls.
      3) Wiring and control diagrams with data to explain detailed operation and control of each component.
      4) A control sequence describing start-up, operation and shutdown.
      5) Detailed description of the function of each principal component of the system.
      6) Procedure for starting.
      7) Procedure for operating.
      8) Shut-down instructions.
      9) Installation instructions.
     10) Adjustments, maintenance and overhaul instructions.
     11) Lubrication schedule including type, grade, temperature range and frequency.
      12) Safety precautions, diagrams and illustrations.
      13) Test procedures.
      14) Performance data.
     15) Parts lists, with manufacturer's names and catalog numbers.
     16) Preventive maintenance schedule.
     17) Service organization with name, address and telephone number.
     18) Valve identification chart and schedule.
     19) ASME certificates.
    20) Hydronic balance report.

B. Standards Compliance: Where equipment or materials are specified to conform to requirements of recognized technical or industrial organizations such as American National Standards Institute (ANSI) American Society for Mechanical Engineers (ASME) American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), American Society for Testing Materials (ASTM), Underwriters Laboratories (UL), American Gas Association (AGA), American Society of Plumbing Engineers (ASPE), American Refrigeration Institute (ARI), or National Electrical Manufacturer’s Association (NEMA), that use a label or published listing as a method of
indicating compliance, proof of such conformance shall be submitted and approved. The label or listing of the specified organization will be acceptable evidence.

C. Certificates of Conformance or Compliance: Submit original and not pre-printed certifications. Do not make statements in the certifications that could be interpreted to imply that the product does not meet all requirements.

D. Certified Test Reports: Certified Test Reports are reports of tests conducted on previously manufactured materials or equipment identical to that proposed for use. Before delivery of materials and equipment, submit certified copies of test reports specified in the individual sections.

E. Factory Tests: Factory tests are tests, which are required to be performed on the actual materials or equipment, proposed for use. Submit results of the tests in accordance with the requirements for laboratory test results of this Contract.

F. Permits and Certificates of Inspection: Furnish the originals.

G. Testing procedures and test results required in this and other sections. Furnish 2 copies.

H. Other data required by other sections of this Division. Furnish 2 copies.

1.12 CONSTRUCTION COST BREAKDOWN

A. Prepare and submit for review a construction cost breakdown for the major subdivisions of the PLUMBING?? work in accordance with General and Supplemental Conditions and Project Specification.

B. Subdivide each item on the breakdown into two headings: labor and materials. Include overhead and profit in each entry.

C. Submit one copy of the breakdown directly to the Engineer and the remaining copies sent through regular channels.

1.13 TOOLS

A. Provide all special tools needed for proper operation and routine adjustment and maintenance of systems and equipment. Deliver tools to Owner's representative and request a receipt for same.

1.14 WARRANTIES

A. Refer to Project Specification for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements.

B. Where periods more than one year are specified in the specifications, such longer periods shall govern. However, when any component fails at any time during this period, the warranty period for such component and all other components, which are inactive because of, said failure shall be suspended. The warranty period for such components shall resume to run for the remaining portion of the warranty period when failed component is completely repaired and in operation; however, in no case shall the resumed portion of the warranty period be less than 3 months in duration.

C. Neither payment for work, nor total or partial occupancy of work by the Owner, within or prior to the warranty period specified, shall be construed as acceptance of faulty work or shall condone any negligence or omission of Contractor in doing the work.
D. Compile and assemble the warranties specified in Division 22, into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference.

E. Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; and names and addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.15 SEISMIC RESTRAINT

A. Provide seismic restraint for plumbing equipment, piping, and accessories.

B. Contractor shall submit certification of suitability of seismic restraint methods signed by Licensed Structural Engineer registered in State of California.

1.16 SYSTEM OPERATIONAL TESTS

A. The Contractor shall inform the Owner one week prior to start of testing in order that the Owner's representative may be present.

B. After balancing and prior to final inspection, the contractor shall operate all plumbing systems trouble free and stable. Contractor shall submit a written report certified by the Owner's representative indicating the successful completion of a stable and trouble free testing.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Standard Products: Materials and equipment shall be essentially the standard cataloged products of manufacturers regularly engaged in production of such materials or equipment and shall be their latest standard designs that comply with the specification requirements.

B. Materials and equipment shall duplicate items that have been in satisfactory commercial or industrial use at least two years prior to bid opening, unless more stringent requirements are specified. Where two or more units of the same type of equipment are required, these units shall be products of a single manufacturer. The components thereof, however, are not required to be exclusively of the same manufacturer.

C. Each major component of equipment shall have manufacturer's name, address, model, and serial number on a nameplate securely affixed in a conspicuous place. The nameplate of the distributing agent will not be acceptable.

D. In these specification and drawings, whenever more than one (1) manufacturer's product is specified, the manufacturer specified on the drawings and the first named product in these specifications is the basis of design and the use of alternate-named manufacturer's product or substitutes shall comply with the requirements of Section 22 0510.

2.02 PRODUCT LISTING

A. When two or more items of same material or equipment are required (pipe and fittings, plumbing fixtures, pumps, valves, etc.) they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, sheet
metal, wire, steel bar stock, welding rods, solder, fasteners, and similar items used in Work, except as otherwise indicated.

2.03 NAMEPLATE DATA

A. Provide permanent operational data nameplate on each item of power operated plumbing equipment, indicating manufacturer, product name, model name, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location.

2.04 SUBSTITUTIONS

A. General: Submittals of "Substitutions" shall be in accordance with requirements of Division 01.

B. By proposing a substitution, it is deemed that the Contractor shall bear the cost of any and all design and construction changes (whether architectural, structural, electrical, and Plumbing) necessary to accommodate the substitution, if said substitution is accepted.

C. Specific: Refer to Specification Sections 22 0510 & 22 0512 for additional requirements.

2.05 SUBMITTALS

A. General: Make submittals in accordance with requirements of Division 01.

B. Specific: Refer to Specification Sections 22 0510 for additional requirements.

PART 3 - EXECUTION

3.01 WORKMANSHIP AND INSTALLATION METHODS

A. Workmanship shall be in the best standard practice of the trade.

B. Install equipment in accordance with the manufacturer's instructions and recommendations unless otherwise noted or specified.

3.02 TESTS

A. General:
   1. Demonstrate that all components of the work of this Division have been provided and that they operate in accordance with the Contract Documents.
   2. Provide instruments and personnel for tests and demonstrations. Submit signed test results.

B. Specific: Refer to the other sections of this Division for test requirements.

3.03 DELIVERY, HANDLING, STORAGE OF MATERIALS AND PROTECTION OF WORK

A. Protect materials against dirt, water, chemical and mechanical damages both while in storage and during construction.

B. Cover materials in such a manner that no finished surfaces will be damaged, marred or splattered with plaster or paint, and all moving parts will be kept clean and dry.
C. Replace or refinish any damaged materials including fronts of control panels, piping, insulation, and equipment.

D. All plumbing fixtures, vents, and waste lines shall be aggressively protected during construction process to ensure that no contamination of the system occurs.

E. The use of permanently installed plumbing fixtures during construction is prohibited.

F. Keep cabinets and other openings closed to prevent entry of foreign matter.

G. Specific: Refer to other sections of this Division for additional requirements.

3.04 PROJECT CONDITIONS

A. Check and coordinate for clearance, accessibility and placement of equipment either by going through openings provided or by placing equipment during construction. Ordering of equipment to be shipped disassembled, or disassembly of equipment at Project Site and reassembly of equipment to accomplish this requirement shall be executed without additional cost. Where provided openings are inadequate to accommodate equipment, provide new openings and restoration of same, all at no additional cost. Obtain written approval for new openings before proceeding.

B. Verify location of all plumbing fixtures and equipment within finished spaces with the Architectural Drawings. In the event that Plumbing Drawings do not indicate exact locations, or are in conflict with the Architectural Drawings, obtain information regarding proper locations. Installation of work without proper instruction under such circumstances will result in relocation of work, when directed, without additional cost.

3.05 INSTRUCTION TO OWNER PERSONNEL

A. Contractor shall furnish, without additional expense to the Owner, the services of competent instructors who will give full instruction to the designated personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the equipment or system specified. Each instructor shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance of work. Instruction shall be given at the Owner's convenience. The number of man-days (eight-hours) of instruction furnished shall be as specified in other sections. When more than four man-days of instruction are specified, approximately half of the time shall be used for classroom instruction. All other time shall be used for instruction with the equipment or system. When significant changes or modifications are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications.

B. Contractor shall videotape, both visual and audio, instruction to Owner's personnel on the maintenance and operation of the plumbing equipment and systems.

C. Submit certification, signed by Owner's agent that instructions have been completed and the videotape has been reviewed and delivered to the Owner.

D. Printed operating instructions and a copy of wiring diagrams are to be mounted in all equipment areas, framed and behind glass or encased in plastic. Printed operating instructions shall include steps for starting up and securing equipment. As a precedent to final acceptance four (4) copies of instructions are to be submitted to the Architect for review. Contractor shall turn over to Owner in a neat brochure form, equipment guarantee and maintenance instructions.
3.06 CLEANING

A. Cleaning shall be done as the work proceeds. Periodically remove waste and debris to keep the site as clean as is practical.

B. Refer the Division 01 for general requirements for cleaning.

C. Leave exposed parts of the plumbing work in a neat and clean condition, with painted surfaces unblemished and plated metal surfaces polished.

D. Thoroughly clean all materials, equipment and appliances. Clean and prepare all surfaces to be painted. Clean the entire premises of unused materials, debris, spots and marks to the satisfaction of the Architect.

E. Remove, thoroughly clean and replace all strainers and valves after the system has been put in operation until system is clear of all foreign matter and repeat this operation after ten (10) days and again after the system has been in operation thirty (30) days. Submit certification that this operation has been completed.

3.07 SAFETY REQUIREMENTS

A. Enclose and guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts in accordance with OSHA requirements. Insulate, guard, and cover any high-temperature equipment and piping so located as to endanger personnel or create a fire hazard.

END OF SECTION 22 0511
SECTION 22 0512

PLUMBING PRODUCT SUBSTITUTIONS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This Section specifies administrative and procedural requirements for handling requests made after award of the Contract for substitutions of products specified in Division 22.

1.02 RELATED SECTIONS

A. Procedure for Contractor's construction Schedule and the Schedule of Submittals are included under Division 01.

B. Standards: Refer to Division 01 for applicability of industry standards to products specified.

C. Procedural requirements governing the Contractor's selection of products and product options are included under Division 01.

D. Refer to Division 01 for Products and Substitutions.

E. Refer to Sections 22 0510 & 22 0511 for additional requirements.

1.03 DEFINITIONS

A. "Products" is defined to include purchased items for incorporation into the work, regardless of whether specifically purchased for project or taken from Contractor's stock of previously purchased products. "Materials" is defined as products which must be substantially cut, shaped, worked, mixed, finished, refined or otherwise fabricated, processed, installed or applied to form units of work.

B. "Equipment" is defined as products with operational parts, regardless of whether motorized or manually operated, and particularly including products with service connections (wiring, piping, etc.). Definitions in this paragraph are not intended to negate the meaning of other terms used in contract documents, including "specialties", "systems", "structure", "finishes", "accessories", "furnishings", "special construction", and similar terms, which are self-explanatory and have recognized meanings in the construction industry.

1.04 SUBSTITUTIONS

A. The requirements for substitutions do not apply to specified Contractor options on products and construction methods. Revisions to contract documents, where requested by Owner, Architect or Engineer, are "changes" not "substitutions". Substitutions requested during bidding period, which have been accepted prior to Contract Date, are included in contract document and are not subject to requirements for substitutions as specified herein. Contractor's determination of and compliance with governing regulations and orders issued by governing authorities do not constitute "substitutions"; and do not constitute a basis for change orders, except as provided for in contract documents. Otherwise, contractor's requests of changes in products, materials and methods of construction required by contract documents are considered
requests for "substitutions", and are subject to requirements hereof.

B. Conditions: The Contractor's substitution request will be received and considered by the Architect when one or more of the following conditions are satisfied, as determined by the Architect; otherwise requests will be returned without action except to record noncompliance with these requirements.

1. Extensive revisions to Contract Documents are not required.
2. Proposed changes are in keeping with the general intent of Contract Documents.
3. The request is directly related to an "or approved equal" clause or similar language in the Contract Documents.
4. All costs required to make all necessary revisions and modifications to the contract documents resulting from the substitution, including but not limited to, all professional fees and the cost of DSA approval will be the Contractor's responsibility.
5. All costs required to make all necessary revisions and modifications to the building structure, electrical and all other related construction costs resulting from the substitution, including but not limited to, material, products, equipment, testing, and inspection will be the Contractor’s responsibility.
6. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
7. Contractor will coordinate the installation of the accepted substitute, making such changes as may be required for the work to be complete in all respects.
8. Contractor certifies that the substitution is not heavier than the specified item and does not necessitate any structural and electrical redesign; will fit within the room or area designed for the specified item; and will not exceed any maximum dimensions specified or shown on the original contract Documents. All roof mounted equipment must be less than or equal to the maximum height dimension from the finished roof as shown on the drawings.
9. Contractor represents that he has personally investigated the proposed substitute product and determined that it is equal or superior in all respects to that specified.
10. Contractor represents that he will provide the same warranty for the substitution that he would for that specified.

1.05 SUBMITTALS

A. Requests for Substitutions: Any request for substitution shall follow the guidelines of Substitution Requirements in Division 01, Section 22 0510, & 22 0511.

B. Substitution Warranty: All submittals of Request for Substitutions under the General and Supplementary Conditions of this Section shall be accompanied by a completely executed (filled out) and signed Substitution Warranty in the form entitled "Substitution Warranty", bound herein. Substitutions will not be accepted without the Substitution Warranty. In addition to other requirements, Contractor shall warrant in writing on his own letterhead that substituted materials shall perform as specified, and assume complete responsibility for same, including responsibility and costs required for modifications to building or other materials or equipment, and any additional coordination with work of other trades. Testing, if required, shall be paid by Contractor.

C. Responsibility of Contractor: The contractor shall be solely and directly responsible for fitting accepted substitute material and equipment into the available space in a manner acceptable to the Architect, and for the proper operation of the substituted equipment with all other equipment with which it may be associated. The Contractor shall bear all
costs of meeting the above requirements for presenting a proposed substitution, and if the substitution is accepted, he must bear all costs involved.

D. Submit the following as part of the Request for Substitutions:

1. Data showing proposed equipment is "equal" to that specified and is fully equipped, fits the space allotted and has physical configuration and weight similar to the equipment specified in detail.

2. A complete layout, where applicable, of equipment room or area must be submitted for equipment proposed in "Request for Substitution". Submittal shall conform to requirements of Division 01 and Section 22 0510 "Basic Mechanical Requirement" as it applies to "Coordination Drawings."

3. Seismic Restraint: Where seismic restraint is required for products or equipment as specified, methods of seismic restraint signed by licensed Structural Engineer registered in the State of California, shall be submitted for review to the Division of the State Architect.

1.06 ARCHITECT’S ACTION

A. The Architect may request additional information or documentation necessary for evaluation of the request. Requests, by the Architect, for additional information or documentation will be in accordance with Division 01 requirements. The Architect will notify the Contractor of acceptance or rejection of the proposed substitution. If a decision on use of a proposed substitute cannot be made or obtained within the time allocated, Contractor shall use the “Bases of Design” product specified by name in the contract documents. Acceptance will be in the form of a Change Order.

PART 2 - PRODUCTS

2.01 SUBSTITUTIONS

A. Substitutions shall conform to the product requirements for the specified products or equipment.

PART 3 - EXECUTION

(Not Applicable.)

END OF SECTION 22 0512
In addition to other requirements, Contractor shall warrant in writing that substituted materials shall perform as specified, and assume complete responsibility for same, including responsibility and costs required for modifications to building or other materials or equipment, and any additional coordination with work of other trades. Testing, if required, shall be paid by contractor. The following is an example of the type Substitution Warranty which shall be executed by the Contractor, on his own letterhead:

SUBSTITUTION WARRANTY

We propose to provide

________________________________________________________________________

(Describe items being proposed for substitution)

for______________________________________________________________ in lieu of

(List project name)

as indicated on the drawings and described in Section ___________ of the Specifications.

We agree to assume the cost of any and all modifications to the Contract Documents and to other portions of the work as indicated in the Specification Sections 22 0510, 22 0511, & 22 012, and as necessary to accommodate for substituted material(s) and system(s) as indicated in this letter of “Substitution Warranty”.

We hereby warrant that ___________________________________________________

(Provide Description)

is the equivalent of _____________________________________________________

(Specified Product)

in every respect and will perform satisfactorily under the conditions and use indicated on the Drawings and described in the Specifications.

Signed:  _______________________________________   Date:  _________________

(Manufacturer/Supplier)

Signed:  _______________________________________   Date:  _________________

(Subcontractor)

Signed:  _______________________________________   Date:  _________________

(Contractor)

NOTE:  Affix Corporate Seal over Signatures.
SECTION 22 0513

ELECTRICAL REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This Section specifies the basic requirements for electrical components, which are an integral part of packaged Plumbing equipment. These components include, but are not limited to factory-installed motors, starters, and disconnect switches furnished as an integral part of packaged Plumbing equipment.

B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for Plumbing equipment are scheduled on Drawings.

C. All motors, power driven equipment and automatic control equipment, except motor starters as hereinafter set forth required and connected with the work of this section of the specifications are to be furnished and installed under Division 22.

D. Control low (24V) and control line (120V) voltage wiring, conduit and related switches and relays required for the automatic control and/or interlock of motors and equipment includes final connection, are to be furnished and installed under Division 22. Materials and installation to conform to Class 1 or 2, CAC Title 24, Article E725, and as restricted under Division 26 of these specifications.

E. Power wiring, conduit, outlets, disconnect switches, motor starters and motor-rated contactors, and making of final connections, except as hereinafter specified, are to be furnished and installed under the Division 26 of these Specification.

F. All power supply wiring for providing a power source to, control valves, control transformers, etc., shall be furnished and installed under Division 22.

G. Identify circuits and equipment as outlined in the Electrical Sections of these Specifications.

H. Space provisions have been made on electrical panels for control power source.

1.02 RELATED SECTIONS

A. Separate electrical components and materials required for field installation and electrical connections are specified in Division 26.

B. This section applies to all Division 22 sections specifying packaged Plumbing equipment.

1.03 REFERENCES

A. NEMA Standards MG 1: Motors and Generators

B. NEMA Standards ICS 2: Industrial Control Devices, Controllers, and Assemblies

C. NEMA Standard 250: Enclosures for Electrical Equipment

D. NEMA Standard KS 1: Enclosed Switches

E. Comply with National Electrical Code (NFPA 70).
1.04 SUBMITTALS

A. No separate submittal is required. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification sections.

1.05 QUALITY ASSURANCE

A. Electrical components and materials shall be UL labeled.

PART 2 - PRODUCTS

2.01 MOTORS

A. Provide all motors necessary for equipment under the Plumbing Work. See Electrical Drawings for voltage and phase of electrical services.

B. The following are basis requirements for simple or common motors. For special motors, more detailed and specific requirements are specified in the individual equipment specifications.

1. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.
2. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range.
3. 2-speed motors shall have 2 separate windings on poly-phase motors.
4. Temperature Rating: As a minimum motors shall be rated for 40 degree C environment with maximum 50 degree C temperature rise for continuous duty at full load (Class A Insulation).
5. Starting capability: Frequency of starts as indicated by automatic control system, and not less than 5 evenly time spaced starts per hour for manually controlled motors.
   a. Frames: NEMA Standard No. 48 or 54; use driven equipment manufacturer's standards to suit specific application.
   b. Bearings:
      1) Ball or roller bearings with inner and outer shaft seals.
      2) Re-greasable bearings, except permanently sealed where motor is normally inaccessible for regular maintenance.
      3) Bearings designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.
      4) Bearings for fractional horsepower, light duty motors, sleeve type bearings are permitted.
   c. Enclosure Type:
      1) Open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation.
      2) Guarded drip-proof motors where exposed to contact by employees or building occupants.
      3) Weather protected Type I for outdoor use, Type II where not housed (Epoxy encapsulated or TEFC).
d. Overload protection: Polyphase built-in thermal overload protection and, where indicated, internal sensing device suitable for signaling and stopping motor at starter. Single phase, provide thermal overload protection.

e. Noise rating: "Quiet".

f. Efficiencies shall be guaranteed minimum values in accordance with the following tabulation. Efficiencies shall be established in accordance with NEMA Test Standards MG1-12.53A using IEEE Test Procedure 112, Method B:

<table>
<thead>
<tr>
<th>HP</th>
<th>EFFICIENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>81.5</td>
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<tr>
<td>3-5</td>
<td>86.5</td>
</tr>
<tr>
<td>7-1/2 - 10</td>
<td>90.6</td>
</tr>
<tr>
<td>15-30</td>
<td>92.0</td>
</tr>
</tbody>
</table>

g. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

h. Provide all motors with junction boxes or terminals boxes and provide adjustable slide rails for all motors with belt drives.

i. Motors rated 1 HP and larger shall have shaft, bearings and etc. capable of operating with multiple grooved sheaves and two or more belts.

j. V Type Belt Drives: Drives requiring not more than 2 belts; variable pitch type; size for mid-point of operating range. Drives requiring 3 or more belts; nonadjustable constant speed type. Provide belts in matched sets.

2.02 MOTOR STARTERS

A. Unless provided as part of packaged Plumbing equipment or otherwise indicated, starters for motors will be provided under Division 26. Provide to Division 26 the data necessary for motor starter heater sizing for all motors.

B. Starters for factory packaged Plumbing equipment specified under Division 22 shall be provided as part of the package.

C. Motor Starter Characteristics:

1. Enclosures: NEMA 1, general purpose enclosures with padlock ears, except in wet locations shall be NEMA 3R with conduit hubs, or units in hazardous locations, which shall have NEC proper class and division.

2. Type and size of starter shall be as recommended by motor manufacturer and the driven equipment manufacturer for applicable protection and start-up condition.

D. Manual switches shall have:

1. Pilot lights and extra positions for multi-speed motors.

2. Overload protection: melting alloy type thermal overload relays.

E. Magnetic Starters:

1. Maintained contact push buttons and pilot lights, properly arranged for single speed or multi-speed operation as indicated.

2. Trip-free thermal overload relays, each phase.

3. Interlocks, switches and similar devices as required for coordination with control requirements of Division-25 Controls sections.
4. Built-in control circuit transformer, fused from line side, where service exceeds 240 volts.
5. Externally operated manual reset.
6. Under-voltage release or protection.

F. Motor Connections:
   1. Flexible conduit, except where plug-in electrical cords are specifically indicated.

2.03 DISCONNECT SWITCHES

   A. When applied as part of factory furnished and mounted equipment, disconnects shall meet the requirements for disconnect switches set forth in Division 26.

PART 3 - EXECUTION

3.01 SEISMIC RESTRAINT

   A. All electrical devices shall be seismically restrained.

END OF SECTION 22 0513
SECTION 22 0514
SELECTIVE PLUMBING DEMOLITION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This Section includes limited scope of selective Plumbing demolition work as follows:
   1. Nondestructive removal of materials and equipment for reuse or salvage as indicated.
   2. Dismantling Plumbing fixtures, materials and equipment made obsolete by these installations.

1.02 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 and Division 22 Specification Sections.

B. Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of utility services and details for dust and noise control.
   1. Coordinate sequencing and Owner occupancy specified in Division 01.
   2. Coordinate other selective demolition work as outlined in Division 01.

1.03 PROJECT CONDITIONS

A. Conditions Affecting Selective Demolition: The following project conditions apply:
   1. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
   2. Locate, identify, and protect plumbing services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas. Provide minimum of 72-hour notice to Owner prior to utility interruption.

1.04 SEQUENCE AND SCHEDULING

A. Coordinate the shut-off and disconnection of utility services with the Owner and the utility company.

B. Notify the Architect at least 7 days prior to commencing demolition operations.

C. Perform demolition in phases as indicated.

PART 2 - PRODUCTS (Not Applicable).
PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas where selective demolition is to occur. Determine extent of work and affect on existing conditions to remain. Advise Architect of any conditions that might create extensive alterations beyond indicated scope.

3.02 SELECTIVE DEMOLITION

A. General: Demolish, remove, demount, and disconnect abandoned Plumbing fixtures, materials and equipment indicated to be removed and not indicated to be salvaged or saved.

B. Materials and Equipment To Be Salvaged: Remove, demount, and disconnect existing Plumbing fixtures, materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for storage.

1. Protect all removed and salvaged equipment from being damaged during the demolition work.

C. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.

D. Plumbing Materials and Equipment: Demolish, remove, demount, and disconnect the following items:

1. Inactive and obsolete, piping, fittings and specialties, equipment, controls, fixtures, and insulation.
   a. Obtain written approval form Architect and owner for piping embedded in floors, walls, and ceilings which may remain, if such materials do not interfere with new installations.
      1) Drain and cap piping allowed to remain.
   b. Remove materials above accessible ceilings.

2. Perform cutting and patching required for demolition.
PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This Section includes limited scope of general construction materials and methods for access doors and panels in walls and ceilings for access to plumbing materials.

B. Requirements of access doors are outlined in Division 08.

C. Access doors and panels are required for all plumbing equipment requiring maintenance, inspection, adjustment, monitoring, etc… which are installed in inaccessible areas such as behind walls, above ceiling, under floor, etc…

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of access door or panel.

1.03 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer Qualifications: Engage an experienced Installer for the installation of access panels and doors.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in the Work include, but are not limited to, the following:

1. Elmdor / Stoneman.
3. Milcor Inc.

2.02 ACCESS DOORS

A. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.

B. Frames: 16-gage steel, with a 1-inch-wide exposed perimeter flange.

1. For installation in masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling: 1 inch-wide-exposed perimeter flange and adjustable metal masonry anchors.
2. For gypsum wallboard or plaster: perforated flanges with wallboard bead.
3. For full-bed plaster applications: galvanized expanded metal lath and exposed casing bead, welded to perimeter frame.

C. Flush Panel Doors: 14-gage sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.

1. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.

D. Locking Devices: Flush, screwdriver-operated cam locks.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which access door and panel products are to be installed. Do not proceed with work until unsatisfactory conditions have been in manner acceptable to Installer.

3.02 APPLICATION

A. Nonrated Walls and Ceilings: Prime coat finish door and frame, Allen key latch face of wall type; Smith 4760, Elmdor / Stoneman DW Series.

B. Fire Rated Walls and Ceilings: "B" Labeled U.L. 1-1/2 hours, prime coat finish door and frame, flush keyed cylinder lock; Milcor.

C. Tile Walls: Cover and frame 18-8 satin stainless steel, face-of-wall type, vandal resistant screws; J. R. Smith 4762, Elmdor / Stoneman DW Series.

3.03 INSTALLATION OF ACCESS DOORS

A. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.

B. Adjust hardware and panels after installation for proper operation.

3.04 COORDINATION

A. General: Coordinate locations of ceilings access doors with lights, air outlets, speakers, etc. Submit drawings showing relative locations of doors to other ceiling items for acceptance by the Architect prior to installation. Transparencies of floor plans and/or reflected ceiling plans will be available from the Architect for this purpose.

B. Location: Doors may be located to serve more than one item where feasible, providing they are approved as specified. Sizes suitable for purpose intended, with 12" x 12" minimum.

C. Access doors and panels not required in accessible ceiling systems where direct access to plumbing items is possible.

END OF SECTION 22 0515
SECTION 22 0519
METERS AND GAGES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This Section includes the following types of meters and gages:
   1. Temperature gages and fittings.
   2. Pressure gages and fittings.
   3. Flow meters.

B. Meters and gages furnished as part of factory-fabricated equipment are specified as part of equipment assembly in other Division 22 sections.

1.02 SUBMITTALS

A. General: Submit the following in accordance with conditions of Contract and Division 1 Specification Sections and Section 22 0510 "Basic Plumbing Requirements".
   1. Product data for each type of meter and gage. Include scale range, ratings.
      Submit meter and gage schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gage.
   2. Maintenance data for each type of meter and gage for inclusion in Operating and Maintenance Manuals specified in Division 1 and Division 22 Section "Basic Plumbing Requirements".

1.03 QUALITY ASSURANCE

A. ASME and ISA Compliance: Comply with applicable portions of ASME and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gages.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Mercury-In-Glass Thermometers:
      a. Marshalltown Instruments, Inc.
      b. Trerice (H.O.) Co.
      c. Weiss Instruments, Inc.
      d. Weksler Instruments Corp.
   2. Thermometer Wells: Same as for thermometers.
   3. Pressure Gages:
      d. Marshalltown Instruments, Inc.
      e. Trerice (H.O.) Co.
“L” TOWER BUILDING  
SEISMIC AND CODE UPGRADES  
RIO HONDO COLLEGE

f. Weiss Instruments, Inc.  
g. Weksler Instruments Corp.  
h. WIKA Instruments Corp.

4. Pressure Gage Accessories: Same as for pressure gages.

5. Water Orifice-Type Measurement System:  
   a. Armstrong Pumps, Inc.  
   b. Bell & Gossett, ITT, Fluid Handling Div.

6. Calibrated Balance Valves  
   a. Armstrong Pumps, Inc.  
   b. Bell and Gossett, ITT, Fluid Handling Div.

7. Venturi-Type Flow Measurement System  
   a. Armstrong Pumps, Inc.  
   b. Barco Div., Marison Industries  
   c. Gerand Engineering Co.

8. Test Plugs  
   a. MG Piping Products Co.  
   b. Peterson Equipment Co., Inc.  
   c. Sisco, A Spedco, Inc. Co.  
   d. Trerice (H.O.) Co.  
   e. Watts Regulator Co.

2.02 THERMOMETERS, GENERAL  

A. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.

B. Scale range: Temperature ranges for services listed as follows:
   1. Domestic Hot Water: 30 to 240 deg with 2-degree scale divisions.
   2. Domestic Cold Water: 0 to 100 deg F with 2-degree scale divisions.
   3. Heating Water: 30 to 300 deg with 2-degree scale divisions.
   4. Condenser Water: 0 to 160 deg F with 2-degree scale divisions.
   5. Chilled Water: 0 to 100 deg F with 2-degree scale divisions.
   6. Steam and Condensate: 50 to 400 Deg F with 2-degree scale divisions.

2.03 MERCURY-IN-GLASS THERMOMETERS  

A. Case: Die cast, aluminum finished, in baked epoxy enamel, glass front, spring secured, 9 inches long.

B. Adjustable Joint: Finished to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.

C. Tube: Red reading, mercury filled, magnifying lens.

D. Scale: Satin-faced, nonreflective aluminum, with permanently etched markings.

E. Stem: Copper-plated steel, aluminum or brass, for separable socket, length to suit installation.

2.04 THERMOMETER WELLS  

A. Thermometer Wells: Brass or stainless steel, pressure rated to match piping system design pressure; with 2-inch extension for insulated piping and threaded cap nut with chain permanently fastened to well and cap.
2.05 PRESSURE GAGES

A. Type: General use, ASME B40.1, Grade A, phosphor bronze bourdon-tube type, bottom connection.
B. Case: Drawn steel or brass, glass lens, 4-1/2-inches diameter.
C. Connector: Brass, 1/4-inch NPS.
D. Scale: White coated aluminum, with permanently etched markings.
E. Accuracy: Plus or minus 1 percent of range span.
F. Range: Conform to the following:
   1. Vacuum: 30" & 0-15 psi compound range; 1" and 1/2 psi graduations.
   2. Chilled and heating water systems, except as otherwise indicated: 0-60 psi range, 1 psi graduation.
   3. Condenser water system, except as otherwise indicated: (0-15); (0-30) psi range, (1/4 psi); (1/2 psi) graduation.
   4. Except as otherwise indicated: 0-100 psi range, 1 psi graduation.
   5. High temperature water system: 0-300 psi range, 2 psi graduations.

2.06 PRESSURE GAGE ACCESSORIES

A. Syphon: 1/4-inch NPS straight coil constructed of brass tubing with threads on each end.
B. Snubber: 1/4-inch NPS brass bushing with corrosion-resistant porous metal disc. Disc material shall be suitable for fluid served and rated pressure.

2.07 FLOW METERS, GENERAL

A. Flow rate of elements and meters shall be same as connected equipment or system.

2.08 WAFER ORIFICE-TYPE FLOW ELEMENTS

A. Type: Differential-pressure wafer type orifice insert flow elements designed for installation between pipe flanges.
B. Construction: Cast-iron body, brass valves with integral check readout valves and caps, and calibrated nameplate. Elements pressure rated for 300 psig and 250 degree F.

2.09 CALIBRATED BALANCE VALVE

A. Type: Differential-pressure, ball type, adjustable orifice designed for installation in piping.
B. Construction: Bronze body/brass ball construction with glass and carbon filled TFE seal rings, screwed connections with integral check readout valves and caps and calibrated nameplate and memory stop and drain connection. Elements pressure rated for 300 psig and 250 degree f.

2.10 VENTURI-TYPE FLOW ELEMENTS

A. Type: Differential-pressure venturi type, designed for installation in piping.
B. Construction: Bronze or cadmium-plated steel with brass fittings and attached tag with flow conversion data. Ends shall be threaded for 2 inches and smaller elements and flanged or welded for 2-1/2 inches and larger elements.

2.11 PITOT TUBE-TYPE FLOW ELEMENTS

A. Type: Differential-pressure pitot tube-type design with probe for insertion into piping.
B. Construction: Stainless steel probe of length to span inside of pipe, with brass fittings and attached tag with flow conversion data. Elements shall be pressure rated for 150 psig and 250 degree F (120 Degree C).

2.12 METERS

A. Portable Meters: Differential-pressure gage and two 12-foot hoses in carrying case with handle.
B. Scale: In inches of water unless otherwise indicated.
C. Accuracy: Plus or minus 2 percent between 20 to 80 percent of range.
D. Each meter shall be complete with operating instructions.

2.13 TEST PLUGS

A. Test Plugs shall be nickel-plated brass body, with 1/2-inch NPS fitting and 2 self-sealing valve-type core inserts, suitable for inserting a 1/8-inch O.D. probe assembly from a dial-type thermometer or pressure gage. Test plug shall have gasketed and threaded cap with retention chain and body of length to extend beyond insulation. Pressure rating shall be 500 psig.
B. Core Material: conform to the following for fluids and temperature range:
C. Test Kit: Provide test kit consisting of 1 pressure gage, gage adapter with probe, 2 bimetal dial thermometers, and carrying case.
D. Ranges of pressure gage and thermometers shall be approximately 2 times systems operating conditions.

PART 3 - EXECUTION

3.01 THERMOMETERS INSTALLATION

A. Install thermometers in vertical and tilted positions to allow reading by observer standing on floor.
B. Install in the following locations and elsewhere as indicated:
   1. At inlet and outlet of each hydronic zone.
   2. At inlet and outlet of each hydronic boiler and chiller.
   3. At inlet and outlet of each hydronic coil in air-handling units and built-up central systems.
   4. At inlet and outlet of each hydronic heat exchanger.
   5. At inlet and outlet of each hydronic heat recovery unit.
   6. At inlet and outlet of each thermal storage tank.
C. Thermometer Wells: Install in piping tee where thermometers are indicated, in vertical
position. Fill well with oil or graphite and secure cap.

3.02 INSTALLATION OF PRESSURE GAGES

A. Install pressure gages in piping tee with pressure gage valve, located on pipe at most readable position.

B. Install in the following locations, and elsewhere as indicated:
   1. At suction and discharge of each pump.
   2. At discharge of each pressure-reducing valve.
   3. At building water service entrance.
   4. At chilled water and condenser water inlets and outlets of chillers.

C. Pressure Gage Needle Valves: Install in piping tee with snubber. Install syphon in lieu of snubber for steam pressure gages.

3.03 INSTALLATION OF TEST PLUGS

A. Test Plugs: Install in piping tee where indicated, located on pipe at most readable position. Secure cap.

3.04 INSTALLATION OF FLOW-MEASURING ELEMENTS AND METERS

A. Locations: Install flow measuring elements in the following locations and elsewhere as indicated.
   1. At discharge of each pump.
   2. At inlet of each hydronic coil in built-up central systems.

B. Differential-Pressure-Type Flow Elements: Install minimum straight lengths of pipe upstream and downstream from element as described by the manufacturer's installation instructions.

C. Install wafer orifice-type element between 2 Class 125 pipe flanges, ANSI B16.1 (cast iron) or ANSI B16.24 (bronze).

D. Install connections for attachments to portable flow meters in a readily accessible location.

3.05 INSTALLATION OF CALIBRATED BALANCE VALVES

A. Install calibrated balance valves in the following locations and elsewhere as indicated.
   1. At each fan coil unit.
   2. At each unitary water source heat pump.
   3. At each 3-way valve.

3.06 ADJUSTING AND CLEANING

A. Adjusting: Adjust faces of meters and gauges to proper angle for best visibility.

B. Cleaning: Clean windows of meters and gages and factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touch-up paint.
3.07 CONNECTIONS

A. Piping installation requirements are specified in other sections of Division 22. The drawings indicate the general arrangement of piping, fittings, and specialties. The following are specific connection requirements:

B. Install meters and gages piping adjacent to machine to allow servicing and maintaining of machine.

END OF SECTION 22 0519
SECTION 22 0523

VALVES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This Section includes general duty valves common to most mechanical piping systems.

1. Special purpose valves are specified in individual piping system specifications.

1.02 RELATED SECTIONS

A. Division 22 Section "Mechanical Identification" for valve tags and charts.

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract, Division 01 Specification Sections, and Section 15010 "Basic Mechanical Requirements."

1. Product data, including body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions.

2. Provide valve schedule showing manufacturer's figure number and sizes.

1.04 QUALITY ASSURANCE

A. Single Source Responsibility: Comply with the requirements specified in Division 01 Section "Materials and Equipment," under "Source Limitations."

B. American Society of Mechanical Engineers (ASME) Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.

C. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Compliance: Comply with the various MSS Standard Practices referenced.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Preparation For Transport: Prepare valves for shipping as follows:

1. Ensure valves are dry and internally protected against rust and corrosion.

2. Protect valve ends against damage to threads, flange faces, and weld-end preps.

3. Set valves in best position for handling. Set globe and gate valves closed to prevent ratting; set ball and plug valves open to minimize exposure of functional surfaces; and block swing check valves in either closed or open position.

B. Storage: Use the following precautions during storage:

1. Do not remove valve end protectors unless necessary for inspection; then reinstall for storage.

2. Protect valves from weather. Store valves indoors. Maintain valve temperature higher than the ambient dew point temperature. If outdoor storage is necessary, support valves off the ground or pavement in watertight enclosures.

PART 2 PRODUCTS
2.01 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products from one of the manufacturers listed in valve schedule.

2.02 VALVE FEATURES, GENERAL

A. Valve Design: Rising stem or rising outside screw and yoke stems.
   1. Non-rising stem valves may be used where headroom prevents full extension of rising stems.

B. Pressure and Temperature Ratings: As scheduled and required to suit system pressures and temperatures.

C. Sizes: Same size as upstream pipe, unless otherwise indicated.

D. Operators: Provide the following special operator features:
   1. Hand wheels, fastened to valve stem, for valves other than quarter turn.
   2. Lever handles, on quarter-turn valves 6-inch and smaller, except for plug valves. Provide plug valves with square heads; provide one wrench for every 10 plug valves.
   3. Chain-wheel operators, for valves 2-1/2 inch and larger, install 72 inches or higher above finished floor elevation. Extend chains to an elevation of 5'-0" above finished floor elevation.
   4. Gear drive operators, on quarter-turn valves 8-inch and larger.

E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.

F. End Connections: As indicated in the valve specifications.
      a. Caution: Where soldered end connections are used, use solder having a melting point below 840 deg. F for gate, globe, and check valves; below 421 deg. F for ball valves.

2.03 GATE VALVES

A. Gate Valves, 2-Inch and Smaller: MSS SP-80; Class 150, body and union bonnet of ASTM B62 cast bronze; with threaded or solder ends, solid disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron hand wheel. Do not use solder end valves for hot water heating or steam piping applications.
### Gate Valves, 2-1/2 Inch and Larger

B. Gate Valves, 2-1/2 Inch and Larger: MSS SP-70; Class 125 iron body, bronze mounted, with body and bonnet conforming to ASTM A126 class B; with flanged ends, "Teflon" impregnated packing, and two-piece backing gland assembly.

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>OS &amp; Y RS</th>
<th>NRS</th>
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<tbody>
<tr>
<td>Crane</td>
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<td>F-2882</td>
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<tr>
<td>KITZ</td>
<td>72</td>
<td>75</td>
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</tbody>
</table>

"x" means not available. Provide lead-free products.

### Ball Valves

**2.04 BALL VALVES**

#### A. Ball Valves, 2 Inches and Smaller

Ball Valves, 2 Inches and Smaller: Rated for 150 psi saturated stem pressure, 400 psi WOG pressure; two- or three-piece construction; with bronze body conforming to ASTM B 62, full port only, chrome-plated brass ball, replaceable "Teflon" or "TFE" seats and seals, blowout-proof stem, and vinyl covered steel handle. Provide solder ends for condenser water, chilled water, and domestic hot and cold water service; threaded ends for heating hot water and low-pressure steam.

##### 1. Ball Valves - 1 Inch and Smaller:

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>THREADED ENDS</th>
<th>SOLDER ENDS</th>
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<tbody>
<tr>
<td>Conbraco (Apollo)</td>
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<td>Watts</td>
<td>B-6000</td>
<td>B-6001</td>
</tr>
<tr>
<td>Milwaukee</td>
<td>BA-100</td>
<td>BA-150</td>
</tr>
<tr>
<td>KITZ</td>
<td>58</td>
<td>59</td>
</tr>
</tbody>
</table>

"x" means not available. Provide lead-free products.

##### 2. Ball Valves - 1-1/4 Inch to 2 Inch:

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>THREADED ENDS</th>
<th>SOLDER ENDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conbraco (Apollo)</td>
<td>82-100</td>
<td>82-200</td>
</tr>
<tr>
<td>Nibco</td>
<td>T-590-Y</td>
<td>S-590-Y</td>
</tr>
<tr>
<td>Stockham</td>
<td>S-216 BR-R-T</td>
<td>S-216-BR-R-S</td>
</tr>
<tr>
<td>Watts</td>
<td>B-6800</td>
<td>B-6801</td>
</tr>
<tr>
<td>KITZ</td>
<td>62</td>
<td>63</td>
</tr>
</tbody>
</table>

"x" means not available. Provide lead-free products.
2.05  PLUG VALVES

A. Plug Valves, 2-Inch and Smaller: Rated at 150 psi WOG; bronze body, with straightaway pattern, square head, and threaded ends.
   1. Lunkenheimer: 454 or equal.
   2. Homestead: 611 (Semi Steel Body) or equal.

B. Plug Valves, 2-1/2 Inch and Larger: MSS SP-78; rated at 175 psi WOG; lubricated plug type, with semi steel body, single gland, wrench operated and flanged ends.
   1. Powell: 2201 or equal.
   2. Homestead: 605 or equal.

2.06  GLOBE VALVES

A. Globe Valves, 2-Inch and Smaller: MSS SP-80; Class 125; body and screwed bonnet of ASTM B 62 cast bronze; with threaded or solder ends, brass or replaceable composition disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron hand wheel. Provide Class 150 valves meeting the above where system pressure requires.

<table>
<thead>
<tr>
<th>CLASS 125 MANUFACTURER</th>
<th>CLASS 125 THREADED</th>
<th>CLASS 150 SOLDER</th>
<th>THREADED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crane</td>
<td>1</td>
<td>1310</td>
<td>17TF</td>
</tr>
<tr>
<td>Milwaukee</td>
<td>502</td>
<td>1502</td>
<td>590</td>
</tr>
<tr>
<td>Nibco</td>
<td>T-211-B</td>
<td>S-211-B</td>
<td>T-235-Y</td>
</tr>
<tr>
<td></td>
<td>T-211-Y</td>
<td>S-211-Y</td>
<td></td>
</tr>
<tr>
<td>KITZ</td>
<td>11</td>
<td>12</td>
<td>10</td>
</tr>
</tbody>
</table>

"x" means not available. Provide lead-free products.

B. Globe Valves, 2-1/2-Inch and Larger: MSS SP-85; Class 125 iron body and bolted bonnet conforming to ASTM A 126, Class B; with outside screw and yoke, bronze mounted, flanged ends, and "Teflon" impregnated packing, and two-piece backing gland assembly.

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>STRAIGHT BODY</th>
<th>ANGLE BODY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crane</td>
<td>351</td>
<td>353</td>
</tr>
<tr>
<td>Milwaukee</td>
<td>F2981</td>
<td>F2986</td>
</tr>
<tr>
<td>Nibco</td>
<td>F-718-B</td>
<td>F-818-B</td>
</tr>
<tr>
<td>KITZ</td>
<td>76</td>
<td>X</td>
</tr>
</tbody>
</table>

"x" means not available. Provide lead-free products.

2.07  BUTTERFLY VALVES

A. General - Where butterfly valves are used as shutoff for termination, or equipment removal or repair, select ductile iron lug type valves, bi-directional, dead-end service rated to the full working pressure of the valve. Select wafer type valves for other
applications. Provide gear operators on butterfly valves 8” and larger. Valve bodies to have extended necks to provide for 2-1/4” insulation as needed. Butterfly valves 12 inch and smaller rated to 200 psi, 14 inch and larger 150 psi.

1. Butterfly Valves 2-1/2 Inches and Larger:
   a. The following are model numbers for wafer-type, with nickel-plated ductile-iron disc:

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>LEVER</th>
<th>GEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crane</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Nibco</td>
<td>WD-20103</td>
<td>WD-20105</td>
</tr>
<tr>
<td>Milwaukee</td>
<td>MW-222E</td>
<td>MW-322E</td>
</tr>
<tr>
<td>KITZ</td>
<td>DJ Series</td>
<td>DJ Series</td>
</tr>
</tbody>
</table>

   Grooved Ends: Victaulic Series 300 and 704. Provide lead-free products.

   b. The following are model numbers for lug-type, with nickel-plated ductile-iron disc:

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>LEVER</th>
<th>GEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crane</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>Nibco</td>
<td>LD-20103</td>
<td>LD-20105</td>
</tr>
<tr>
<td>Milwaukee</td>
<td>ML-222E</td>
<td>ML-322E</td>
</tr>
<tr>
<td>KITZ</td>
<td>DJ Series</td>
<td>DJ Series</td>
</tr>
</tbody>
</table>

   Grooved Ends: Victaulic Series 300 and 704. Provide lead-free products.

   c. The following are model numbers for wafer-type, with aluminum-bronze disc:

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>LEVER</th>
<th>GEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crane</td>
<td>42</td>
<td>42</td>
</tr>
<tr>
<td>Nibco</td>
<td>WD-20003</td>
<td>WD-20005</td>
</tr>
<tr>
<td>Milwaukee</td>
<td>CW-223E</td>
<td>CW-323E</td>
</tr>
<tr>
<td>KITZ</td>
<td>DJ Series</td>
<td>DJ Series</td>
</tr>
</tbody>
</table>

   Grooved Ends: Victaulic Series 300A, 700A, and 703A. Provide lead-free products.

   d. The following are model numbers for lug-type, with aluminum-bronze disc:

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>LEVER</th>
<th>GEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center Line</td>
<td>Series LT</td>
<td>Series LT</td>
</tr>
<tr>
<td>Crane</td>
<td>44</td>
<td>44</td>
</tr>
<tr>
<td>Nibco</td>
<td>LD-20003</td>
<td>LD-20005</td>
</tr>
<tr>
<td>Milwaukee</td>
<td>CL-223E</td>
<td>CL-323E</td>
</tr>
<tr>
<td>KITZ</td>
<td>DJ Series</td>
<td>DJ Series</td>
</tr>
</tbody>
</table>

   Grooved Ends: Victaulic Series 300A, 700A, and 703A. Provide lead-free products.

2.08 CHECK VALVES

A. Swing Check Valves, 2-Inch and Smaller: MSS SP-80; Class 125, cast-bronze body and cap conforming to ASTM B 62; with horizontal swing, Y-pattern, and bronze disc;
and having threaded or solder ends. Provide valves capable of being reground while the valve remains in the line. Provide Class 150 valves meeting the above specifications, with threaded end connections, where system pressure requires or where Class 125 valves are not available.

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>CLASS 125 THREADED ENDS</th>
<th>CLASS 125 SOLDER ENDS</th>
<th>CLASS 125 THREADED ENDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crane</td>
<td>37</td>
<td>1342</td>
<td>137</td>
</tr>
<tr>
<td>Milwaukee</td>
<td>509</td>
<td>1509</td>
<td>510</td>
</tr>
<tr>
<td>Nibco</td>
<td>T-413</td>
<td>S-413</td>
<td>T-433</td>
</tr>
<tr>
<td>KITZ</td>
<td>22</td>
<td>23</td>
<td>29</td>
</tr>
</tbody>
</table>


B. Swing Check Valves, 2-1/2 Inch and Larger: MSS SP-71; Class 125 (Class 175 FM approved for fire protection piping systems), cast iron body and bolted cap conforming to ASTM A 126, Class B; horizontal wing, and bronze disc or cast-iron disc with bronze disc ring; and flanged ends. Provide valves capable of being refitted while the valve remains in the line.

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>CLASS 125</th>
<th>CLASS 175</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crane</td>
<td>373</td>
<td>x</td>
</tr>
<tr>
<td>Milwaukee</td>
<td>F2974</td>
<td>x</td>
</tr>
<tr>
<td>Nibco</td>
<td>F-918</td>
<td>x</td>
</tr>
<tr>
<td>KITZ</td>
<td>78</td>
<td>x</td>
</tr>
</tbody>
</table>


C. Lift Check Valves, 2-Inch and Smaller: Class 125; cast-bronze body and cap conforming to ASTM B 62; horizontal or angle pattern, lift-type valve, with stainless steel spring, bronze disc holder with renewable "Teflon" disc, and threaded ends. Provide valves capable of being refitted and ground while the valve remains in the line.

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>HORIZONTAL</th>
<th>ANGLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jenkins</td>
<td>655-A</td>
<td>x</td>
</tr>
<tr>
<td>Lunkenheimer</td>
<td>233</td>
<td>x</td>
</tr>
</tbody>
</table>

“x” means not available. Provide lead-free products.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine valve interior through the end ports for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks used to prevent disc movement during shipping and handling.

B. Actuate valve through an open-close and close-open cycle. Examine functionally significant features, such as guides and seats made accessible by such actuation. Following examination, return the valve closure member to the shipping position.

C. Examine threads on both the valve and the mating pipe for form (i.e., out-of-round or local indentation) and cleanliness.

VALVES
22 0523-6
D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.

E. Prior to valve installation, examine the piping for cleanliness, freedom from foreign materials, and proper alignment.

F. Replace defective valves with new valves.

3.02 VALVE ENDS SELECTION

A. Select valves with the following ends or types of pipe/tube connections:
   1. Copper Tube Size, 2-Inch and Smaller: Solder ends, except provide threaded ends for heating hot water and low-pressure steam service.
   2. Steel Pipe Sizes, 2-Inch and Smaller: threaded or grooved end.
   3. Steel Pipe Sizes 2-1/2 Inch and Larger: grooved end or flanged.

3.03 VALVE INSTALLATIONS

A. General Application: Refer to piping system specification sections for specific valve applications and arrangements. Use gate, ball, and butterfly valves for shut-off duty. Use globe, plug, and ball valves for throttling duty.

B. Locate valves for easy access and provide separate support where necessary. Where concealed, install behind access panel with valve located for complete accessibility for servicing.

C. Install valves and unions for each fixture and item of equipment. Arrange valves to allow equipment removal without system shutdown. Unions are not required on flanged devices.

D. Install three-valve bypass around each pressure reducing valve using throttling-type valves.

E. Install valves in horizontal piping with stem at or above the center of the pipe.

F. Install valves in a position to allow full stem movement.

G. Installation of Check Valves: Install for proper direction of flow as follows:
   1. Swing Check Valves: Horizontal position with hinge pin level.
   2. Lift Check Valve: With stem upright and plumb.

H. Where shut-off valves are installed in a confined space such as in a wall or furring, install ball valves with operating handle parallel with face of wall.

I. Where valves are located in walls, do not install more than 6'-0" from finished floor. Where valves are located above ceilings, install centered on access point and not greater than 24" above access point.

3.04 SOLDER CONNECTIONS

A. Cut tube square and to exact lengths.
B. Clean end of tube to depth of valve socket with steel wool, sand cloth, or a steel wire brush to a bright finish. Clean valve socket in same manner.

C. Apply proper soldering flux in an even coat to inside of valve socket and outside of tube.

D. Open gate and glove valves to full open position.

E. Remove the cap and disc holder of swing check valves having composition discs.

F. Insert tube into valve socket, making sure the end rests against the shoulder inside valve. Rotate tube or valve slightly to ensure even distribution of the flux.

G. Apply heat evenly to outside of valve around joint until solder will melt upon contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

H. Use 95-5 tin/antimony lead-free solder for all solder joints unless indicated otherwise.

3.05 THREADED CONNECTIONS

A. Note the internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.

B. Align threads at point of assembly.

C. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).

D. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

3.06 FLANGED CONNECTIONS

A. Align flange surfaces parallel.

B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

3.07 FIELD QUALITY CONTROL

A. Tests: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust or replace packing to stop leaks; replace valves if leak persists.

3.08 ADJUSTING AND CLEANING

A. Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare valves to receive finish painting or insulation.

3.09 VALVE PRESSURE/TEMPERATURE CLASSIFICATION SCHEDULES

A. Below schedules are for standard installation conditions. Variations or special valves and/or conditions set forth in other Division 15 Sections shall take precedence.
1. **VALVES, 2-INCH AND SMALLER**

<table>
<thead>
<tr>
<th>SERVICE</th>
<th>GATE</th>
<th>GLOBE</th>
<th>BALL</th>
<th>CHECK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condenser Water</td>
<td>125</td>
<td>125</td>
<td>150</td>
<td>125</td>
</tr>
<tr>
<td>Chilled Water</td>
<td>125</td>
<td>125</td>
<td>150</td>
<td>125</td>
</tr>
<tr>
<td>Domestic Hot and Cold Water</td>
<td>125</td>
<td>125</td>
<td>150</td>
<td>125</td>
</tr>
<tr>
<td>Heating Hot Water</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>Low-Pressure Steam</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
</tr>
</tbody>
</table>

2. **VALVES, 2-1/2 INCH AND LARGER**

<table>
<thead>
<tr>
<th>SERVICE</th>
<th>GATE</th>
<th>GLOBE</th>
<th>BUTTERFLY</th>
<th>CHECK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condenser</td>
<td>125</td>
<td>125</td>
<td>200</td>
<td>125</td>
</tr>
<tr>
<td>Chilled Water</td>
<td>125</td>
<td>125</td>
<td>200</td>
<td>125</td>
</tr>
<tr>
<td>Domestic Hot and Cold Water</td>
<td>125</td>
<td>125</td>
<td>200</td>
<td>125</td>
</tr>
<tr>
<td>Heating Hot Water</td>
<td>125</td>
<td>125</td>
<td>200</td>
<td>125</td>
</tr>
<tr>
<td>Low-Pressure Steam</td>
<td>125</td>
<td>125</td>
<td>200</td>
<td>125</td>
</tr>
</tbody>
</table>

END OF SECTION 22 0523
SECTION 22 0529
SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Extent of supports and anchors required by this section is indicated on drawings or in other Division-22 sections and include the following:
   1. Horizontal-Piping Hangers and Supports;
   2. Vertical-Piping Clamps;
   3. Hanger-Rod Attachments;
   4. Building Attachments;
   5. Saddles and Shields;
   6. Miscellaneous Materials;
   7. Anchors;
   8. Equipment Supports.

1.02 RELATED SECTIONS

A. This section is part of each Division-22 section making reference to or requiring supports and anchors specified herein.
B. Supports and anchors furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division-22 sections.
C. Section 03 3000: Cast-in-Place Concrete.

1.03 QUALITY ASSURANCE

A. Codes and Standards:
   1. Code Compliance: Comply with applicable plumbing codes pertaining to product materials and installation of supports and anchors.
   2. UL and FM Compliance: Provide products which are UL-listed and FM approved.
   3. MSS Standard Compliance:
      a. Provide pipe hangers and supports of which materials, design, and manufacturer comply with MSS SP-58.
      b. Select and apply pipe hangers and supports, complying with MSS SP-69.
      c. Fabricate and install pipe hangers and supports, complying with MSS SP-89.
      d. Terminology used in this section is defined in MSS SP-90.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor.

PART 2 - PRODUCTS

2.01 MANUFACTURED UNITS
A. Hangers and support components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58.
   1. Components shall have galvanized coatings where installed for piping and equipment that will not have field-applied finish.
   2. Pipe attachments shall have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.

B. Thermal Hanger Shield Inserts: 100-psi average compressive strength, waterproofed calcium silicate, encased with a sheet metal shield. Insert and shield shall cover entire circumference of the pipe and shall be of length indicated by manufacturer for pipe size and thickness of insulation.

2.02 HORIZONTAL-PIPING HANGERS AND SUPPORTS

A. General: Except as otherwise indicated, provide factory fabricated horizontal-piping hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems.
   1. Adjustable Steel Clevis Hangers: MSS Type 1.

2.03 VERTICAL-PIPING CLAMPS

A. General: Except as otherwise indicated, provide factory fabricated vertical-piping clamps complying with MSS SP-58, of one of the following types listed, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated clamps for copper-piping systems.
   
   B. Two-Bolt Riser Clamps: MSS Type 8.

2.04 HANGER-ROD AND BUILDING ATTACHMENTS

A. General Hanger Rod Attachment: Refer to structural drawings for requirements of hanger rod and building attachments. If a specific attachment that is required is not detailed on the structural drawings, one of the following attachments may be submitted for review by the structural engineer prior to installation. Except as otherwise indicated, provide factory fabricated hanger-rod attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachment to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.

B. General Building Attachment: Except as otherwise indicated, provide factory fabricated building attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building
attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems.

1. Concrete Inserts: MSS Type 18.
2. Center Beam Clamps: MSS Type 21.
5. Malleable Beam Clamps: MSS Type 30.
6. Steel Brackets: One of the following for indicated loading:

2.05 SADDLES AND SHIELDS

A. General: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.

B. Protection Shields: MSS Type 40; provide high density insert of same thickness of insulation.

2.06 MANUFACTURERS OF HANGERS AND SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide hangers and supports of one of the following:

1. B-Line Systems, Inc.
2. Tolco, Inc.
3. Elcen Metal Products Co.
5. ITT Grinnel Corp.

2.07 MISCELLANEOUS MATERIALS

A. Steel Plates, Shapes and Bars: ASTM A36.

B. Cement Grout: Portland cement (ASTM C150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

C. Pipe Alignment Guides: Factory fabricated, of cast semisteel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base with two-section guiding spider that bolts tightly to pipe. Length of guides shall be as recommended by manufacturer to allow indicated travel.

D. Pipe Roll Stand: Factory fabricated cast iron stand, size as required, with insulation installed on piping.

2.08 ISOLATORS

A. Isolators: Provide factory-fabricated isolators of size required.

B. Spring Isolators: Refer to Section 22 0548 VIBRATION CONTROL.

C. Manufacturers: Semco "Trisolator" or Potter-Roemer PR-ISO.

PART 3 - EXECUTION
3.01 INSPECTION
A. Examine substrates and conditions under which supports and anchors are to be installed. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION
A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachment.
B. Prior to installation of hangers, supports, anchors and associated work, installer shall meet at project site with Contractor, installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and Architect/Engineer for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

3.03 INSTALLATION OF BUILDING ATTACHMENTS
A. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.

3.04 INSTALLATION OF HANGERS AND SUPPORTS
A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.
B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and type as installed for adjacent similar piping.
C. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.
D. Provisions of Movement: Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors.
E. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
F. Pipe Slopes: Install hangers and supports to provide required pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 Pressure Piping Codes are not exceeded.

G. Bare Piping: Install isolators for all bare domestic water and bare hydronic piping.

H. Insulated Piping: Comply with the following installation requirements.
   1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.
   2. Shields: Where low-compressive-strength insulation or vapor barriers are indicated on cold or chilled water piping, install coated protective shields. Provide rigid insulation reinforcement at shields.

I. Hangers and supports to be capable to resist the minimum seismic forces indicated in drawings.

3.05 EQUIPMENT SUPPORTS

A. Concrete housekeeping bases will be provided as work of Division 3.

B. Furnish to Contractor, scaled layouts of all required bases, with dimensions of bases, and location to column center lines. Furnish templates, anchor bolts, and accessories, necessary for base construction.

3.06 ADJUSTING AND CLEANING

A. Hanger Adjustment: Adjust hangers so as to distribute loads equally on attachments.

B. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.

C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

D. Touch-Up Painting: Immediately after erection of anchors and supports, clean field welds and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA-1 requirements for touch-up of field-painted surfaces.
   1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

E. For galvanized surfaces clean welds bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION 22 0529
“L” TOWER BUILDING
SEISMIC AND CODE UPGRADES
RIO HONDO COLLEGE

SUPPORTS AND ANCHORS
22 0529-6
SECTION 22 0548
VIBRATION CONTROL FOR PLUMBING

PART 1 - GENERAL

1.01 DESIGN REQUIREMENTS

A. It is the intent of this Specification to provide the necessary design for the avoidance of excessive noise or vibration in the building due to the operation of machinery or equipment, or due to interconnected piping, ductwork, or conduit and to seismically restraint piping, ductwork and equipment per the applicable codes against seismic forces in any direction.

1. All isolators shall:
   a. Be provided by a single manufacturer.
   b. Be designed or treated for resistance to corrosion. Structural steel bases shall be cleaned of welding slag and coated with an SCAQMD compliant primer.
   c. Be selected to perform their function without undue stress or overloading. All isolators shall have a method for leveling and have a 1/4" thick ribbed neoprene acoustical pad under the spring baseplate.
   d. Be installed in a manner to prevent the transmission of vibration to the structure. No rigid connections between rotating or oscillating equipment or piping and the building will be permitted.
   e. Be designed to be non-resonant with equipment forcing frequencies or support structure natural frequencies.

2. Anchor floor mounted isolated equipment to concrete housekeeping pads of sufficient size to accommodate the anchorage of seismic restraints. Housekeeping pads shall be anchored to the structure as specified by the Structural Engineer of Record.

3. Each motor assembly shall be supported on a single structural steel frame.

4. Where called for in the specifications or on the drawings, all structural steel bases, including concrete pouring form bases, shall be designed and fabricated by the isolation manufacturer. Isolation manufacturer shall be a licensed fabricator for the City of Los Angeles, California.

5. Unless otherwise indicated, all equipment mounted on vibration bases shall have a minimum operating clearance of 1" between structural steel base and floor or support base beneath. The minimum operating clearance between concrete inertia bases and housekeeping pads shall be 1 inch. Check clearance space after installation to ensure that no debris has been left to possibly short circuit isolation bases.

6. Where necessary due to height limitations, provide height saving brackets.

7. Design isolators for positive anchorage against uplift and overturning.

1.02 MANUFACTURERS

A. Acceptable Isolation Manufacturer:

1. M. W. Sausse’ & Co., Inc. (Vibrex)
2. Mason Industries, Inc
3. Or Approved Equal
B. Purchased and/or fabricated equipment must be designed and manufactured with provision for positive anchorage against seismic forces.

C. Seismic restraints for pipes and ducts shall be as per the SMACNA Guidelines for seismic Restraint of Mechanical Systems and shall be approved by DSA.

D. Seismic restraints for equipment and piping shall be designed to meet the criteria of the current California Code of Regulations.

E. The manufacturer of Vibration Isolation and Seismic Control Equipment shall have the following responsibilities:
   1. Determine adequate vibration isolation and seismic restraint sizes and locations.
   2. Provide piping and equipment isolation systems and seismic restraints as scheduled and/or specified.
   3. Provide installation instructions and drawings to assure proper installation and performance.

1.03 SUBMITTALS

A. Make Submittals in Accordance with:
   2. Plumbing General Provisions - Sections 22 0510 and 22 0511.

B. Submit Shop Drawings and Manufacturer's Literature
   1. Specific vibration isolators and seismic restraints to be utilized showing compliance with the specifications.
   2. Isolation frame construction for each machine including dimensions, structural member sizes, support points and restraint locations and details.
   3. Methods for isolation and restraint of suspended piping, ductwork, and equipment.
   5. Seismic restraint calculations signed and stamped by an engineer licensed in the State of California and experienced in the design of isolation and seismic restraint for flexibly mounted equipment.

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATOR TYPES

A. "RMS" shall be a laterally stable un-housed spring isolator. Spring, top plate, and baseplate assembly shall be welded. Mounting shall comply with all requirements stated in paragraph above.

B. "RMSG" shall be the same as "RMS" above, but shall include height saving brackets for attachment to the equipment frame or isolation base.

C. "RMSP-EQ" shall be the same as "RMS" above except that the spring shall be enclosed in a welded steel cylinder with uplift restraints for horizontal and vertical seismic control.

D. "RMLS-EQ" shall be the same as "RMS" above, and shall be equipped with a steel housing designed for seismic restraint and with vertical limit stops to prevent the equipment changing from its loaded height should it be necessary to remove a portion of its weight. This housing may also be used as rigid blocking during rigging so that the
installed height and the operating height of the isolated equipment remain the same. O.S.H.P.D. pre-approval # OPA-0029.

E. "RMLS-SB" shall be a steel frame constructed of structural wide flange members unless shown otherwise and shall be rectangular in shape. The depths of the steel members shall not be less than one tenth (1/10) of the longest span between base supports or designed for a maximum beam deflection of .005". If the latter method is used, submittals shall include calculations showing the necessary moment of inertia. All steel members shall be coped and fitted, or constructed using the overlap insert method to assure a structural strength that is greater than the individual member strength. The steel frame is placed directly on top of the RMLS-EQ type isolators. O.S.H.P.D. Pre-approved isolator/seismic restraints.

F. "RMU-EQ-SH": shall be an individual semi-housed steel spring isolator complete with vertical motion limit stops incorporating seismic restraints, leveling, and ribbed neoprene pad bonded to the base-plate. O.S.H.P.D. pre-approval # OPA-0098.

G. "AS" shall be air spring isolators and shall incorporate the following:

1. A complete vibration isolation system consisting of a minimum of three air springs and a total of three height sensing valves. If there are two or more air springs per location, they shall be connected to the outlet of the height control valve in parallel. An associated interconnecting air supply system is required which is not included in this work.

2. The air spring shall operate at its normal operating height and the maximum pressure shall not exceed the manufacturer's recommended rating of 100 PSI. The system shall maintain an elevation of +/- 1/8", once adjusted.

3. The type air spring to be utilized shall be based upon the required natural frequency as indicated in the schedule. In order to avoid instability, auxiliary height saving brackets, housings, etc. may be utilized, subject to approval.

H. "RP-EQ" shall be a rubber pad type elastomer mounting, consisting of a steel bearing plate with 1/4" thick neoprene ribbed acoustical pad. Maximum loading shall be 60 PSI. Proper anchorage for seismic loads shall be indicated on drawings.

I. FUD-EQ shall be rubber-in-shear isolators incorporating mounting bolts for bolting to equipment base, a bottom steel plate for bolting isolator to sub base or structure, and built in seismic restraints.

J. "RMXA" shall be a rectangular steel housing that shall be bolted to the overhead structure and designed to allow up to 30 degrees rod misalignment. Hanger shall consist of a steel spring located in a molded neoprene retaining cup with hanger rod bushing.

K. "PRMXA" - Same as type "RMXA" with the addition of a steel load transfer plate so that the equipment or piping operating height is the same as the installed height.

L. "HXA" -Same as type "RMXA" with the addition of a neoprene element in series to isolate the upper connection.

M. "PHXA" - Same as type "HXA" with the addition of a steel load transfer plate so that the equipment or piping operating height is the same as the installed height.

N. "HSS" - shall be a 'rubber in shear' isolator element contained within a rectangular steel housing.
2.02 RAIL AND BASE TYPES

A. "RMR" spring rail isolator. Rails shall have springs of proper size and constant, installed between a continuous structural steel channel (upper member) and a continuous flat steel plate (bottom member) in such manner, quantity, and location that efficient uniform deflection and loading to the structure is assured. Rails shall be furnished with Vibrex hold down stabilizers to restrict excessive amplitudes. Cross bracing must be used when necessary for seismic stability.

B. "RMB" shall be the same as "RMR" above except that it shall be designed as an integral fan and motor base with an adjustable motor slide base.

C. "RMSR" shall be a set of wide flange structural steel rails supplied with height saving brackets to reduce the mounting height of the equipment. The maximum allowable deflection of any point on the loaded frame relative to the unloaded frame shall be 0.005". A wide flange section depth greater than 1/10 the supporting span between isolators will be accepted as satisfying the deflection requirement.

D. "RMSB" shall be a steel frame constructed of structural wide flange members unless shown otherwise and shall be rectangular in shape. The depths of the steel members shall not be less than one tenth (1/10) of the longest span between base supports or designed for a maximum beam deflection of .005". If the latter method is used, submittals shall include calculations showing the necessary moment of inertia. All steel members shall be coped and fitted, or constructed using the overlap insert method to assure a structural strength that is greater than the individual member strength. Adjustable motor slide bases shall be included when required for centrifugal fan applications. The steel bases shall have an operating clearance of one (1") inch above the supporting structure. Where bases are used to mount pumps, the bases shall be large enough to support the pipe elbows if required.

E. "RMSBI" shall be a steel frame inertia base with all welded members and constructed of structural channel shapes. The base shall be designed for a thickness or inertia mass to equipment weight ratio as shown on the schedule with a minimum thickness of six (6") inches. The bases shall include a template and anchor bolts to anchor the equipment. Inertia bases shall have 1/2" (#4) rebar spaced a maximum of 12" on centers in each direction and located 1-1/2" from the bottom of the base. Adjustable motor slide bases shall be included when required for centrifugal fan applications. Bases shall be supplied with height saving brackets to reduce the mounting height of the equipment.

F. "RMUAB-EQ" shall be a steel frame made of structural angle with type “RMU-EQ-SH" O.S.H.P.D. pre-approved combination isolator/restraints.

G. "RMLS-R" shall be a set of multiple wide flange structural steel rails supplied with type RMLS-EQ vibration isolator/seismic restraints and height saving brackets to reduce the mounting height of the equipment. The maximum allowable deflection of any point on the loaded frame relative to the unloaded frame shall be 0.005". A wide flange section depth greater than 1/10 the supporting span between isolators will be accepted as satisfying the deflection requirement.

H. Type "RMLSB" shall be a steel frame constructed of structural wide flange members unless shown otherwise and shall be rectangular in shape. The depths of the steel members shall not be less than one tenth (1/10) of the longest span between base supports or designed for a maximum beam deflection of .005". If the latter method is used, submittals shall include calculations showing the necessary moment of inertia.
All steel members shall be coped and fitted, or constructed using the overlap insert method to assure a structural strength that is greater than the individual member strength. Frame shall be supplied complete with height saving brackets and type RMLSE-Q, O.S.H.P.D. pre-approved isolator/seismic restraints.

1. Type RMLSB is the same as type “RMLSB” but rather than utilizing height saving brackets the steel frame is placed directly on top of the RMLSE-Q type isolators.

2.03 SEISMIC RESTRAINTS

A. Shall be capable of safely accepting external forces as specified in the applicable codes without failure. Restraints shall maintain equipment and piping in a captive position during an earthquake. Restraints shall not short circuit vibration isolation systems or transmit objectionable vibration or noise under normal operating conditions. Seismic restraints shall be provided on all equipment as scheduled on the drawings. Submit calculations by a Licensed Structural Engineer Registered in State of California to verify snubber capacities.

B. Type "3500" seismic restraint shall be constructed of steel plate, concentric steel pipes, and structural members in an all welded assembly. All contact points shall be cushioned with minimum 1/4" thick resilient pad. Restraints shall be O.S.H.P.D pre-approved type OPA-0029.

C. Type "3200" seismic restraint shall be all directional type with interlocking steel members constructed of structural angle and A-36 threaded rod. All contact points shall be cushioned with minimum 1/4" thick resilient pad or bushing.

D. Type "CR" seismic restraints shall be constructed of 7x19 strand galvanized aircraft cable. Cable assembly shall come complete with minimum (2) "U" bolt clamps per end and thimbles to protect cable from chafing. Allowed loads shall be the cable breaking strength with a safety factor of three. Actual loads shall be calculated with the worst case of all load applied to one cable and anchor pattern. Cable shall be installed with 1/4" slack to prevent the transmission of vibration to the structure.

PART 3 - EXECUTION

3.01 GENERAL

A. Install in accordance with manufacturer’s written instructions. Vibration isolators must not be installed in a manner that will result in piping stress or misalignment.

B. The structural steel or concrete inertia base shall be placed in position and supported temporarily by blocks or shims, as appropriate, prior to the installation of the equipment or isolators. The isolators shall be installed without raising the equipment and frame assembly.

C. After the entire installation is complete and under full operational load, the isolator shall be adjusted so that the load is transferred from the blocks or shims to the isolator. When all isolators are properly adjusted, the blocks or shims shall be barely free and shall be removed.

D. Once the equipment is in operation, install and anchor the seismic restraints with proper operating clearances as indicated on drawings.

E. Plumbing equipment shall be isolated from the building structure by vibration isolators.
as scheduled on the drawings.

F. All piping 1 1/4" and over located in mechanical equipment rooms, and for a minimum of fifty (50) feet or 100 pipe diameters whichever is greater, from connection to vibrating plumbing or electrical equipment, shall be isolated from the building structure by means of vibration isolators as identified above.

G. All plumbing piping and vertical risers shall be isolated from the building structure by means of vibration isolators and guides.

H. All piping to be isolated shall freely pass through walls and floors without contact. Penetration points shall be sleeved or otherwise formed to allow passage of piping and maintain adequate clearance (Minimum of 2 inches all around) around the outside surfaces. Any materials used to fill the clearance space shall be permanently flexible so that vibration will not pass through it.

I. No rigid connections between equipment and building structure, including electrical conduit, shall be made that degrades the vibration isolation system herein specified. Inform other following trades, such as plastering, or electrical, to avoid any contact which would short-circuit the vibration isolation.

J. Bring to the Architect's attention prior to installation any conflicts with other trades which will result in unavoidable rigid contact with equipment or piping as described herein, due to inadequate space or other unforeseen conditions. Corrective work necessitated by conflicts after installation shall be at the contractor's expense.

K. Bring to the Architect's attention any discrepancies between the specifications and field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the contractor's expense.

L. Obtain inspection and approval of any isolation installation to be covered or enclosed, prior to such closure.

M. Thrust restraints shall consist of spring hangers with the same deflection as specified for the spring mountings. Thrust restraints shall be attached to the fan at the centerline of air discharge opening.

N. Correct, at no additional cost, all installations that are deemed defective in workmanship or materials.

3.02 PIPING ISOLATORS

A. All piping except fire standpipe systems are included under this section.

B. Isolate piping within 50 feet of rotating equipment and pressure reducing stations.

C. The isolators shall be installed with the isolator hanger box attached to, or hung as close as possible to, approved locations on the supporting structure.

D. The isolators shall be suspended from substantial structural members, not from slab diaphragm unless specifically permitted.

E. Hanger rods shall be aligned to clear the hanger box.

F. Horizontal floor supported piping shall be isolated by type "RMLS-EQ", with a minimum static deflection of 1.0 inch or the same deflection as isolated equipment to which pipe is connected, whichever is greater.

G. Vertical riser pipe support and restraint system shall consist of type "RMS" springs and
type "PG-EQ" guides. Install vertical riser guides so that clearances are maintained around concentric pipes in the guides. Install vertical restraints on the floor location as shown on drawings.

H. Pipe anchors, where required, shall utilize resilient pipe anchors, type "RPA" or equivalent, to avoid direct contact of piping with building.

I. Pipe Extension and Alignment connectors: Provide connectors at pump suction and discharge, riser take offs, cooling and heating coils, and elsewhere as required to accommodate thermal expansion and misalignment.

J. Seismic restraint spacing shall be in accordance with applicable codes.

3.03 INSPECTION

A. On completion of installation of all vibration isolation and seismic control devices herein specified, the local representative of the isolation materials manufacturer shall inspect the completed system and report in writing any installation error, improperly selected isolation devices, or other faults in the system that could affect the performance of the system. The contractor shall submit a report to the Architect, including the above report with consequent steps taken to properly complete the isolation work.

END OF SECTION 22 0548
SECTION 22 1100

BASIC PLUMBING PIPING MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This Section specifies piping materials and installation methods common to more than one section of Division 22 and includes joining materials, fire stop sealants, and basic piping installation instructions.

1.02 RELATED SECTIONS

A. The following sections contain requirements that relate to this section:

1. Division 22 Section "Basic Mechanical Requirements" applies to the work of this Section.
2. Piping materials and installation methods peculiar to individual systems are specified within their respective system specification sections of Division 02 and 22.
3. Valves are specified in a separate section and in individual piping system sections of Division 22.
4. Division 22 Section "Supports and Anchors".
5. Division 22 Section "Mechanical Identification".

1.03 SUBMITTALS

A. Refer to Division 01 and Division 22 Section "Basic Mechanical Requirements" for administrative and procedural requirements for submittals.
B. Product Data: Submit product data on fire stop sealants.

1.04 QUALITY ASSURANCE

B. Soldering and Brazing procedures shall conform to ANSI B9.1 Standard Safety Code for Mechanical Refrigeration.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Provide factory-applied plastic end-caps on each length of pipe and tube, except for concrete, corrugated metal, hub-and-spigot, and clay pipe. Maintain end-caps through shipping, storage and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.
B. Protect stored pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed structural capacity of the floor.
C. Protect flanges, fittings, and specialties from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

A. Refer to the individual piping system specification Sections in Division 22 for specifications on piping and fittings relative to that particular system.

B. Weld-O-Lets: Welding Weld-O-Lets may be used in lieu of tees where branch connection pipe size is two or more pipe sizes smaller than main header size.

2.02 JOINING MATERIALS

A. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.

B. Brazing Materials: Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials appropriate for the materials being joined.

C. Soldering Materials: Refer to individual piping system specifications for solder appropriate for each respective system.

1. Soldering materials shall not contain lead.

D. Gaskets for Flanged Joints: Gasket material shall be full-faced for cast-iron flanges and raised-face for steel flanges. Select materials to suit the service of the piping system in which installed and which conform to their respective ANSI Standard (A21.11, B16.20, or B16.21). Provide materials that will not be detrimentally affected by the chemical and thermal conditions of the fluid being carried.

2.03 SLEEVES AND SEALS

A. Sleeves:

1. Sheet-Metal Sleeves: 5” and Smaller, 20 gage galvanized sheet metal; 6” and Larger, 10 gage, galvanized sheet metal, round tube closed with welded longitudinal joint.

2. Steel Sleeves: Schedule 40 galvanized, welded steel pipe, ASTM A53, Grade A.

3. Galvanized steel telescoping type: Galvanized sheet metal per manufacturer’s standards.

4. Polyethylene Sleeves: Manufacturer’s standard product.

B. Mechanical Sleeve Seals: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.04 FIRESTOP SEALANT

A. Fire stopping material shall be asbestos-free and capable of maintaining an effective barrier against flame and gases in compliance with the following requirements:
1. Flame Spread: 25 or less, ASTM E 84.
2. Smoke Development: 50 or less, ASTM E 84.

B. Material when installed shall have the same fire rating as the assembly in which it is being installed.

2.05 PIPING ISOLATION

A. Manufacturer's standard product for providing sound and electrolysis isolation.

PART 3 - EXECUTION

3.01 PREPARATION

A. Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.
B. Remove scale, slag, dirt, and debris for both inside and outside of piping and fittings before assembly.

3.02 INSTALLATIONS

A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated. Refer to individual system specifications for requirements for coordination drawing submittals.

B. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated otherwise.

C. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

D. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated on the Drawings.

E. Install piping tight to slabs, beams, joists, columns, walls and other permanent elements of the building. Provide space to permit insulation applications, with 1" clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

F. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.

G. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4" ball valve, and short 3/4" threaded nipple and cap.

H. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals.

I. Coordinate to provide curb, minimum 4" above finish floor, for all pipe shafts or floor openings for multiple pipes.
J. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, or floors, the fire rated integrity shall be maintained.

3.03 PIPE SUPPORTS AND HANGERS

A. All pipe Supports and Hangers shall be per requirements of Specification Section 22-0529 “Supports and Hangers”.

3.04 FITTINGS AND SPECIALTIES

A. Use fittings for all changes in direction and all branch connections.
B. Remake leaking joints using new materials.
C. Install Y-type strainers with blow-down valves on the supply side of each control valve, pressure reducing or regulating valve, solenoid valve, and elsewhere as indicated.
D. Install unions adjacent to each valve and at the final connection to each piece of equipment and plumbing fixture having 2” and smaller connections, and elsewhere as indicated.
E. Install Flanges in piping 2-1/2” and larger, where indicated, adjacent to each valve, and at the final connection to each piece of equipment.
F. Install dielectric unions to connect piping materials of dissimilar metals in dry piping systems (gas, compressed air, vacuum).
G. Install dielectric fittings to connect piping materials of dissimilar metals in wet piping systems (water, steam).

3.05 JOINTS

A. Steel Pipe Joints:
   1. Pipe 2” and Smaller: Thread pipe with tapered pipe threads in accordance with ANSI B2.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint lubricant or sealant suitable for the service for which the pipe is intended on the male threads at each joint and tighten to leave not more than 3 threads exposed.
   2. Pipe Larger than 2”:
      a. Weld pipe joints (except for exterior water service pipe) in accordance with ASME Code for Pressure Piping, B31.
      b. Weld pipe joints of exterior water service pipe in accordance with AWWA C206.
      c. Install flanges on all valves, apparatus, and equipment. Weld pipe flanges to pipe ends in accordance with ASME B31.1.0 Code for Pressure Piping. Clean flange faces and install gaskets. Tighten bolts to torque specified by manufacturer of flange and flange bolts, to provide uniform compression of gaskets.

B. Non-ferrous Pipe Joints:
2. Thoroughly clean tube surface and inside surface of the cup of the fittings, using every fine emery cloth, prior to making soldered or brazed joints. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.

3. Mechanical Joints: Flared compression fittings may be used for refrigerant lines 3/4" and smaller.

C. Joints for other piping materials are specified within the respective piping systems sections.

3.06 INSTALLATION OF SLEEVES

A. Provide pipe sleeves for pipes to pass through walls, floor and roofs. Diameter of sleeve to be 1-inch larger than the outside diameter of pipe or pipe and covering of insulated pipe. Galvanized steel telescoping type sleeves or polyethylene may be used. Where seepage may occur, use steel pipe sleeves.

B. All pipe sleeves through floors other than floors on grade shall extend 2-inches above finished floor and shall be caulked with mineral wool. Provide collar where polyethylene sleeve is used.

C. Where required in existing construction, or where sleeves have been omitted, openings for pipe may be core drilled in floors and/or walls or partitions, providing prior acceptance of such core drilling is obtained from the Architect. Holes core drilled through floors above grade shall be provided with sleeves extending 2-inches above finish floor as hereinbefore specified.

D. Seal with resilient sealant: Dow Corning "Fire Stop" or approved equal.

3.07 INSTALLATION OF FIRE STOP SEALANT

A. Fire-stopping shall be provided at, but not limited to, duct, and piping penetrations through floor slabs and through time rated partitions or firewalls.

B. Install fire-stopping materials in accordance with the manufacturer's instructions and the following requirements.

1. Filling: Fire-stopping materials shall completely fill the void spaces.

C. Coordination: Coordinate the work with other trades. Firestopping materials at penetrations of insulated pipes and ducts shall be applied prior to insulation, unless the insulation meets the requirements specified for firestopping.

D. Surface Preparation: Surfaces to be in contact with firestopping materials shall be free of dirt, grease, oil, loose material, rust, or other substances that may affect proper fitting or the required fire resistance.

3.08 INSTALLATION OF PIPE ISOLATION

A. Provide sound and electrolysis isolation on all uninsulated, pipes, Semco "Trisolators" or Potter-Roemer "Prisolators".
3.09 INSTALLATION OF PIPE FLASHING

A. Pipe flashing assemblies, "Semco" Fig. 1100-4, as required, seal the joint between flashing and pipe with waterproofing compound. Install counterflashing sleeve to cover a minimum of 3/4-inch to top of lead flashing, making the top joint permanently watertight.

3.10 TESTING OF PIPING

A. Provide notification of test at least three working days prior to tests on all or part of any piping system. Do not allow or cause any piping system to be insulated, covered, concealed or enclosed until such systems have been tested and reviewed.

B. Provide all necessary materials (including temporary isolation valves or caps), pumps, testing media and labor for testing. Temporarily remove any device in piping system, which will not withstand test pressure specified, and reinstall same after successful testing. Test time begins to accrue after full test pressure is achieved.

C. Testing and inspection of all piping systems and associated equipment for leaks shall be accomplished after installation and cleaning and prior to placing into service. Flanges, threaded joints and all welds shall be left unpainted and uninsulated until the piping systems have been approved.

D. A rigid visual inspection of each specific piping system shall be made prior to conducting tightness tests, to ascertain that all appurtenances and equipment are provided, properly connected and supported, and in all respects ready for testing.

E. Equipment such as pumps, chillers, tanks, heat exchangers, flexible hose, safety valves and similar equipment shall not be subjected to the piping system test pressure. Equipment shall either be disconnected from the piping or be isolated by valves or blanks during testing and reinstalled after acceptance by the Owner.

F. Indicating pressure gauges mounted locally may be tested with the lines provided the test pressure does not exceed the scale range.

G. Orifice plates, rotometers, displacement meters and other line inserts shall either not be installed until completion of all testing, or shall be removed prior to any tests and reinstalled after test has been accepted by the Owner.

H. The application of pressure to a system shall be under control at all times, so that in no case shall the test pressure be exceeded by more than 6 percent.

I. Gauges used for testing shall be tested for accuracy as directed or approved by the Owner, and then installed as close as possible to the low point of the piping system.

J. Do not apply test pressure until the piping system and its contents approach the same temperature.

K. While piping is under test, exercise care that excessive pressure does not occur due to increase in ambient temperature.

L. Control Valves:

1. Control valves which are installed with block and by-pass valve shall have the block valve closed, the by-pass valve opened, and a temporary pipe piece inserted in place of the control valve (or a test blank may be installed on each
side of the control valve) until all flushing and testing of all lines of that system is completed and accepted by the Owner, after which they shall be reinstalled.

2. Control valves installed without block or by-pass valves shall be replaced by a pipe piece during flushing and testing of the system. After acceptance of the flushing they shall be reinstalled.

M. Minimum piping test pressures shall be as noted in tabulation; or they shall be 150 percent of design pressure for the specific system being tested, whichever is higher.

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>TEST MEDIUM</th>
<th>TESTING PRESSURE (PSIG)</th>
<th>DURATION (HOURS)</th>
<th>ACCEPTABLE TOLERANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil, Water, Vent, &amp; Storm Water</td>
<td>Water</td>
<td>Top of highest vent</td>
<td>4</td>
<td>No joint sweat</td>
</tr>
<tr>
<td>Water</td>
<td>Water</td>
<td>150</td>
<td>4</td>
<td>None. Except temperature change.</td>
</tr>
<tr>
<td>Fuel Gas</td>
<td>Air</td>
<td>60</td>
<td>4</td>
<td>None. Except temperature change.</td>
</tr>
<tr>
<td>Fire Sprinkler</td>
<td>Water</td>
<td>200</td>
<td>4</td>
<td>None. Except temperature change.</td>
</tr>
</tbody>
</table>

N. Conduct hydrostatic tests with water at a temperature below 100 degrees F.

1. Fill the system slowly with water and vent at highest points to expel the air before pressurizing.
2. Carefully examine all joints for leaks or defects.
3. Provide connections as required to accomplish the above.

O. Keep accurate test records of each line or system tested and provide copies of same to Owner after acceptance. Each test shall include:

1. Identification of piping system and test number.
2. Testing medium.
3. Test pressure.
4. Date of test acceptance.

3.11 ADJUSTMENTS

A. At the completion of the Work, completely adjust all valves and equipment for their proper use and rating.

END OF SECTION 22 1100
SECTION 22 1116
WATER DISTRIBUTION PIPING (INSIDE BUILDINGS)

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section includes potable cold water, hot water, and circulation hot water piping, fittings, and specialties within the building to a point of 5 feet outside the building.

1.02 RELATED SECTIONS

A. The following sections contain requirements that relate to this section.

1. Division 22
   a. Section 22 0510 “Basic Plumbing Requirements”.
   b. Section 22 0511 Supplementary Plumbing Requirements”.
   c. Section 22 1111 “Earthwork For Plumbing Systems”.
   d. Section 22 1113 “Water Distribution System – Exterior of Buildings”.
   e. Section 22 0523 “Valves”.
   f. Section 22 0519 "Meters and Gages".
   g. Section 22 0553 “Plumbing Identification”.

2. Division 31 Section 31 1313.

3. Division 07 Section "Joint Sealers" for materials and methods for sealing pipe penetrations through rated walls and fire and smoke barriers.

B. Separate sections of Division 22 specify Basic Piping Materials and Methods, Hangers, and Supports, Expansion Compensation, piping system identification materials and requirements, general duty valves, pipe insulation, fire protection piping, and plumbing equipment.

1.03 DEFINITIONS

A. Water Distribution Pipe: A pipe within the building or on the premises that conveys water from the water service pipe or meter to the points of usage.

B. Water Service Pipe: The pipe from the water main or other source of potable water supply to the water distributing system of the building served.

C. Pipe sizes used in this Specification are nominal pipe size (NPS).

1.04 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.

1. Product data for each piping specialty and valve specified.
2. Test reports specified in Part 3 of this Section.
3. Maintenance data for each piping specialty and valve specified for inclusion in Maintenance Manual specified in Division 01 and Division 22 Section "Basic Plumbing Requirements."
1.05 QUALITY ASSURANCE

A. Codes and Standards
      a. Accessible plumbing fixtures for adults; dimensions shall comply with the requirements of CCT, T-24, Section 1115.B.
      b. Heights and location of fixtures shall be according to CCR, T-24, Chapter 11-B and Table 1115.B-1.
      c. Fixture Controls shall comply with CCR, T-24 Section 1115.B.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Provide factory-applied plastic end-caps on each length of pipe and tube, except for concrete, corrugated metal, hub-and-spigot, clay pipe. Maintain end-caps through shipping, storage and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.

B. Protect stored pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed structural capacity of the floor.

C. Protect flanges, fittings and specialties, from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

D. Store CPVC, and PVC pipe and fittings where protected from direct sunlight.

E. Store pipe in a manner to prevent sagging and bending.

1.07 SEQUENCING AND SCHEDULING

A. Coordinate the size and location of concrete equipment pads. Cast anchor-bolt inserts into pad. Concrete, reinforcement, and formwork requirements are specified in Division 3.

B. Coordinate the installation of pipe sleeves for foundation wall penetrations.

1.08 EXTRA MATERIALS

A. Maintenance Stock: Furnish one valve key for each key-operated wall hydrant, hose bib, fixture supply, or faucet installed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer Uniformity: Conform to the requirements specified in Division 22 Section "Basic Plumbing Requirements."

1. Hose Bibs:
   a. Lee Brass Co.
   b. Acorn
   c. Watts Regulator Co.
   d. Woodford Mfg. Co.

2. Relief Valves:
3. Water Hammer Arresters:
   a. Precision Plumbing Products, Inc.
   c. Sioux Chief
   d. Watts Regulator Co.
   e. Zurn Industries, Inc.; Hydromechanics Div.

4. Vacuum Breakers for Hose Connections:
   b. Conbraco Industries, Inc.
   c. Watts Regulator Co.

5. Mechanical Sleeve Seals:
   a. Thunderline Corp.

6. Pipe Escutcheons:
   b. Grinnell

7. Dielectric Waterway Fittings:
   a. Epco Sales, Inc.
   b. Victaulic Company of America

8. Dielectric Unions:
   a. Eclipse, Inc.
   b. Perfection Corp.
   c. Watts Regulator Co.

2.02 PIPE AND TUBE MATERIALS, GENERAL

A. Pipe and Tube: Refer to Part 3, Article "Application, General," for identification of systems where the below materials are used.

B. Copper Tube: (Within Building) ASTM B88, Type L Water Tube, drawn temper.

C. Copper Tube: (Underground) ASTM B88, Type K Water Tube, annealed temper.

2.03 FITTINGS

A. Wrought Copper Solder-Joint Fittings: ANSI B16.22, streamlined pattern.

B. Wrought Copper and Bronze Grooved-End Fittings: ASTM B75 Tube and ASTM B584 Bronze Castings.


D. Dielectric Unions: Threaded, solder, or grooved-end connections as required to suit application; constructed to isolate dissimilar metals, prevent galvanic action, and prevent corrosion.

E. Dielectric Unions: Flexible Connectors: Stainless-steel bellows with woven, flexible, bronze wire reinforced protective jacket; minimum 150 psig working pressure, maximum 250 degree F operating temperature. Connectors shall have flanged or threaded-end connections to match equipment connected and shall be 12" long and capable of 3/4-inch misalignment. Sweat ends are not acceptable.
2.04 JOINING MATERIALS

A. Solder Filler Metal: ASTM B32, 95-5 Tin-Antimony 'lead-free' solder.
B. Brazing Filler Metals: AWS A5.8, BCUP Series.
C. Gasket Material: Thickness, material, and type suitable for fluid to be handled and design temperatures and pressure.

2.05 GENERAL-DUTY VALVES

A. General-duty valves (i.e., gate, globe, check, ball, and butterfly valves) are specified in Division 22 Section "Valves." Special duty valves are specified below by their generic name; refer to Part 3 Article "Valve Application" for specific uses and applications for each valve specified.

2.06 SPECIAL DUTY VALVES

A. Balance Cocks: 400 PSI WOG, 2 piece, ball valve, handle, memory stop, with threaded-end connections conforming to ASME B1.20.1.
B. Balance Cocks: 400 PSI WOG, 2 piece bronze, ball valve, handle, memory stop, with solder-end connections.

2.07 PIPING SPECIALTIES

A. Water Hammer Arresters:
   1. J.R. Smith or Approved Equal
   2. Bellows type, with stainless steel casing and bellows, pressure rated for 250 psi, tested and certified in accordance with PDI Standard WH-201 shall be of the following sizes unless otherwise indicated on the drawings:
      a. Self-closing valves, lavatories, sinks, etc.

<table>
<thead>
<tr>
<th>Supply header or pipe size (Inch)</th>
<th>Manufacturer Name</th>
<th>Water Hammer Arrester Model No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2&quot;</td>
<td>J.R. Smith</td>
<td>5005</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>J.R. Smith</td>
<td>5005</td>
</tr>
<tr>
<td>1&quot;</td>
<td>J.R. Smith</td>
<td>5010</td>
</tr>
</tbody>
</table>

3. Flushometer, automatic and solenoid valves:
   a. J.R. Smith or Approved Equal

<table>
<thead>
<tr>
<th>Supply header or pipe size (Inch)</th>
<th>Manufacturer Name (a)</th>
<th>Water Hammer Arrester Model No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4&quot;</td>
<td>J.R. Smith</td>
<td>5010</td>
</tr>
<tr>
<td>1&quot;</td>
<td>J.R. Smith</td>
<td>5010</td>
</tr>
<tr>
<td>1-1/4&quot;</td>
<td>J.R. Smith</td>
<td>5030</td>
</tr>
<tr>
<td>1-1/2&quot;</td>
<td>J.R. Smith</td>
<td>5040</td>
</tr>
<tr>
<td>2&quot;</td>
<td>J.R. Smith</td>
<td>5050</td>
</tr>
</tbody>
</table>

B. Y-Type Strainers: Provide strainers full line size of connecting piping, with ends matching piping system materials. Screens shall be Type 304 stainless steel, with
3/64" perforations at 233 per square inch. Strainers in copper lined to have bronze bodies.

1. Provide strainers with 125 psi working pressure rating for low pressure applications, and 250 psi pressure rating for high pressure application.
2. Threaded ends, 2" and Smaller: Cast-iron body, or bronze body, screwed screen retainer with centered blow-down fitted with pipe plug.
3. Threaded Ends, 2-1/2" and Larger: Cast-iron body or bronze body bolted screen retainer with off-center blow-down fitted with pipe plug.
4. Flanged Ends, 2-1/2" and Larger: Cast-iron body or bronze body, bolted screen retainer with off-center blow-down fitted with pipe plug.

C. Hose-Connections: Hose connections shall have garden hose threaded outlets conforming to ASME B1.20.7.

D. Hose Bibs: Bronze body with chrome- or nickel-plated finish, with renewable composition disc, removable wheel handle, vacuum breaker, 3/4- inch solder inlet, hose outlet.

E. Vacuum Breakers: Hose connection vacuum breakers shall conform to ASSE Standard 1011, with finish to match hose connection.

F. Relief Valves: Sizes for relief valves shall be in accordance with ASME Boiler and Pressure Vessel Codes for indicated capacity of the appliance for which installed.

1. Combined Pressure-Temperature Relief Valves: Bronze body, test lever, thermostat, complying with ANSI Z21.22 listing requirements for temperature discharge capacity. Temperature relief valves shall be factory set at 210 degree F, and pressure relief at 150 psi.

G. Escutcheons: Chrome-plated, stamped steel, hinged, split-ring escutcheon, with set screw. Inside diameter shall closely fit pipe outside diameter, or outside of pipe insulation.

H. Sleeves:

1. Sheet-Metal Sleeves: 10 gage, galvanized sheet metal, round tube closed with welded longitudinal joint.
2. Steel Sleeves: Schedule 40 galvanized, welded steel pipe, ASTM A53, Grade A.
3. Mechanical Sleeve Seals: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine rough-in requirements for plumbing fixtures and other equipment with water connections to verify actual locations of piping connections prior to installation.

3.02 PREPARATION

A. Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.
B. Remove scale, slag, dirt, and debris for both inside and outside of piping and fittings before assembly.
3.03 PIPE APPLICATIONS

A. Install Type L, drawn copper tube with wrought copper fittings and solder joints for pipe sizes 4 inches and smaller, above ground, within building.

B. Install Type K, annealed temper copper tube for pipe sizes 2 inches and smaller, with minimum number of joints, below ground.

C. Water piping in sizes 2-1/2 to 6 inches may be Type L drawn copper tube with roll-grooved ends and mechanical couplings, above ground within building.

3.04 PIPING INSTALLATION

A. General Locations and Arrangements; Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.

B. Use fittings for all changes in direction and branch connections.

C. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted unless expressly indicated.

D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

E. Conceal all piping installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

F. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

G. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.

H. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4-inch ball valve, and short 3/4-inch threaded nipple and cap.

I. Pipe sleeves smaller than 6 inches shall be galvanized steel pipe; pipe sleeves 6 inches and larger shall be galvanized steel sheet metal.

J. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls with sleeves and mechanical sleeve seals.

K. Fire Barrier Penetrations: Where pipes pass though fire-rated walls, partitions, ceilings, and floors, maintain the fire-rated integrity. Refer to Division 7 for special sealers and materials.

3.05 HANGERS AND SUPPORTS

A. General: Hanger, support, and anchor devices conforming to MSS SP-69 are specified in Division 22, Section "Supports and Anchors." Conform to the table below for maximum spacing of supports:

B. Pipe Attachments: Install the following:
1. Adjustable steel clevis hangers, MSS Type 1, for individual horizontal runs less than 20 feet in length.
2. Adjustable roller hangers, MSS Type 43, and spring hangers, MSS Type 41 with Type 49, for individual horizontal runs 20 feet and longer.
3. Pipe roll, complete MSS Type 44 for multiple horizontal runs, 20 feet or longer, support on a trapeze.
4. Spring hangers to support vertical runs.

C. Install hangers for horizontal piping with the following maximum spacing and minimum rod sizes:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 3/4</td>
<td>7</td>
<td>3/8</td>
<td>5</td>
<td>3/8</td>
</tr>
<tr>
<td>1</td>
<td>7</td>
<td>3/8</td>
<td>6</td>
<td>3/8</td>
</tr>
<tr>
<td>1-1/4</td>
<td>7</td>
<td>3/8</td>
<td>7</td>
<td>3/8</td>
</tr>
<tr>
<td>1-1/2</td>
<td>9</td>
<td>3/8</td>
<td>8</td>
<td>3/8</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>3/8</td>
<td>8</td>
<td>3/8</td>
</tr>
<tr>
<td>2-1/2</td>
<td>11</td>
<td>3/8</td>
<td>9</td>
<td>3/8</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>1/2</td>
<td>10</td>
<td>1/2</td>
</tr>
<tr>
<td>3-1/2</td>
<td>13</td>
<td>1/2</td>
<td>11</td>
<td>1/2</td>
</tr>
<tr>
<td>4</td>
<td>14</td>
<td>5/8</td>
<td>12</td>
<td>1/2</td>
</tr>
<tr>
<td>5</td>
<td>16</td>
<td>5/8</td>
<td>13</td>
<td>1/2</td>
</tr>
<tr>
<td>6</td>
<td>17</td>
<td>3/4</td>
<td>14</td>
<td>5/8</td>
</tr>
<tr>
<td>8</td>
<td>19</td>
<td>7/8</td>
<td>16</td>
<td>3/4</td>
</tr>
<tr>
<td>10</td>
<td>22</td>
<td>7/8</td>
<td>18</td>
<td>3/4</td>
</tr>
<tr>
<td>12</td>
<td>23</td>
<td>7/8</td>
<td>19</td>
<td>3/4</td>
</tr>
</tbody>
</table>

D. Support vertical steel pipe and copper tube at each floor.

3.06 PIPE AND TUBE JOINT CONSTRUCTION

A. Soldered Joints: Comply with the procedures contained in the AWS "Soldering Manual."

B. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."

1. CAUTION: Remove stems, seats, and packing of valves and accessible internal parts of piping specialties before soldering and brazing.
2. Fill the tubing and fittings during soldering and brazing with an inert gas (nitrogen or carbon dioxide) to prevent formation of scale.
3. Heat joints to proper and uniform temperature.

C. Threaded Joints: Conform to ASME B1.20.1, tapered pipe threaded for field-cut threads. Join pipe fittings and valves as follows:

1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
2. Align threads at point of assembly.
3. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).
4. Assembly joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.
a. Damaged Threads: Do not use pipe with corroded or damaged threads. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

D. Flanged Joints: Align flange surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

E. Grooved-End Joints: Prepare pipe and tubing and install in accordance with manufacturer’s installation instructions.

3.07 SERVICE ENTRANCE

A. Extend water distribution piping to connect to water service piping, of size and in location indicated for service entrance to building. Water service piping is specified in separate section of Division 22.

B. For trenching and backfill see Section 31 1313 and Section 22 1111.

C. Install sleeve and mechanical sleeve seal at penetrations through foundation wall for watertight installation.

3.08 VALVE APPLICATIONS

A. General-Duty Valve Applications: The Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   2. Throttling duty: Use globe and ball valves.

3.09 INSTALLATION OF VALVES

A. Sectional Valves: Install sectional valves on each branch and riser, close to main, where branch or riser serves 2 or more plumbing fixtures or equipment connections, and elsewhere as indicated. For sectional valves 2 inches and smaller, use gate valves; for sectional valves 2-1/2 inches and larger, use gate or butterfly valves.

B. Shut-off Valves: Install shut-off valves at inlet and outlet of each plumbing equipment item and elsewhere as indicated.
   1. At plumbing equipment: 2” and smaller use gate or ball valves.
   2. At plumbing equipment: 2-1/2” and larger use gate or butterfly valves.
   3. For plumbing fixtures see fixture trim.
   4. All other locations use gate valves.

C. Drain Valves: Install drain valves on each plumbing equipment item, located to drain equipment completely for service or repair. Install drain valves at the base of each riser, at low points of horizontal runs, and elsewhere as required to drain distribution piping system completely. For drain valves use 3/4” hose end drain valve.

D. Hose Bibs: Install on exposed piping where indicated. Provide vacuum breaker.

3.10 INSTALLATION PIPING SPECIALTIES

A. Install backflow Preventers at each connection to mechanical equipment and systems and in compliance with the plumbing code and authority having jurisdiction. Install air
cap fitting and pipe relief outlet drain without valves to nearest floor drain. Identify all piping downstream of backflow preventers as "industrial water".

B. Install pressure-regulating valves with inlet and outlet shutoff valves and balance cock bypass. Install pressure gage on valve outlet.

3.11 INSTALLATION OF PIPING WATER HAMMER ARRESTORS

A. Provide an air chamber at each valve water outlet or fixture supply for fixtures with manual closing valves. Air chamber shall be 18 inches long and one pipe size larger than supply to outlet. For a battery of fixtures, one air chamber 30 inches long and the full size of the header, but not less than 1 inch may be installed in lieu of individual air chambers. Precision Plumbing Products, JMJ "System Rated" arrestors are acceptable in lieu of air chambers.

B. Install water hammer arrestors on supply line to fixtures with self-closing, automatic or Flushometer valves. Arrestors shall be as close as possible to individual fixtures and on the end of the header for a battery of fixtures. Arrestors shall be installed in the wall or furring, whenever possible, behind an access panel large enough to permit removal of the arrestor. Sizes as shown on the drawings or as specified hereinafter. Sizes and model numbers are J. R. Smith; equivalent arrestors by Josam, Wade or Zurn are acceptable.

3.12 EQUIPMENT CONNECTIONS

A. Piping Run-outs to Fixtures: Provide hot and cold water piping Run-outs to fixtures of sizes indicated, but in no case smaller than required by plumbing code.

B. Equipment Connections: Connect hot and cold water piping system to equipment as indicated. Provide shutoff valve and union for each connection; provide drain valve on drain connection. For connections 2-1/2 inches and larger, use flanges instead of unions.

3.13 FIELD QUALITY CONTROL

A. Inspections: Inspect water distribution piping as follows:

1. Do not enclose, cover, or put into operation water distribution piping system until it has been inspected and approved by the authority having jurisdiction.

2. During the progress of the installation, notify the plumbing official having jurisdiction at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.

   a. Rough-In Inspection: After system is roughed in and prior to setting fixtures, arrange for inspection of the piping system before concealed or closed in.

   b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to ensure compliance with the requirements of the plumbing code.

3. Re-inspections: Whenever the plumbing official finds that the piping system will not pass the test or inspection, make the required corrections and arrange for re-inspection by the plumbing official.

4. Reports: Prepare inspection reports signed by the plumbing official.

B. Test water distribution piping as follows:
1. Test for leaks and defects all new water distribution piping systems and parts of existing systems that have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.

2. Leave uncovered and unconcealed all new, altered, extended, or replaced water distribution piping until it has been tested and approved. Expose all such work for testing that has been covered or concealed before it has been tested and approved.

3. Cap and subject the piping system to a static water pressure of 50 psig above the operating pressure without exceeding the pressure rating of the piping system materials. Isolate the test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.

4. Repair all leaks and defects with new materials and retest system or portion thereof until satisfactory results are obtained.

5. Prepare reports for all tests and required corrective action.

3.14 ADJUSTING AND CLEANING

A. Clean and disinfect water distribution piping as follows:

1. Purge all new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired prior to use.

2. Use the purging and disinfecting procedure prescribed by the authority having jurisdiction or, in case a method is not prescribed by that authority, the procedure described in either AWWA C651, or AWWA C652, or as described below:
   a. Flush the piping system with clean, potable water until dirty water does not appear at the points of outlet.
   b. Fill the system or part thereof with a water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) the system or part thereof and allow to stand for 24 hours.
   c. Drain the system or part thereof of the previous solution and refill with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate and allow to stand for 3 hours.
   d. Following the allowed standing time, flush the system with clean, potable water until chlorine does not remain in the water coming from the system.
   e. Submit water samples in sterile bottles to the authority having jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination.

B. Prepare reports for all purging and disinfecting activities.

3.15 COMMISSIONING

A. Fill the system. Check compression tanks, where used, to determine that they are not air bound and that the system is completely full of water.
B. Before operating the system, perform these steps:
   1. Close drain valve, hydrants, and hose bibs.
   2. Open valves to full open position.
   3. Remove and clean strainers.
   5. Lubricate pump motors and bearings.

END OF SECTION 22 1116
SECTION 22 1119
ESCUTCHEONS, DIELECTRIC FITTINGS, UNIONS AND STRAINERS

PART 1 - GENERAL

1.01 SECTION INCLUDES
A. This Section specifies piping specialties and installation methods common to more than one section of Division 22.

1.02 RELATED SECTIONS
A. This section applies to all piping systems specified in Division 22.
B. Valves are specified in a separate section and in individual piping system Sections of Division 22.
C. Fire Barrier Penetration Seals are specified in Section 22 1100.

1.03 SUBMITTALS
A. Refer to Division 01 and Section 22 0510 “Basic Plumbing Requirements” for administrative and procedural requirements for submittals.
B. Product Data: Submit product data on the following items:
   1. Escutcheons
   2. Dielectric Unions and Fittings
   3. Mechanical Sleeve Seals
   4. Strainers

1.04 DELIVERY, STORAGE, AND HANDLING
A. Protect flanges, fittings, and specialties from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
A. Manufacturer Uniformity: Conform to the requirements specified in Basic Mechanical Requirements, under "Product Options."
B. Manufacturer: Subject to compliance with requirements, provide piping materials and specialties from one of the following:
   1. Pipe Escutcheons:
      a. McGuire
      b. BrassCraft
      c. Pasco
   2. Dielectric Waterway Fittings:
      a. Epco Sales, Inc.
      b. Victaulic Company of America
   3. Dielectric Unions:
4. Strainers:
   a. Armstrong Machine Works
   b. Hoffman Specialty ITT; Fluid Handling Div.
   c. Metraflex Co.
   d. R-P&C Valve; Div. White Consolidated Industries, Inc.
   e. Spirax Sarco
   f. Trane Co.
   g. Victaulic Co. of America. (low pressure applications only).
   h. Watts Regulator Co.

5. Mechanical Sleeve Seals:
   a. Thunderline Corp.

2.02 PIPE AND FITTINGS

A. Refer to the individual piping system specification sections in Division 22 for specifications on piping and fittings relative to that particular system.

2.03 JOINING MATERIALS

A. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.

B. Brazing Materials: Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials appropriate for the materials being joined.

C. Soldering Materials: Refer to individual piping system specifications for solder appropriate for each respective system.

D. Gaskets for Flanged Joints: Gasket material shall be full-faced for cast-iron flanges and raised-face for steel flanges. Select materials to suit the service of the piping system in which installed and which conform to their respective ANSI Standard (A21.11, B16.20, or B16.21). Provide materials that will not be detrimentally affected by the chemical and thermal conditions of the fluid being carried.

2.04 PIPING SPECIALTIES

A. Escutcheons: Chrome-plated, stamped steel, hinged, split-ring escutcheon, with set screw. Inside diameter shall closely fit pipe outside diameter, or outside of pipe insulation where pipe is insulated. Outside diameter shall completely cover the opening in floors, walls, or ceilings.

B. Unions: Malleable-iron, Class 150 for low pressure service and class 250 for high pressure service; hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.

C. Dielectric Unions: Provide dielectric unions with appropriate end connections for the pipe materials in which installed (screwed, soldered, or flanged), which effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion.

D. Dielectric Waterway Fittings: Electroplated steel or brass nipple, with an inert and non-corrosive, thermoplastic lining.
E. Y-Type Strainers: Provide strainers full line size of connecting piping, with ends matching piping system materials. Screens shall be Type 304 stainless steel, with 3/64” perforations at 225 holes per square inch.

1. Provide strainers with 125 psi working pressure rating for low-pressure applications, and 250 psi pressure rating for high-pressure application.
2. Threaded Ends, 2” and Smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with pipe plug.
3. Threaded Ends, 2-1/2” and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.
4. Flanged Ends, 2-1/2” and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.
5. Butt Welded Ends, 2-1/2” and Larger for Low Pressure Application: Schedule 40 cast carbon steel body, bolted screen retainer with off-center blowdown fitted with pipe plug.
6. Butt Welded Ends, 2-1/2” and Larger for High Pressure Application: Schedule 80 cast carbon steel body, bolted screen retainer with off-center blowdown fitted with pipe plug.
7. Grooved Ends, 2-1/2” and Larger: Tee pattern, ductile-iron or malleable-iron body and access end cap, access coupling with EDPM gasket.

F. Mechanical Sleeve Seals: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

PART 3 - EXECUTION

3.01 ESCUTCHEONS

A. Install escutcheons at all exposed penetrations of piping through walls, ceilings, and floors in rooms with finish surfaces.

3.02 FITTINGS AND SPECIALTIES

A. Install strainers on the supply side of each control valve, pressure reducing or regulating valve, solenoid valve, and elsewhere as indicated.
B. Install unions adjacent to each valve, and at the final connection to each piece of equipment and plumbing fixture having 2” and smaller connections, and elsewhere as indicated.
C. Install Flanges in piping 2-1/2” and larger, where indicated, adjacent to each valve, and at the final connection to each piece of equipment.
D. Install dielectric unions to connect piping materials of dissimilar metals in dry piping systems (gas, compressed air, vacuum).
E. Install dielectric fittings to connect piping materials of dissimilar metals in wet piping systems (water, steam).

END OF SECTION 22 1119
PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This Section includes building sanitary and storm drainage and vent piping systems, including drains and drainage specialties.

1.02 RELATED SECTIONS

A. The following sections contain requirements that relate to this section:

1. Division 22 Section "Plumbing Identification," for labeling and identification of drainage and vent piping.

1.03 DEFINITIONS

A. Building Drain: That part of the lowest piping of a drainage system which receives the discharge from soil, waste, and other drainage pipes inside the walls of the building and conveys it to the building sewer.

B. Building Sewer: That part of the piping within public or private premises which conveys sewage, rain water or other liquid wastes to a point of disposal.

C. Drainage System: Includes all the piping within public or private premises which conveys sewage, rain water or other liquid wastes to a point of disposal. It does not include the mains of public sewer systems or a private or public sewage treatment or disposal plant.

D. Vent System: A pipe or pipes installed to provide a flow of air to or from a drainage system, or to provide a circulation of air within such system to protect trap seals from siphonage and backpressure.

1.04 SUBMITTALS

A. Product data for the following products:

1. Drainage piping specialties

1.05 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the provisions of the following:


1.06 SEQUENCING AND SCHEDULING

A. Coordinate the installation of roof drains, flashing, and roof penetrations.

B. Coordinate flashing materials installation of roofing, waterproofing, and adjoining substrate work.
C. Coordinate the installation of drains in poured-in-place concrete slabs, to include proper drain elevations, installation of flashing, and slope of slab to drains.

D. Coordinate with installation of sanitary and storm sewer system as necessary to interface building drains with drainage piping system.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide drainage and vent systems from one of the following:

1. Drainage Piping Specialties, including backwater valves, expansion joints, drains, trap primers, and vandal-proof vent caps:
   
   c. Zurn Industries Inc; Hydromechanics Div.
   d. Tyler Pipe; Subs. of Tyler Corp.

2.02 ABOVE GROUND DRAINAGE AND VENT PIPE AND FITTINGS

A. General: Select from the following options:

1. Pipe Sizes Larger than 2": Cast-iron soil pipe. Conform to ASTM A74, for service weight, hub-and-spigot soil pipe and fittings, with clamps and compression gasket joints conforming to ASTM C564. Piping shall bear the CISPI stamp.

2. Pipe Sizes Larger than 2": Hub-less cast-iron soil pipe. Conform to CISPI Standard 301, Service weight, cast-iron soil pipe and fittings, with neoprene gaskets conforming to CISPI Standard 310. Piping shall bear the CISPI stamp.

2.03 UNDERGROUND BUILDING DRAIN PIPE AND FITTINGS

A. Pipe and fittings shall have heavy coating of coal tar varnish or 'asphaltum' on both inside and outside surfaces.

B. General: For pipe and fittings below grade and/or below finish floor of floors on grade select from the following options:

1. Pipe Sizes 15" and Smaller: Cast-iron soil pipe. Conform to ASTM A74, for standard weight hub and spigot soil pipe and fittings, with clamps and neoprene gasket, conforming to ASTM C564. Piping shall bear the CISPI stamp.

2. Pipe Sizes 16" and Smaller: Hub-less cast iron soil pipe, conform to CISPI Standard 301, service weight; with "Best" or "MG" cast iron joint connection couplings. Coupling body shall conform to ASTM A-48 or ASTM A-74 with neoprene gasket conforming to ASTM C-564. Piping shall bear the CISPI stamp.

2.04 DRAINAGE PIPE SPECIALTIES

A. Trap Primers: Bronze body valve with automatic vacuum breaker, with 1/2 inch connections matching piping system. Complying with ASSE 1018.

B. Expansion Joints: Cast-iron body with adjustable bronze sleeve, bronze bolts with wing nuts.
C. Cleanout Plugs: Cast-bronze or brass, threads complying with ANSI B2.1, countersunk head.

2.05 CLEANOUTS

A. Cleanouts on cast iron soil pipe, iron body with ABS plugs screwed into caulkng ferrules. Cleanouts on steel pipe, ABS plugs. Cleanouts on vitrified clay pipe, vitrified clay pipe. Where cleanouts occur in finished interior surfaces, smooth polished chromium plated. Exposed parts of floor cleanouts in finished rooms, non-slip polished nickel bronze. Floor cleanouts adjustable type. Where cleanouts occur in carpeted floor areas, the cover shall be elevated so as to be flush with finished carpeted areas.

B. Floor Cleanouts: Cast-iron body and frame, with cleanout plug and adjustable round top as follows:
   1. Floor level type in rooms with concrete floor: Smith #4021, Josam 58330-2, or Zurn Z1420-25 with cast iron top.

C. Wall Cleanouts: Cast-iron body adaptable to pipe with ABS plastic plug; stainless steel cover including screws.
   1. Wall type for cast-iron pipes: Smith #4532, Josam 58790-4, or Zurn Z-1445-1.
   2. Wall type for steel pipes: Smith #4472, Josam 58890-4, or Zurn 1460-8.

D. Flashing Flanges: Cast-iron watertight stack or wall sleeve with membrane flashing ring. Provide under-deck clamp and sleeve length as required.

E. Vent Flashing Sleeves: Cast-iron caulking type roof coupling for cast-iron stacks, cast-iron threaded type roof coupling for steel stacks.

F. Vandal-Proof Vent Caps: Cast-iron body full size of vent pipe, with caulked base connection for cast-iron pipes, threaded base for steel pipes.

2.06 FLOOR DRAINS

A. Floor drains are specified in Section 15440 "Plumbing Fixtures".

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify all dimensions by field dimensions. Verify that all drainage and vent piping and specialties may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.

B. Verify existing grades, inverts, utilities, obstacles, and topographical conditions prior to installations.

C. Examine rough-in requirements for plumbing fixtures and other equipment having drain connections to verify actual locations of piping connections prior to installation.

D. Examine walls, floors, roof, and plumbing chases for suitable conditions where piping and specialties are to be installed.

E. Do not proceed until unsatisfactory conditions have been corrected.
3.02 PREPARATION FOUNDATION FOR UNDERGROUND BUILDING DRAINS
   A. Grade trench bottoms to provide a smooth, firm, and stable foundation, free from rock, throughout the length of the pipe.
   B. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid and backfill with clean sand or pea gravel to indicated invert elevation.
   C. Shape bottom of trench to fit bottom of pipe for 90-degrees (bottom 1/4 of the circumference). Fill unevenness with tamped sand backfill. At each pipe joint dig bell holes to relieve the bell of the pipe of all loads, and to ensure continuous bearing of the pipe barrel on the foundation.

3.03 PIPE APPLICATIONS - ABOVE GROUND, WITHIN BUILDING
   A. General: Select from following options:
      1. Install hub-and-spigot, service weight, cast-iron soil pipe with compression gasket joints for larger than 2 inches drainage and vent pipe. Piping shall bear the CISPI stamp.
      2. Install Hub-less, service weight, cast-iron soil pipe and fittings for larger than 2 inch drainage and vent pipe. Piping shall bear the CISPI stamp.

3.04 PIPE APPLICATIONS - BELOW GROUND, WITHIN BUILDING
   A. General: Select from the following options:
      1. Install hub-and-spigot, heavy service weight, cast-iron, soil pipe and fittings with gasket joints for 15 inch and smaller drainage pipe. Piping shall bear the CISPI stamp.
      2. Install hub-less, service weight, cast-iron soil pipe with Anaco Husky SD 4000 stainless steel couplings with neoprene gaskets. Piping shall bear the CISPI stamp.

3.05 PIPE AND TUBE JOINT CONSTRUCTION
   A. Copper Tubing: Solder joints in accordance with the procedures specified in AWS "Soldering Manual."
   B. Cast-Iron Soil Pipe: Make lead and oakum caulked joints, compression joints, and hub-less joints in accordance with the recommendations in the CISPI Cast Iron Soil Pipe and Fittings Handbook, Chapter IV.
   C. Install couplings per manufacturer's recommendations.

3.06 INSTALLATION
   A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into account many design considerations. So far as practical, install piping as indicated.
   B. Use fittings for all changes in direction and all branch connections.
   C. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

F. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Allow sufficient space above removable ceiling panels to allow for panel removal.

G. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6 inch shall be steel; pipe sleeves 6 inches and larger shall be sheet metal.

H. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings and floors, maintain the fire rated integrity.

I. Make changes in direction for drainage and vent piping using appropriate 45 degree wyes, half-wye, or long sweep quarter, sixth, eight, or sixteenth bends. Sanitary tees or short quarter bends may be used on vertical stacks of drainage lines where the change in direction of flow is from horizontal to vertical, except use long-turn tees where two fixtures are installed back to back and have a common drain. Straight tees, elbows, and crosses may be used on vent lines. No change in direction of flow greater than 90 degrees shall be made. Where different sizes of drainage pipes and fittings are connected, use proper size, standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited.

J. Install underground building drains to conform with the plumbing code, and in accordance with the Cast Iron Soil Pipe Institute Engineering Manual. Lay underground building drains beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.

K. Install building drain pitched down at minimum slope of 1/4 inch per foot (2 percent) for piping 3 inch and smaller, and 1/8 inch per foot (1 percent) for piping 4 inch and larger.

L. Extend building drain to connect to sewer piping, of size and in location indicated for service entrance to building. Sewer piping is specified in a separate section of Division 15.

M. Install sleeve and mechanical sleeve through foundation wall for watertight installation.

3.07 HANGERS AND SUPPORTS

A. General: Hangers, supports, and anchorage devices are specified in Division 22 Section "Basic Mechanical Materials and Methods." Conform to the table below for maximum spacing of supports:

B. Install the following pipe attachments:
   1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet in length.
C. Install hangers at the following intervals:

<table>
<thead>
<tr>
<th>Pipe material</th>
<th>Max. Horizontal Spacing (Ft.)</th>
<th>Max. Vertical Spacing (Ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cast Iron Pipe</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>Copper Tubing 1-1/2&quot; &amp; Smaller</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Copper Tubing 2&quot; &amp; Larger</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

3.08 INSTALLATION OF PIPE SPECIALTIES

A. Install backwater valves in sanitary building drain piping as indicated, and as required by the plumbing code. For interior installation, provide cleanout cover flush to floor centered over backwater valve cover and of adequate size to remove valve cover for service.

B. Install expansion joints on vertical risers as indicated, and as required by the plumbing code.

C. Above Ground Cleanouts: Install in above ground piping and building drain piping as indicated, and:
   1. As required by plumbing code.
   2. At each horizontal change in direction of piping greater than 135 degrees.
   3. At maximum intervals of 50' for piping 3" and smaller and 100' for larger piping.
   4. At base of each vertical soil or waste stack.

D. Cleanouts Covers: Install floor and wall cleanout covers for concealed piping.

E. Flashing Flanges: Install flashing flange and clamping device with each stack and cleanout passing through roof, secure over stack flashing in accordance with manufacturer's instructions.

3.09 INSTALLATION OF TRAP PRIMERS

A. Install trap primers with piping pitched towards drain trap, minimum of 1/8 inch per foot (1 percent). Adjust trap primer for proper flow. Provide trap primer for all floor drains and floor sinks. Multiple outlet primers are acceptable.

3.10 CONNECTIONS

A. Piping Run-outs to Fixtures: Provide drainage and vent piping run-outs to plumbing fixtures and drains, with approved trap, of sizes indicated; but in no case smaller than required by the plumbing code.

3.11 FIELD QUALITY CONTROL

A. Inspections:
   1. Do not enclose, cover, or put into operation drainage and vent piping system until it has been inspected and approved by the authority having jurisdiction.
   2. During the progress of the installation, notify the plumbing official having jurisdiction, at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.
a. Rough-In Inspection: Arrange for inspection of the piping system before concealed or closed-in after system is roughed-in, and prior to setting fixtures.

b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to insure compliance with the requirements of the plumbing code.

3. Re-inspections: Whenever the piping system fails to pass the test or inspection, make the required corrections, and arrange for re-inspection by the plumbing official.

4. Reports: Prepare inspection reports, signed by the plumbing official.

B. Piping System Test: Test drainage and vent system in accordance with the procedures of the authority having jurisdiction, or in the absence of a published procedure, as follows:

1. Test for leaks and defects all new drainage and vent piping systems and parts of existing systems, which have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.

2. Leave uncovered and unconcealed all new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose all such work for testing, which has been covered or concealed before it has been tested and approved.

3. Rough Plumbing Test Procedure: Except for outside leaders and perforated or open jointed drain tile, test the piping of plumbing drainage and venting systems upon completion of the rough piping installation. Tightly close all openings in the piping system, and fill with water to the point of overflow, but not less than 10 feet head of water. Water level shall not drop during the period from 15 minutes before the inspection starts, through completion of the inspection. Inspect all joints for leaks.

4. Finished Plumbing Test Procedure: After the plumbing fixtures have been set and their traps filled with water, their connections shall be tested and proved gas and water-tight. Plug the stack openings on the roof and building drain where it leaves the building, and introduce air into the system equal to a pressure of 1" water column. Use a "U" tube or manometer inserted in the trap of a water closet to measure this pressure. Air pressure shall remain constant without the introduction of additional air throughout the period of inspection. Inspect all plumbing fixture connections for gas and water leaks.

5. Repair all leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.

6. Prepare reports for all tests and required corrective action.

3.12 ADJUSTING AND CLEANING

A. Clean interior of piping system. Remove dirt and debris as work progresses.

B. Clean drain strainers, domes, and traps. Remove dirt and debris.

3.13 PROTECTION

A. Protect drains during remainder of construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of day or whenever work stops.
END OF SECTION 22 1316
SECTION 22 3436
WATER HEATERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Extent of water heater work required by this section is indicated on drawings and schedules, and by requirements of this section.

1.02 RELATED SECTIONS

A. Refer to other Division 22 Sections for water piping, specialties, pumps, fuel piping, and breechings which are required external to water heaters for installation; not work of this section.
B. Refer to other Division 25 Sections for field installed automatic temperature controls required in conjunction with water heaters; not work of this section.
C. Electrical Work: Refer to Division 22 Section "Electrical Requirements of Plumbing Equipment" for requirements.
D. Refer to Division 26 Sections for other electrical wiring including motor starters, disconnects, wires/cables, raceways, and other required electrical devices; not work of this section.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data including rated capacities and efficiencies of selected model clearly indicated; operating weights; furnished specialties and accessories; and installation and start-up instructions.
B. Wiring Diagrams: Submit manufacturer's electrical requirements for electrical power supply wiring to water heaters. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring required for final installation of water heaters and controls. Differentiate between portions that are to be field-installed.
C. Warranties: Submit certificates for all heaters requiring extended warranties.

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of water heaters of types and capacities required, whose products have been in satisfactory use in similar service for not less than 3 years.
B. Codes and Standards:
   1. UL Compliance: Construct water heaters in accordance with the following UL standards:
      a. UL 174, "Household Electric Storage-Tank Water Heaters".
      b. UL 1453, "Electric Booster and Commercial Storage Tank Water Heaters".
   2. California Code of Regulations (CCR): All water heater models submitted for review shall have identification label on certification showing compliance with CCR Title 24, "Energy Conservation Standards".
   3. NFPA Compliance: Install electric water heaters in accordance with requirements of NFPA 70, "National Electrical Code".
4. NFPA Compliance: Install gas-fired water heaters in accordance with requirements of NFPA 54, "National Fuel Gas Code".
5. AGA (and NSF) Labels: Provide water heaters which are listed and labeled by American Gas Association and (National Sanitation Foundation.)
6. ASHRAE Compliance: Provide water heaters with Performance Efficiencies not less than prescribed in ASHRAE 90A, "Energy Conservation in New Building Design".

1.05 DELIVERY, STORAGE, AND HANDLING

A. Handle water heaters and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged water heaters or components; remove from site and replace with new.

B. Store water heaters and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

C. Comply with manufacturer's rigging and installation instructions for unloading water heaters, and moving units to final location for installation.

1.06 SPECIAL PROJECT WARRANTY

A. Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, water heaters with inadequate or defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement is limited to component replacement only, and does not include labor for removal and reinstallation.

1. Warranty Period: 5 years from Date of Substantial Completion.

PART 2 - PRODUCTS

2.01 COMMERCIAL GAS-FIRED WATER HEATERS

A. General: Provide commercial gas-fired water heaters of sizes and capacities as indicated on schedule. Provide certification of design by AGA under Volume III tests for commercial water heaters for delivery of 180 degree F (982 degree C) water.

B. Heater: Construct for working pressure of 150 PSI; boiler type hand hole cleanout; magnesium anode rod; 3/4" tapping for relief valve; glass lining on internal surfaces exposed to water.

C. Safety Controls: Equip with automatic gas shutoff device to shut off entire gas supply in event of excessive temperature in tank; and pilot safety shutoff.

D. Draft Hood: Equip with AGA certified draft hood.

E. Jacket: Insulate tank with vermin-proof glass fiber insulation. Provide outer steel jacket with baked enamel finish over bonderized undercoating.

F. Accessories: Provide brass drain valve; 3/4" pressure and temperature relief valve; and radiant floor shield.

G. Controls: Provide gas pressure regulator; pilot gas regulator; thermostat; and temperature limit control.
H. Manufacturers: Subject to compliance with requirements, provide commercial gas-fired water heaters of one of the following:
   1. American Water Heaters
   2. Rheem Water Heater Div; City Investing Co.
   4. Lockinvar Water Heaters

2.02 COMMERCIAL ELECTRIC WATER HEATERS

A. General: Provide commercial electric water heaters of sizes, capacities, and electrical characteristics as indicated.

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, thermostat stepped through magnetic contactors.

D. Safety Controls: Double pole, manual reset, high limit; probe type electric low water cutoff; both factory wired.

E. Jacket: Equip with full size control compartments with front panel opening. Insulate tank with vermin-proof glass fiber insulation. Provide outer steel jacket with bonderized undercoat and baked enamel finish.

F. Accessories: Provide brass drain valve; 3/4" temperature and pressure relief valve; ASME tank, construction for 125 PSI working pressure; and 4" x 6" hand hole cleanout.

G. Controls: Adjustable immersion thermostat; power circuit fusing; pilot light.

H. Manufacturers: Subject to compliance with requirements, provide commercial electric water heaters of one of the following:
   1. Rheem Water Heater Div; City Investing Co.
   2. A. O. Smith Corp. - Consumer Products Div.
   3. Lockinvar Water Heaters

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which water heaters are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF WATER HEATERS

A. General: Install water heaters in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

B. Support: Place units on concrete pads, orient so controls and devices needing service and maintenance have adequate access.

C. Piping: Connect hot and cold water piping to units with shutoff valves and unions. Connect recirculating water line to unit with shutoff valve, check valve, and union. Extend relief valve discharge to closet floor drain, or as indicated.
D. Gages: Provide thermometers on inlet and outlet piping of water heaters, in accordance with Basic Mechanical Materials and Methods Section "Meters and Gages."

E. Gas-Fired Water Heaters: Connect gas supply to gas line with drip let, tee, gas cock, and union; full size of unit inlet connection. Locate piping so as not to interfere with service of unit.

1. Flue: Connect flue to draft hood with gas-tight connection. Provide flue of minimum size as flue outlet on heater. Comply with gas utility requirements.

F. Electric Water Heaters:

1. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.
   a. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-16 sections. Do not proceed with water heater start-up until wiring installation is acceptable to water heater Installer.

3.03 FIELD QUALITY CONTROL

A. Start-Up: Start-up, test, and adjust gas-fired water heaters in accordance with manufacturer's start-up instructions, and utility company's requirements. Check and calibrate controls, adjust burner for maximum efficiency.

B. Start-Up: Start-up, test, and adjust electric water heaters in accordance with manufacturer's start-up instructions. Check and calibrate controls.

END OF SECTION 22 3436
PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section specifies plumbing fixtures and trim. The types of fixtures specified include the following:
   1. Lavatories (including wheelchair type)
   2. Service Sinks
   3. Water Closets
   4. Urinals
   5. Mop Basins
   6. Electric Water Coolers (including wheelchair type)
   7. Faucets
   8. Flush Valves
   9. Fixture Supports (including wheelchair type)
   10. Toilet Seats
   11. Fittings, Trim, and Accessories
   12. Floor Drains
   13. Roof Drains

1.02 RELATED SECTIONS

A. Separate grab bars and toilet accessories not in integral part of plumbing fixtures and are specified in Division 10.

B. Electrical Requirements for, Water Heaters, water conditioners, and other plumbing equipment are specified in other Sections of Division 22 & Division 26.

1.03 SUBMITTALS

A. Product Data: Submit Product Data and installation instructions for each fixture, faucet, specialties, accessories, and trim specified; clearly indicate rated capacities of selected models of water coolers, and water heaters.


C. Wiring Diagrams: Submit manufacturer's electrical requirements and wiring diagrams for power supply to units. Clearly differentiate between portions of wiring that are factory installed and field installed portions.

D. Maintenance Data: Include data in Maintenance Manual specified in Division 01 and Section 22 0510.

E. Quality Control Submittals:
1. Submit certification of compliance with specified ANSI, UL, and ASHRAE Standards.
2. Submit certification of compliance with performance verification requirements specified in this Section.

1.04 QUALITY ASSURANCE

A. Codes and Standards:
   2. ARI Standard 1010: "Drinking-Fountains and Self-Contained Mechanically-Refrigerated Drinking-Water Coolers."
      a. Accessible plumbing fixtures for adults; dimensions shall comply with the requirements of CCR, T-24, Section 1115 B.
      b. Heights and location of fixtures shall be according to CCR, T-24, Chapter 11-B and Table 1115B-1.
      c. Fixture Controls shall comply with CCR, T-24 section 1118 B.
   4. UL Standard 399: "Drinking-Water Coolers."

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store fixtures where environmental conditions are uniformly maintained within the manufacturer's recommended temperatures to prevent damage.
B. Store fixtures and trim in the manufacturer's original shipping containers. Do not stack containers or store in such a manner that may cause damage to the fixture or trim.

1.06 SEQUENCE AND SCHEDULING

A. Schedule rough-in installations with the installation of other building components.

1.07 MAINTENANCE

A. Extra Stock: Furnish special wrenches and other devices necessary for servicing plumbing fixtures and trim to Owner with receipt in a quantity of one device for each 10 fixtures.
B. Repair Kits: Furnish faucet repair kits complete with all necessary washers, springs, pins, retainer packings, O-rings, sleeves, and seats in a quantity of 1 kit for each 40 faucets.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer uniformity shall be as specified in Section 22 0510: "Basic Plumbing Requirements".
B. The following specification mentions manufacturers to establish a standard quality. The following fixtures and accessories are acceptable, if used throughout:
1. Water Closets, Urinals, Lavatories, Service Sinks:
   a. American Standard
   b. Crane Co.
   c. Kohler Co.

2. Stainless Steel Sinks:

3. Faucets:
   a. Chicago Faucet Co.
   b. American Standard
   c. T & S Brass
   d. Speakman

4. Flush Valves:
   a. Sloan Valve Co.
   b. Zurn

5. Water Closet Seats:
   a. Olsonite
   b. Beneke Corp
   c. Church Products

6. Fixture Supports:
   c. Zurn Industries, Inc.; Hydromechanics Div.

7. Drains:
   c. Zurn

2.02 FIXTURES

A. Plumbing fixture trim and exposed supplies and wastes are to be brass with polished chromium plated finish unless otherwise specified. Provide individual lose key or screwdriver stops for all fixture supplies. Separately trap all wastes. Furnish chrome plated wall escutcheons for all exposed supplies and trap arms. Locate stops below fixtures or countertops. All fixtures for use by the disabled shall have exposed hot water pipe and tailpiece and trap insulated with 1/2" rubber foam insulation.

B. All plumbing fixture faucets submitted for review shall have identification label or certification showing compliance with California Title 24, Part 5, Article 1, "Energy Conservation Standards"; Article 1, T20-1406; Article 2, T20-1525 and Article 4, 1604, and 1606.

C. Provide fixtures as scheduled on plumbing drawings and requirements of this Section.

2.03 SINK FAUCET

A. Description: General Service faucet. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

   1. Maximum Flow Rate: 1.5 gpm

2.04 FLUSHOMETER
A. Description: Flushometer for urinal and water-closet-type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.

1. Consumption for Urinal: 0.5 gal./flush
2. Consumption for Water-closet: 1.28 gal./flush

2.05 WATER CLOSET

A. Description: Accessible Wall-mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation.

   a. Design Consumption: 1.28 gal./flush

B. Description: Accessible Floor-mounting, floor-outlet, vitreous-china fixture designed for flushometer valve operation.

   a. Design Consumption: 1.28 gal./flush

2.06 URINAL

A. Description: Accessible, Wall-mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation.

1. Design Consumption: 0.5 gal./flush

2.07 FIXTURE SUPPORTS

A. Lavatory Supports: Adjustable cast iron, with thin concealed arms and sleeves, and complete with escutcheons and mounting fasteners.

B. Water Closet Supports: Adjustable, factory painted, cast iron face plate, support base, and appropriate type waste fitting having face plate gasket; zinc plated steel fixture studs and fasteners; coated and threaded adjustable wall coupling with neoprene closet outlet gasket; and chrome plated fixture cap nuts and fiber fixture washers. Provide an appropriate model to suit deep or shallow rough-in, siphon jet or blow-out water closet, and type of sanitary piping system to which it is connected.

C. Wheelchair Water Closet Supports: Adjustable, factory painted, cast iron face plate, support base, and appropriate type waste fitting having face plate gasket; zinc plated steel fixture studs and fasteners; coated and threaded adjustable wall coupling with neoprene closet outlet gasket; and chrome plated fixture cap nuts and fiber fixture washers. Units shall have elevated mounting heights of wheelchair fixtures, siphon jet or blow-out water closet, and type of sanitary piping system to which it is connected.

2.08 ESCUTCHEONS

A. Select one of the two options below:

1. Chrome-plated cast brass with set screw.
2. Chrome-plated sheet steel with friction clips.
PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify all dimensions by field measurements. Verify that all plumbing fixtures may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.

B. Examine rough-in for potable water and waste piping systems to verify actual locations of piping connections prior to installing fixtures.

C. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.

D. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF FIXTURES

A. Install plumbing fixtures level and plumb, in accordance with fixture manufacturer's written instructions, rough-in drawings, and pertinent codes and regulations, the original design, and the referenced standards.

B. Comply with the installation requirements of California Building Code “CBC” Section 115B and Section 1118B for accessible plumbing fixtures.

C. Fasten plumbing fixtures securely to supports or building structure. Secure supplies behind or within wall construction to provide rigid installation.

D. Securely attach wall hung fixtures to a 3/8 inch x 6 inch wide steel plate. Steel plate to extend at least one stud beyond first and last mounting point. Drill and tap plate at time of installation of fixture or fixture hanger. Support fixture hanger with 1/2” diameter threaded studs, jamb nuts, C.P. Acorn nuts and completely free of wall by means of a second set of jamb nuts. Weld plate to each metal stud crossed by means of a continuous vertical fillet weld and same size as stud thickness. Secure plate to each wood stud crossed by securely bolting to each stud crossed with two 1/2-inch steel bolts, 4-inch center with 1/8-inch maximum x 1-1/2 inch steel back up plates. Notch studs to set plate flush with surface.

E. Set mop basins in a leveling bed of cement grout.

F. Install a stop valve in an accessible location in the water connection to each fixture.

G. Install chrome plated brass escutcheons at each wall, floor, and ceiling penetration in exposed finished locations and with cabinets and millwork.

H. Seal fixtures to walls and floors using silicone sealant as specified in Section 07900. Match sealant color to fixture color.

I. Provide abrasive washers under all single drilling deck mounted trim.

3.03 INSTALLATION OF FLOOR DRAINS

A. Install floor drains in accordance with manufacturer's written instructions and in locations indicated.

B. Install floor drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with finished floor.
C. Set drain elevation depressed below finished slab elevation as listed below to provide proper slope to drain:

<table>
<thead>
<tr>
<th>Depression (Inch)</th>
<th>Radius Of Area Drained (Feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>5</td>
</tr>
<tr>
<td>3/4</td>
<td>10</td>
</tr>
<tr>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>1-1/4</td>
<td>20</td>
</tr>
<tr>
<td>1-1/2</td>
<td>25</td>
</tr>
</tbody>
</table>

D. Trap all drains connected to the sanitary sewer.
E. Install drain flashing collar or flange so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.
F. Position drains so that they are accessible and easy to maintain.

3.04 INSTALLATION OF TRAP PRIMERS

A. Install trap primers with piping pitched towards drain trap, minimum of 1/8 inch per foot (1 percent). Adjust trap primer for proper flow.

3.05 INSTALLATION OF ROOF DRAINS

A. Install roof drains at low points of roof areas, in accordance with the roof membrane manufacturer's installation instructions.
B. Install drain flashing collar or flange so that no leakage occurs between roof drain and adjoining roofing. Maintain integrity of waterproof membranes, where penetrated.
C. Position roof drains so that they are accessible and easy to maintain.

3.06 FIELD QUALITY CONTROL

A. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning units, then retest.
B. Inspect each installed unit for damage. Replace damaged fixtures.

3.07 ADJUSTING

A. Adjust water pressure at drinking fountains, faucets, shower valves, and flush valves to provide proper flow and stream.
B. Replace washers or leaking or dripping faucets and stops.
C. Clean fixtures, trim, and strainers using manufacturer's recommended cleaning methods and materials.

3.08 CLEANING

A. Clean fixtures, trim, and strainers using manufacturer's recommended cleaning methods and materials.
3.09 PROTECTION

A. Provide protective covering for installed fixtures, water coolers, and trim.

B. Do not allow use of fixtures for temporary facilities unless expressly approved in writing by Owner.

3.10 MOUNTING HEIGHTS SCHEDULE

<table>
<thead>
<tr>
<th>Fixture</th>
<th>Mounting Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lavatory or Sink</td>
<td>See Architectural Drawings</td>
</tr>
<tr>
<td>Wheelchair Lavatories</td>
<td>See Architectural Drawings</td>
</tr>
<tr>
<td>Water Closet</td>
<td>See Architectural Drawings</td>
</tr>
<tr>
<td>Accessible Water Closet</td>
<td>See Architectural Drawings</td>
</tr>
<tr>
<td>Standard Urinals</td>
<td>See Architectural Drawings</td>
</tr>
<tr>
<td>Accessible Urinals</td>
<td>See Architectural Drawings</td>
</tr>
<tr>
<td>Wheelchair Water Cooler</td>
<td>See Architectural Drawings</td>
</tr>
</tbody>
</table>

3.11 ROUGH-IN FOR FIXTURES

A. Rough-in for all fixtures and/or equipment as shown on any drawings, including the architectural drawings, which forms a part of the contract documents. This shall include all fixtures and equipment shown and/or noted as N.I.C. (not in contract) or as U.O.S. (furnished under another section of the specification). Stub out all piping to the exact location of the fixtures and set symmetrical with the fixture. Stub out for fixture supply pipes with drop ear fittings secured to stud or backing plate. Stub out two pipe diameter and terminate with pipe cap. When liens are indicated as capped or plugged at floor level, plug flush with the finished floor.

END OF SECTION 22 4000
SECTION 23 0510
BASIC HAVC REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Project specification Sections, apply to this and the other sections of Division 23.

B. This Division is an integrated whole comprising interrelated and interdependent Section and shall be considered in its entirety in determining requirements of the Work.

C. Refer to other sections of this Division for additional requirements or information regarding the subjects of this Section.

1.02 SECTION INCLUDES

A. This Section includes general administrative and procedural requirements for HVAC installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:

1. Submittals.
2. Coordination drawings.
3. Record documents.
5. Rough-ins.
6. Mechanical installations.
7. Cutting and patching.

1.03 SUBMITTALS

A. General: Follow the procedures specified in Division 01.

B. HVAC submittals shall include shop drawings, product data, and samples per requirements of each section of specification

C. HVAC Submittals and Product Data: Assemble “submittals” and “product data” into tabbed brochures according to main areas of work i.e. (HVAC); Temperature Control; Testing, Adjusting, and Balancing.

1. Assemble each brochure with tabbed separators for each Specification Section where products are noted to be submitted, with separate tabs for each product listed.
2. Temperature "control shop drawings" may be submitted separately after preparations for review.
3. For items such as valves, hangers and accessories, indicate specific items and where they are to be used.
4. Contractor need only to submit for review those items specified to be submitted, unless requested by the Architect for special review.

D. All submittals shall be submitted in hard copy, electronic submittals are not acceptable.
E. Increase the number of HVAC related submittals including; shop drawings, product data, and samples submitted to allow for required distribution by one additional copy, which will be retained by the Mechanical Consulting Engineer.

F. Submit for review, only the specific items required in this Section or other Sections of Division 23.

G. Additional submittals shall include, but not limited:
   1. Air balance reports and equipment data record drawings.
   2. Certification of completion of testing.
   3. Certification of completion of operation instructions.
   4. Operating instruction brochure.
   5. Maintenance instruction brochures.
   7. 1/4" = 1'-0" or larger scale layouts of "Equivalent" equipment or "Or Approved Equal" equipment.
   8. Coordination Drawings, where requested or required.

H. Submittal materials will be reviewed for substantial conformity with the intent of the contract plans and specifications only. Such review does not indicate approval of dimensions, quantities, coordination with other trades, or work methods of the contractor, which are indicated thereon.

I. Additional copies may be required by individual sections of these specifications.

1.04 COORDINATION

A. The Contractor shall be totally responsible for coordinating the layout of all building elements to avoid conflict of the work of the structural, mechanical, electrical systems, and architectural features of the building.

B. The cost of any extra work of any kind caused by a conflict due to this lack of coordination shall be borne by the Contractor.

1.05 COORDINATION OF DRAWINGS

A. Prepare coordination drawings in accordance with requirements of Project Specification to a scale of 1/4" = 1'-0" or larger; detailing major elements, components, required clearances, and systems of HVAC equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of the installations are of importance to the efficient flow of the Work, including but not necessarily limited to the following:

   1. Indicate the proposed locations of piping, ductwork, equipment, and materials. Include the following:
      a. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
      b. Equipment for connections and support details.

   2. Prepare reflected ceiling plans to coordinate and integrate installations with other systems and components, such as, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling-mounted items.
B. Submittal of "Or Equal" substitutions of equipment will not be reviewed unless accompanied by coordination drawings.

1.06 RECORD DOCUMENTS
A. Prepare record documents in accordance with the requirements of project specification. In addition to the requirements of project specification, indicate the following installed conditions:
   1. Record drawings of all installed as specified in Division 1 the locations and invert elevations of underground installations.

1.07 MAINTENANCE MANUALS
A. Prepare maintenance manuals in accordance with Project specification and Division 23 Section "Supplementary Mechanical Requirements".

1.08 DELIVERY, STORAGE, AND HANDLING
A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, mill certification, and other information needed for identification.

1.09 EQUIVALENT EQUIPMENT
A. In these specification and drawings, whenever more than one (1) manufacturer’s product is specified, the manufacturer specified on the drawings and the first named product in these specifications is the basis of design and the use of alternate-named manufacturer’s product or substitutes may require modification in the design work and agency approvals. If such alternatives or substitutions are proposed by the contractor, contractor shall adhere to the following requirements:
   1. Contractor shall clearly identify all proposed alternatives or substitutions in the submittal package.
   2. The Contractor shall assume all costs required to make all necessary revisions and modifications of the contract documents resulting from the substitution or selection of an alternate manufacturer's product, including all professional fees and the cost of DSA approval.
   3. The Contractor shall assume all costs required for any additional modification to building structure, electrical and all other related construction costs resulting from the substitution or selection of an alternate manufacturer's product.

B. These specifications and/or drawings, names and specifies certain equipment in detail which are the basis of design and are explained in paragraph 1.09-A above. It also names alternate equipment by manufacturer, which is not considered to be a "substitution".

C. Submit equivalent equipment to the Architect for review per the requirements of Division 01, and Section "Basic Mechanical Requirements."

D. Equipment of Manufacturers named in Division 23 will be considered equivalent to that specified in detail and/or named on the drawings if:
   1. The proposed equipment is of equivalent quality, capacity.
   2. Equipment is as fully equipped, fits the space allotted, and has physical configuration and weight similar to the equipment specified in detail.
E. A complete lay out of an equipment room or area must be submitted for equivalent equipment. Notice space limitations. Layouts to include plans and section views at a scale of not less than 1/4" = 1 ft.

F. The Architect shall determine the acceptability of "Equivalent Equipment."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

3.02 MECHANICAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of HVAC systems, materials, and equipment. Comply with the following requirements:

1. Coordinate HVAC systems, equipment, and materials installation with other building components.

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 HVAC 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 HVAC 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 heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible as required by California Building Code.

7. Coordinate connection of HVAC system 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 shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect prior to commencement of installation.

9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components.

10. Install all HVAC equipment to facilitate servicing, maintenance, and repair or replacement of equipment components in full compliance with California Building Code and the equipment manufacturer's recommendations. If the drawings or the manufacturer does not provide a specific space requirement for servicing equipment, provide as a minimum, horizontal distance of 36" from face of equipment to opposite vertical surface.
11. Install access panels or doors for all equipment and components which require access for adjustment and maintenance, where units are concealed behind finished surfaces.

12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

13. Any equipment located above a ceiling that has any component, which is serviceable shall be installed within 12" of the top of the ceiling.

3.03 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with project specification. In addition to the requirements specified in project specification, the following requirements apply:

1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

B. Perform cutting, fitting, and patching of HVAC equipment and materials required to:

1. Uncover Work to provide for installation of ill-timed Work.
2. Remove and replace defective work.
3. Remove and replace Work not conforming to requirements of the Contract Documents.
4. Remove samples of installed Work as specified for testing.
5. Install equipment and materials in existing structures.
6. Upon written instructions from the Architect, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.

C. Cut, remove and legally dispose of selected HVAC equipment, components, and materials as indicated, including but not limited to removal of HVAC piping, refrigerant lines, heating units, and other HVAC 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.

1. Patch existing finished surfaces and building components using experienced installers and new materials matching existing materials. For installer’s qualifications refer to the materials and methods required for the surface and building components being patched.

END OF SECTION 23 0510
SECTION 23 0511
SUPPLEMENTARY HVAC REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES
A. This Section specifies supplementary requirements for HVAC installations and includes requirements common to more than one section of Division 23. It expands and supplements the requirements specified in Section 230510 "Basic HVAC Requirements."

1.02 DESCRIPTION
A. Provide a complete and operable installation, including all labor, supervision, materials, equipment, tools, apparatus, transportation, warehousing, rigging, scaffolding and other equipment and services necessary to accomplish the work in accordance with the intent and meaning of these drawings and specifications.

1.03 COORDINATION
A. Coordination of the work is the responsibility of the Contractor.
B. Contractor shall designate an individual competent and versed in the HVAC trades to coordinate the HVAC work with the work of other trades.

1.04 DEFINITIONS (AS USED ON DIVISION 23 DRAWINGS AND HEREIN)
A. "Provide" means furnish, install and connect unless otherwise described in specific instances.
B. "Piping" means pipes, fittings, valves and all like pipe accessories connected thereto.
C. "Ductwork" means ducts, plenums, compartments, or casings including the building structure, which are used to convey or contain air.
D. "Extend", "Submit", "Repair" and similar words mean that the Contractor (or his designated subcontractor) shall accomplish the action described.
E. "Codes" or "Code" means all codes, laws, statutes, rules, regulations, ordinances, orders, decrees, and other requirements of all legally constituted authorities and public utility franchise holders having jurisdiction.
F. "Products", "Materials" and "Equipment" are used interchangeably and mean materials, fixtures, equipment, accessories, etc.
G. "Utility Areas" are defined as mechanical, electrical, janitorial, and similar rooms or spaces which are normally used or occupied only by custodial or maintenance personnel. "Public Areas" are defined as the rooms or spaces, which are not included in the utility areas definition.
H. "Building Boundary" includes concrete walkways immediately adjacent to the building structure.
I. "Below Grade" means buried in the ground.
J. "Substantial Completion" means all components of all systems are functioning but lacking in final adjustment.

K. Pressure rating specified (such as for valves and the like) means design working pressure for and with references to the fluid, which the device will serve.

1.05 RELATED WORK

A. Coordination: Refer to Architectural, HVAC, Plumbing, Civil, Structural, and Electrical Drawings for the construction details and coordinate the work of this Division with that of other Divisions. Order the work of this Division so that progress will harmonize with that of other Divisions and all work will proceed expeditiously. The work of this Division shall include direct responsibility for the correct placing and connection of HVAC work in relation to the work of other Divisions.

B. Examine other Divisions for work related to the Work of this Division, especially Divisions 22 & 26.

1.06 EXISTING CONDITIONS

A. Visit the site prior to bidding and investigate the existing conditions, which affect or will be affected by the work of this Division. Become thoroughly familiar with the working conditions and take into account any special or unusual features peculiar to this job. By the act of submitting a Bid, the Contractor will be deemed to have complied with the foregoing, to have accepted such conditions, and to have made allowance therefore in preparing his Bid.

B. The locations of existing concealed utility lines are shown in accordance with reference data received by the Architect. The Architect does not guarantee the accuracy of such data. The points of connection are therefore approximate and the Bidder shall include adequate funds in his Bid to cover costs of connection regardless of their exact location.

C. Exercise extreme caution during trenching operations. Repair the damage caused by such operations to existing utility lines at no cost to the Owner, whether the lines are shown on drawings or not.

1.07 DRAWINGS AND SPECIFICATIONS

A. These drawings and specification do not include necessary components for construction safety.

B. All provisions shall be deemed mandatory except as expressly indicated as optional by the word "may" or "option".

C. Except where dimensioned, the drawings relating to this division are a diagrammatic presentation of the design concept, which indicates the general area where piping and ductwork is to be run. The drawings do not necessarily indicate any and all offsets and configurations required for coordination with other trades. The contractor is responsible for the correct placing of his work, and the proper location and connection of his work in relation to the work or other trades.
1.08 PERMITS AND INSPECTIONS

A. Obtain, schedule and pay for permits, licenses, approvals, tests, and inspections required by legally constituted authorities and public utility franchise holders having jurisdiction over the work.

B. Afford the Architect's representative every facility for evaluating the skill and competence of the mechanics and to examine the materials. Concealed work shall be reopened when so directed during his periodic visits.

1.09 CODES AND REGULATIONS

A. By submitting a Bid, Contractor is deemed to represent himself as competent to accomplish the work of this Division in conformance with applicable Codes. In case of conflict between the Contract Documents and Code requirements, the Codes shall take precedence. Should such conflicts appear, cease work on the parts of the contract affected and immediately notify the Architect in writing. It shall be the Contractor's responsibility to correct, at no cost to the Owner, any work he executes in violation of Code requirements. Specific references to codes elsewhere in this Division are either to aid the Contractor in locating applicable information or to deny him permission to use options, which are permitted by Codes.

B. Applicable Codes: (Current editions unless otherwise noted)
   1. All local codes; city and/or county as applicable.
   2. OSHA requirements
   3. Uniform Building Code
   4. California Code of Regulations (CCR) Titles (as applicable)
   5. Fire Marshal Regulations
   6. State, County, City Health Department Ordinances and Regulations
   7. Regulations of all other authorities having jurisdiction.

C. Where conflict or variation exists amongst Codes, the most stringent shall govern.

1.10 RECORD AND DOCUMENTATION

A. Accumulate the following and deliver to the Owner's representative prior to final acceptance of the work.
   1. Record (As-Built) Drawings:
      a. Maintain in good order in the field office a complete set of prints for all work being done under Division 23. Update the drawings daily with neat and legible annotations in red ink showing the work as actually installed.
      b. The actual size, location and elevation of all buried lines, valve boxes, manholes, monuments, and stubouts shall be accurately located and dimensioned from building walls or other permanent landmarks.
      c. Furnish the original marked up AS-Built drawings and an electronic copy in AutoCAD-14 format.
   2. Operation and Maintenance Manual: Furnish an operation and maintenance manual covering the stipulated HVAC systems and equipment. Seven copies of the manual, bond in hardback binders or an approved equivalent shall be provided to the Architect.
3. Furnish one complete manual prior to the time that system or equipment tests are performed.
4. Furnish the remaining manuals before the contract is completed.
5. The following identification shall be inscribed on the cover:
   a. OPERATION AND MAINTENANCE MANUAL
   b. PROJECT TITLE
   c. CONTRACTOR NAME & CONTACT INFORMATION
6. Provide a table of contents.
   a. Insert tab sheets to identify discrete subjects.
   b. Instruction sheets shall be legible and easily understood, with large sheets of drawings folded in.
   c. The manual shall be complete in all respects for all materials, piping, valves, devices and equipment, controls, accessories and appurtenances stipulated. Include as a minimum the following:
      1) Updated approved materials lists, shop drawings and catalog information of all items of HVAC system equipment.
      2) System layout showing piping, valves and controls.
      3) Wiring and control diagrams with data to explain detailed operation and control of each component.
      4) A control sequence describing start-up, operation and shutdown.
      5) Detailed description of the function of each principal component of the system.
      6) Procedure for starting.
      7) Procedure for operating.
      8) Shut-down instructions.
      9) Installation instructions.
     10) Adjustments, maintenance and overhaul instructions.
     11) Lubrication schedule including type, grade, temperature range and frequency.
     12) Safety precautions, diagrams and illustrations.
     13) Test procedures.
     14) Performance data.
     15) Parts lists, with manufacturer's names and catalog numbers.
     16) Preventive maintenance schedule.
     17) Service organization with name, address and telephone number.
     18) Valve identification chart and schedule.
     19) ASME certificates.
     20) Air balance report.
     21) Hydronic balance report.

B. Standards Compliance: Where equipment or materials are specified to conform to requirements of standards of recognized technical or industrial organizations such as American National Standards Institute (ANSI) American Society for Mechanical Engineers (ASME) American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), American Society for Testing Materials (ASTM), Underwriters Laboratories (UL), American Gas Association (AGA), American Refrigeration Institute (ARI), or National Electrical Manufacturer's Association (NEMA), that use a label or published listing as a method of indicating compliance, proof of such conformance shall be submitted and approved. The label or listing of the specified organization will be acceptable evidence.

C. Certificates of Conformance or Compliance: Submit original and not pre-printed certifications. Do not make statements in the certifications that could be interpreted to imply that the product does not meet all requirements.
D. Certified Test Reports: Certified Test Reports are reports of tests conducted on previously manufactured materials or equipment identical to that proposed for use. Before delivery of materials and equipment, submit certified copies of test reports specified in the individual sections.

E. Factory Tests: Factory tests are tests, which are required to be performed on the actual materials or equipment, proposed for use. Submit results of the tests in accordance with the requirements for laboratory test results of this Contract.

F. Permits and Certificates of Inspection: Furnish the originals.

G. Testing procedures and test results required in this and other sections. Furnish 2 copies.

H. Other data required by other sections of this Division. Furnish 2 copies.

1.11 CONSTRUCTION COST BREAKDOWN

A. Prepare and submit for review a construction cost breakdown for the major subdivisions of the HVAC work in accordance with General and Supplemental Conditions and Project Specification.

B. Subdivide each item on the breakdown into two headings: labor and materials. Include overhead and profit in each entry.

C. Submit one copy of the breakdown directly to the Engineer and the remaining copies sent through regular channels.

1.12 TOOLS

A. Provide all special tools needed for proper operation and routine adjustment and maintenance of systems and equipment. Deliver tools to Owner's representative and request a receipt for same.

1.13 WARRANTIES

A. Refer to Project Specification for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements.

B. Where periods more than one year are specified in the specifications, such longer periods shall govern. However, when any component fails at any time during this period, the warranty period for such component and all other components, which are inactive because of, said failure shall be suspended. The warranty period for such components shall resume to run for the remaining portion of the warranty period when failed component is completely repaired and in operation; however, in no case shall the resumed portion of the warranty period be less than 3 months in duration.

C. Neither payment for work, nor total or partial occupancy of work by the Owner, within or prior to the warranty period specified, shall be construed as acceptance of faulty work or shall condone any negligence or omission of Contractor in doing the work.

D. Compile and assemble the warranties specified in Division 23, into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference.

E. Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; and names
and addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.14 SEISMIC RESTRAINT

A. Provide seismic restraint for HVAC equipment, piping, and ductwork.
B. Contractor shall submit certification of suitability of seismic restraint methods signed by Licensed Structural Engineer registered in State of California.
C. Contractor may refer to details applicable in the SMACNA, "GUIDELINES FOR SEISMIC RESTRAINT OF HVAC SYSTEMS", using the 'g' forces for "other buildings" classification CCR Title 24 all such details shall be DSA approved. Deliver a copy of these Guidelines to the Owner's Resident Inspector.

1.15 SYSTEM OPERATIONAL TESTS

A. The Contractor shall inform the Owner one week prior to start of testing in order that the Owner's representative may be present.
B. After balancing and prior to final inspection, the contractor shall operate all systems continuously trouble free and stable for a minimum period of fourteen (14) consecutive days including Saturday and Sunday. Each day shall be a minimum of an 8-hour day. Should a problem arise, the fourteen (14) day period shall be restarted and repeated until successfully operated for full 14 days. A written report certified by the Owner's representative shall indicate the successful completion of a stable and trouble free 14-day period.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Standard Products: Materials and equipment shall be essentially the standard cataloged products of manufacturers regularly engaged in production of such materials or equipment and shall be their latest standard designs that comply with the specification requirements.
B. Materials and equipment shall duplicate items that have been in satisfactory commercial or industrial use at least two years prior to bid opening, unless more stringent requirements are specified. Where two or more units of the same type of equipment are required, these units shall be products of a single manufacturer. The components thereof, however, are not required to be exclusively of the same manufacturer.
C. Each major component of equipment shall have manufacturer's name, address, model, and serial number on a nameplate securely affixed in a conspicuous place. The nameplate of the distributing agent will not be acceptable.
D. In these specification and drawings, whenever more than one (1) manufacturer's product is specified, the manufacturer specified on the drawings and the first named product in these specifications is the basis of design and the use of alternate-named manufacturer's product or substitutes shall comply with the requirements of Section 23 0510.
2.02 PRODUCT LISTING

A. When two or more items of same material or equipment are required (pipe and fittings, pumps, valves, air conditioning units, etc.) they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, sheet metal, wire, steel bar stock, welding rods, solder, fasteners, and similar items used in Work, except as otherwise indicated.

2.03 NAMEPLATE DATA

A. Provide permanent operational data nameplate on each item of power operated HVAC equipment, indicating manufacturer, product name, model name, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location.

2.04 SUBSTITUTIONS

A. General: Submittals of "Substitutions" shall be in accordance with requirements of Division 01.

B. By proposing a substitution, it is deemed that the Contractor shall bear the cost of any and all design and construction changes (whether architectural, structural, electrical, HVAC and Plumbing) necessary to accommodate the substitution, if said substitution is accepted.

C. Specific: Refer to Specification Sections 23 0510 & 23 0512 for additional requirements.

2.05 SUBMITTALS

A. General: Make submittals in accordance with requirements of Division 1.

B. Specific: Refer to Specification Sections 23 0510 for additional requirements.

PART 3 - EXECUTION

3.01 WORKMANSHIP AND INSTALLATION METHODS

A. Workmanship shall be in the best standard practice of the trade.

B. Install equipment in accordance with the manufacturer's instructions and recommendations unless otherwise noted or specified.

3.02 TESTS

A. General:

1. Demonstrate that all components of the work of this Division have been provided and that they operate in accordance with the Contract Documents.

2. Provide instruments and personnel for tests and demonstrations. Submit signed test results.

B. Specific: Refer to the other sections of this Division for test requirements.
3.03 DELIVERY, HANDLING, STORAGE OF MATERIALS AND PROTECTION OF WORK

A. Protect materials against dirt, water, chemical and mechanical damages both while in storage and during construction.

B. Cover materials in such a manner that no finished surfaces will be damaged, marred or splattered with plaster or paint, and all moving parts will be kept clean and dry.

C. Replace or refinish any damaged materials including fronts of control panels, ductwork fittings, and shop-fabricated ductwork.

D. Air distribution systems shall be aggressively protected from dust during the construction process to ensure that no contamination of the duct system occurs.

E. The use of permanently installed AHUs and associated air distribution systems for temporary heating and cooling during construction is prohibited.

F. Keep cabinets and other openings closed to prevent entry of foreign matter.

G. Specific: Refer to other sections of this Division for additional requirements.

3.04 PROJECT CONDITIONS

A. Check and coordinate for clearance, accessibility and placement of equipment either by going through openings provided or by placing equipment during construction. Ordering of equipment to be shipped disassembled, or disassembly of equipment at Project Site and reassembly of equipment to accomplish this requirement shall be executed without additional cost. Where provided openings are inadequate to accommodate equipment, provide new openings and restoration of same, all at no additional cost. Obtain written approval for new openings before proceeding.

B. Verify location of all equipment within finished spaces with the Architectural Drawings. In the event that HVAC Drawings do not indicate exact locations, or are in conflict with the Architectural Drawings, obtain information regarding proper locations. Installation of work without proper instruction under such circumstances will result in relocation of work, when directed, without additional cost.

3.05 INSTRUCTION TO OWNER PERSONNEL

A. Contractor shall furnish, without additional expense to the Owner, the services of competent instructors who will give full instruction to the designated personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the equipment or system specified. Each instructor shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance of work. Instruction shall be given at the Owner's convenience. The number of man-days (eight-hours) of instruction furnished shall be as specified in other sections. When more than four man-days of instruction are specified, approximately half of the time shall be used for classroom instruction. All other time shall be used for instruction with the equipment or system. When significant changes or modifications are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications.

B. Contractor shall videotape, both visual and audio, instruction to Owner's personnel on the maintenance and operation of the HVAC systems.
C. Submit certification, signed by Owner's agent that instructions have been completed and the videotape has been reviewed and delivered to the Owner.

D. Printed operating instructions and a copy of wiring diagrams are to be mounted in all equipment areas, framed and behind glass or encased in plastic. Printed operating instructions shall include steps for starting up and securing equipment. As a precedent to final acceptance four (4) copies of instructions are to be submitted to the Architect for review. Contractor shall turn over to Owner in a neat brochure form, equipment guarantee and maintenance instructions.

3.06 CLEANING

A. Cleaning shall be done as the work proceeds. Periodically remove waste and debris to keep the site as clean as is practical.

B. Refer the Division 01 for general requirements for cleaning.

C. Leave exposed parts of the HVAC work in a neat, clean and usable condition, with painted surfaces unblemished and plated metal surfaces polished.

D. Thoroughly clean all materials, equipment and appliances. Clean and prepare all surfaces to be painted. Clean the entire premises of unused materials, debris, spots and marks to the satisfaction of the Architect.

E. Remove, thoroughly clean and replace all strainers and automatic valves after the system has been put in operation until system is clear of all foreign matter and repeat this operation after ten (10) days and again after the system has been in operation thirty (30) days. Submit certification that this operation has been completed.

3.07 SAFETY REQUIREMENTS

A. Enclose and guard belts, pulleys, chains, gears, couplings, projecting set screws, keys, and other rotating parts in accordance with OSHA requirements. Insulate, guard, and cover any high-temperature equipment and piping so located as to endanger personnel or create a fire hazard.

END OF SECTION 23 0511
SECTION 23 0512
HVAC PRODUCT SUBSTITUTIONS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This Section specifies administrative and procedural requirements for handling requests made after award of the Contract for substitutions of products specified in Division 23.

1.02 RELATED SECTIONS

A. Procedure for Contractor's construction Schedule and the Schedule of Submittals are included under Division 01.
B. Standards: Refer to Division 01 for applicability of industry standards to products specified.
C. Procedural requirements governing the Contractor's selection of products and product options are included under Division 01.
D. Refer to Division 01 for Products and Substitutions.
E. Refer to Sections 23 0510 & 23 0511 for additional requirements.

1.03 DEFINITIONS

A. "Products" is defined to include purchased items for incorporation into the work, regardless of whether specifically purchased for project or taken from Contractor's stock of previously purchased products. "Materials" is defined as products which must be substantially cut, shaped, worked, mixed, finished, refined or otherwise fabricated, processed, installed or applied to form units of work.
B. "Equipment" is defined as products with operational parts, regardless of whether motorized or manually operated, and particularly including products with service connections (wiring, piping, etc.). Definitions in this paragraph are not intended to negate the meaning of other terms used in contract documents, including "specialties", "systems", "structure", "finishes", "accessories", "furnishings", "special construction", and similar terms, which are self-explanatory and have recognized meanings in the construction industry.

1.04 SUBSTITUTIONS

A. The requirements for substitutions do not apply to specified Contractor options on products and construction methods. Revisions to contract documents, where requested by Owner, Architect or Engineer, are "changes" not "substitutions". Substitutions requested during bidding period, which have been accepted prior to Contract Date, are included in contract document and are not subject to requirements for substitutions as specified herein. Contractor's determination of and compliance with governing regulations and orders issued by governing authorities do not constitute "substitutions"; and do not constitute a basis for change orders, except as provided for in contract documents. Otherwise, contractor's requests of changes in products, materials and methods of construction required by contract documents are considered...
requests for "substitutions", and are subject to requirements hereof.

B. Conditions: The Contractor's substitution request will be received and considered by the Architect when one or more of the following conditions are satisfied, as determined by the Architect; otherwise requests will be returned without action except to record noncompliance with these requirements.

1. Extensive revisions to Contract Documents are not required.
2. Proposed changes are in keeping with the general intent of Contract Documents.
3. The request is directly related to an "or approved equal" clause or similar language in the Contract Documents.
4. All costs required to make all necessary revisions and modifications to the contract documents resulting from the substitution, including but not limited to, all professional fees and the cost of DSA approval will be the Contractor's responsibility.
5. All costs required to make all necessary revisions and modifications to the building structure, electrical and all other related construction costs resulting from the substitution, including but not limited to, material, products, equipment, testing, and inspection will be the Contractor's responsibility.
6. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
7. Contractor will coordinate the installation of the accepted substitute, making such changes as may be required for the work to be complete in all respects.
8. Contractor certifies that the substitution is not heavier than the specified item and does not necessitate any structural and electrical redesign; will fit within the room or area designed for the specified item; and will not exceed any maximum dimensions specified or shown on the original contract Documents. All roof mounted equipment must be less than or equal to the maximum height dimension from the finished roof as shown on the drawings.
9. Contractor represents that he has personally investigated the proposed substitute product and determined that it is equal or superior in all respects to that specified.
10. Contractor represents that he will provide the same warranty for the substitution that he would for that specified.

1.05 SUBMITTALS

A. Requests for Substitutions: Any request for substitution shall follow the guidelines of Substitution Requirements in Division 01, Section 23 0510, & 23 0511.

B. Substitution Warranty: All submittals of Request for Substitutions under the General and Supplementary Conditions of this Section shall be accompanied by a completely executed (filled out) and signed Substitution Warranty in the form entitled "Substitution Warranty", bound herein. Substitutions will not be accepted without the Substitution Warranty. In addition to other requirements, Contractor shall warrant in writing on his own letterhead that substituted materials shall perform as specified, and assume complete responsibility for same, including responsibility and costs required for modifications to building or other materials or equipment, and any additional coordination with work of other trades. Testing, if required, shall be paid by Contractor.

C. Responsibility of Contractor: The contractor shall be solely and directly responsible for fitting accepted substitute material and equipment into the available space in a manner acceptable to the Architect, and for the proper operation of the substituted equipment with all other equipment with which it may be associated. The Contractor shall bear all
costs of meeting the above requirements for presenting a proposed substitution, and if the substitution is accepted, he must bear all costs involved.

D. Submit the following as part of the Request for Substitutions:

1. Data showing proposed equipment is "equal" to that specified and is fully equipped, fits the space allotted and has physical configuration and weight similar to the equipment specified in detail.

2. A complete layout, where applicable, of equipment room or area must be submitted for equipment proposed in "Request for Substitution". Submittal shall conform to requirements of Division 01 and Section 23 0510 "Basic Mechanical Requirement" as it applies to "Coordination Drawings."

3. Seismic Restraint: Where seismic restraint is required for products or equipment as specified, methods of seismic restraint signed by licensed Structural Engineer registered in the State of California, shall be submitted for review to the Division of the State Architect.

1.06 ARCHITECT'S ACTION

A. The Architect may request additional information or documentation necessary for evaluation of the request. Requests, by the Architect, for additional information or documentation will be in accordance with Division 01 requirements. The Architect will notify the Contractor of acceptance or rejection of the proposed substitution. If a decision on use of a proposed substitute cannot be made or obtained within the time allocated, Contractor shall use the “Bases of Design” product specified by name in the contract documents. Acceptance will be in the form of a Change Order.

PART 2 - PRODUCTS

2.01 SUBSTITUTIONS

A. Substitutions shall conform to the product requirements for the specified products or equipment.

PART 3 - EXECUTION

(Not Applicable.)

END OF SECTION 23 0512
In addition to other requirements, Contractor shall warrant in writing that substituted materials shall perform as specified, and assume complete responsibility for same, including responsibility and costs required for modifications to building or other materials or equipment, and any additional coordination with work of other trades. Testing, if required, shall be paid by contractor. The following is an example of the type Substitution Warranty which shall be executed by the Contractor, on his own letterhead:

**SAMPLE**

**SUBSTITUTIONS WARRANTY**

We propose to provide

__________________________________________________________

(Describe items being proposed for substitution)

for______________________________________________________________ in lieu of

(List project name)

as indicated on the drawings and described in Section ___________ of the Specifications.

We agree to assume the cost of any and all modifications to the Contract Documents and to other portions of the work as indicated in the Specification Sections 23 0510, 23 0511, & 23 012, and as necessary to accommodate for substituted material(s) and system(s) as indicated in this letter of “Substitution Warranty”.

We hereby warrant that ____________________________________________

(Provide Description)

is the equivalent of _____________________________________________

(Specified Product)

in every respect and will perform satisfactorily under the conditions and use indicated on the Drawings and described in the Specifications.

Signed: ____________________________ Date: ________________

(Manufacturer/Supplier)

Signed: ____________________________ Date: ________________

(Subcontractor)

Signed: ____________________________ Date: ________________

(Contractor)

NOTE: Affix Corporate Seal over Signatures.
SECTION 23 0513

ELECTRICAL REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This Section specifies the basic requirements for electrical components, which are an integral part of packaged HVAC equipment. These components include, but are not limited to factory-installed motors, starters, and disconnect switches furnished as an integral part of packaged HVAC equipment.

B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for HVAC equipment are scheduled on Drawings.

C. All motors, power driven equipment and automatic control equipment, except motor starters as hereinafter set forth required and connected with the work of this section of the specifications are to be furnished and installed under Division 23.

D. Control low (24V) and control line (120V) voltage wiring, conduit and related switches and relays required for the automatic control and/or interlock of motors and equipment includes final connection, are to be furnished and installed under Division 23. Materials and installation to conform to Class 1 or 2, CAC Title 24, Article E725, and as restricted under Division 26 of these specifications.

E. Power wiring, conduit, outlets, disconnect switches, motor starters and motor-rated contactors, and making of final connections, except as hereinafter specified, are to be furnished and installed under the Division 26 of these Specification.

F. All power supply wiring for providing a power source to control dampers, control valves, VAV boxes, control transformers, etc., shall be furnished and installed under Division 23.

G. Identify circuits and equipment as outlined in the Electrical Sections of these Specifications.

H. Coordinate requirements for underground conduit only between buildings for control interlocks shown on the drawings. This conduit to be furnished and installed under Division 26 of these Specifications.

I. Space provisions have been made on electrical panels for control power source.

1.02 RELATED SECTIONS

A. Separate electrical components and materials required for field installation and electrical connections are specified in Division 26.

B. This section applies to all Division 23 sections specifying packaged HVAC equipment.

1.03 REFERENCES

A. NEMA Standards MG 1: Motors and Generators

B. NEMA Standards ICS 2: Industrial Control Devices, Controllers, and Assemblies

C. NEMA Standard 250: Enclosures for Electrical Equipment
D. NEMA Standard KS 1: Enclosed Switches
E. Comply with National Electrical Code (NFPA 70).

1.04 SUBMITTALS

A. No separate submittal is required. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification sections.

1.05 QUALITY ASSURANCE

A. Electrical components and materials shall be UL labeled.

PART 2 - PRODUCTS

2.01 MOTORS

A. Provide all motors necessary for equipment under the HVAC Work. See Electrical Drawings for voltage and phase of electrical services.

B. The following are basis requirements for simple or common motors. For special motors, more detailed and specific requirements are specified in the individual equipment specifications.

1. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.
2. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range.
3. 2-speed motors shall have 2 separate windings on poly-phase motors.
4. Temperature Rating: As a minimum motors shall be rated for 40 degree C environment with maximum 50 degree C temperature rise for continuous duty at full load (Class A Insulation).
5. Starting capability: Frequency of starts as indicated by automatic control system, and not less than 5 evenly time spaced starts per hour for manually controlled motors.
   a. Frames: NEMA Standard No. 48 or 54; use driven equipment manufacturer's standards to suit specific application.
   b. Bearings:
      1) Ball or roller bearings with inner and outer shaft seals.
      2) Re-greasable bearings, except permanently sealed where motor is normally inaccessible for regular maintenance.
      3) Bearings designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.
      4) Bearings for fractional horsepower, light duty motors, sleeve type bearings are permitted.
   c. Enclosure Type:
      1) Open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation.
      2) Guarded drip-proof motors where exposed to contact by employees or building occupants.
3) Weather protected Type I for outdoor use, Type II where not housed (Epoxy encapsulated or TEFC).

d. Overload protection: Polyphase built-in thermal overload protection and, where indicated, internal sensing device suitable for signaling and stopping motor at starter. Single phase, provide thermal overload protection.
e. Noise rating: "Quiet".

f. Efficiencies shall be guaranteed minimum values in accordance with the following tabulation. Efficiencies shall be established in accordance with NEMA Test Standards MG1-12.53A using IEEE Test Procedure 112, Method B:

<table>
<thead>
<tr>
<th>HP</th>
<th>EFFICIENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 2</td>
<td>81.5</td>
</tr>
<tr>
<td>3 – 5</td>
<td>86.5</td>
</tr>
<tr>
<td>7-1/2 - 10</td>
<td>90.6</td>
</tr>
<tr>
<td>15 - 30</td>
<td>92.0</td>
</tr>
</tbody>
</table>

g. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

h. Provide all motors with junction boxes or terminals boxes and provide adjustable slide rails for all motors with belt drives.

i. Motors rated 1 HP and larger shall have shaft, bearings and etc. capable of operating with multiple grooved sheaves and two or more belts.

j. V Type Belt Drives: Drives requiring not more than 2 belts; variable pitch type; size for mid-point of operating range. Drives requiring 3 or more belts; nonadjustable constant speed type. Provide belts in matched sets.

2.02 MOTOR STARTERS

A. Unless provided as part of packaged HVAC equipment or otherwise indicated, starters for motors will be provided under Division 26. Provide to Division 26 the data necessary for motor starter heater sizing for all motors.

B. Starters for factory packaged HVAC equipment specified under Division 23 shall be provided as part of the package.

C. Motor Starter Characteristics:

1. Enclosures: NEMA 1, general purpose enclosures with padlock ears, except in wet locations shall be NEMA 3R with conduit hubs, or units in hazardous locations, which shall have NEC proper class and division.

2. Type and size of starter shall be as recommended by motor manufacturer and the driven equipment manufacturer for applicable protection and start-up condition.

D. Manual switches shall have:

1. Pilot lights and extra positions for multi-speed motors.
2. Overload protection: melting alloy type thermal overload relays.

E. Magnetic Starters:

1. Maintained contact push buttons and pilot lights, properly arranged for single speed or multi-speed operation as indicated.
2. Trip-free thermal overload relays, each phase.
3. Interlocks, switches and similar devices as required for coordination with control requirements of Division-25 Controls sections.
4. Built-in control circuit transformer, fused from line side, where service exceeds 240 volts.
5. Externally operated manual reset.
6. Under-voltage release or protection.

F. Motor Connections:
1. Flexible conduit, except where plug-in electrical cords are specifically indicated.

2.03 DISCONNECT SWITCHES

A. When applied as part of factory furnished and mounted equipment, disconnects shall meet the requirements for disconnect switches set forth in Division 26.

PART 3 - EXECUTION

3.01 SEISMIC RESTRAINT

A. All electrical devices shall be seismically restrained.

END OF SECTION 23 0513
PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This Section includes the following types of meters and gages:
   1. Temperature gages and fittings.
   2. Pressure gages and fittings.
   3. Flow meters.

B. Meters and gages furnished as part of factory-fabricated equipment are specified as part of equipment assembly in other Division 23 sections.

1.02 SUBMITTALS

A. General: Submit the following in accordance with conditions of Contract and Division 1 Specification Sections and Section 23 0510 "Basic HVAC Requirements".
   1. Product data for each type of meter and gage. Include scale range, ratings. Submit meter and gage schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gage.
   2. Maintenance data for each type of meter and gage for inclusion in Operating and Maintenance Manuals specified in Division 1 and Division 23 Section "Basic HVAC Requirements".

1.03 QUALITY ASSURANCE

A. ASME and ISA Compliance: Comply with applicable portions of ASME and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gages.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Mercury-In-Glass Thermometers:
      a. Marshalltown Instruments, Inc.
      b. Trerice (H.O.) Co.
      c. Weiss Instruments, Inc.
      d. Weksler Instruments Corp.
   2. Thermometer Wells: Same as for thermometers.
   3. Pressure Gages:
      d. Marshalltown Instruments, Inc.
      e. Trerice (H.O.) Co.
f. Weiss Instruments, Inc.
g. Weksler Instruments Corp.
h. WIKA Instruments Corp.

4. Pressure Gage Accessories: Same as for pressure gages.

5. Water Orifice-Type Measurement System:
   a. Armstrong Pumps, Inc.
   b. Bell & Gossett, ITT. Fluid Handling Div.

6. Calibrated Balance Valves
   a. Armstrong Pumps, Inc.
   b. Bell and Gossett, ITT, Fluid Handling Div.

7. Venturi-Type Flow Measurement System
   a. Armstrong Pumps, Inc.
   b. Barco Div., Marison Industries
   c. Gerard Engineering Co.

8. Test Plugs
   a. MG Piping Products Co.
   b. Peterson Equipment Co., Inc.
   c. Sisco, A Spedco, Inc. Co.
   d. Trerice (H.O.) Co.
   e. Watts Regulator Co.

2.02 THERMOMETERS, GENERAL

A. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.

B. Scale range: Temperature ranges for services listed as follows:
   1. Domestic Hot Water: 30 to 240 deg with 2-degree scale divisions.
   2. Domestic Cold Water: 0 to 100 deg F with 2-degree scale divisions
   3. Heating Water: 30 to 300 deg with 2-degree scale divisions
   4. Condenser Water: 0 to 160 deg F with 2-degree scale divisions
   5. Chilled Water: 0 to 100 deg F with 2-degree scale divisions
   6. Steam and Condensate: 50 to 400 Deg F with 2-degree scale divisions

2.03 MERCURY-IN-GLASS THERMOMETERS

A. Case: Die cast, aluminum finished, in baked epoxy enamel, glass front, spring secured, 9 inches long.

B. Adjustable Joint: Finished to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.

C. Tube: Red reading, mercury filled, magnifying lens.

D. Scale: Satin-faced, nonreflective aluminum, with permanently etched markings.

E. Stem: Copper-plated steel, aluminum or brass, for separable socket, length to suit installation.

2.04 THERMOMETER WELLS

A. Thermometer Wells: Brass or stainless steel, pressure rated to match piping system design pressure; with 2-inch extension for insulated piping and threaded cap nut with chain permanently fastened to well and cap.
2.05 PRESSURE GAGES

A. Type: General use, ASME B40.1, Grade A, phosphor bronze bourdon-tube type, bottom connection.
B. Case: Drawn steel or brass, glass lens, 4-1/2-inches diameter.
C. Connector: Brass, 1/4-inch NPS.
D. Scale: White coated aluminum, with permanently etched markings.
E. Accuracy: Plus or minus 1 percent of range span.
F. Range: Conform to the following:
   1. Vacuum: 30" & 0-15 psi compound range; 1" and 1/2 psi graduations.
   2. Chilled and heating water systems, except as otherwise indicated: 0-60 psi range, 1 psi graduation.
   3. Condenser water system, except as otherwise indicated: (0-15); (0-30) psi range, (1/4 psi); (1/2 psi) graduation.
   4. Except as otherwise indicated: 0-100 psi range, 1 psi graduation.
   5. High temperature water system: 0-300 psi range, 2 psi graduations.

2.06 PRESSURE GAGE ACCESSORIES

A. Syphon: 1/4-inch NPS straight coil constructed of brass tubing with threads on each end.
B. Snubber: 1/4-inch NPS brass bushing with corrosion-resistant porous metal disc. Disc material shall be suitable for fluid served and rated pressure.

2.07 FLOW METERS, GENERAL

A. Flow rate of elements and meters shall be same as connected equipment or system.

2.08 WAFER ORIFICE-TYPE FLOW ELEMENTS

A. Type: Differential-pressure wafer type orifice insert flow elements designed for installation between pipe flanges.
B. Construction: Cast-iron body, brass valves with integral check readout valves and caps, and calibrated nameplate. Elements pressure rated for 300 psig and 250 degree F.

2.09 CALIBRATED BALANCE VALVE

A. Type: Differential-pressure, ball type, adjustable orifice designed for installation in piping.
B. Construction: Bronze body/brass ball construction with glass and carbon filled TFE seal rings, screwed connections with integral check readout valves and caps and calibrated nameplate and memory stop and drain connection. Elements pressure rated for 300 psig and 250 degree f.

2.10 VENTURI-TYPE FLOW ELEMENTS

A. Type: Differential-pressure venturi type, designed for installation in piping.
B. Construction: Bronze or cadmium-plated steel with brass fittings and attached tag with flow conversion data. Ends shall be threaded for 2 inches and smaller elements and flanged or welded for 2-1/2 inches and larger elements.

2.11 PITOT TUBE-TYPE FLOW ELEMENTS

A. Type: Differential-pressure pitot tube-type design with probe for insertion into piping.
B. Construction: Stainless steel probe of length to span inside of pipe, with brass fittings and attached tag with flow conversion data. Elements shall be pressure rated for 150 psig and 250 degree F (120 Degree C).

2.12 METERS

A. Portable Meters: Differential-pressure gage and two 12-foot hoses in carrying case with handle.
B. Scale: In inches of water unless otherwise indicated.
C. Accuracy: Plus or minus 2 percent between 20 to 80 percent of range.
D. Each meter shall be complete with operating instructions.

2.13 TEST PLUGS

A. Test Plugs shall be nickel-plated brass body, with 1/2-inch NPS fitting and 2 self-sealing valve-type core inserts, suitable for inserting a 1/8-inch O.D. probe assembly from a dial-type thermometer or pressure gage. Test plug shall have gasketed and threaded cap with retention chain and body of length to extend beyond insulation. Pressure rating shall be 500 psig.
B. Core Material: conform to the following for fluids and temperature range:
C. Test Kit: Provide test kit consisting of 1 pressure gage, gage adapter with probe, 2 bimetal dial thermometers, and carrying case.
D. Ranges of pressure gage and thermometers shall be approximately 2 times systems operating conditions.

PART 3 - EXECUTION

3.01 THERMOMETERS INSTALLATION

A. Install thermometers in vertical and tilted positions to allow reading by observer standing on floor.
B. Install in the following locations and elsewhere as indicated:
   1. At inlet and outlet of each hydronic zone.
   2. At inlet and outlet of each hydronic boiler and chiller.
   3. At inlet and outlet of each hydronic coil in air-handling units and built-up central systems.
   4. At inlet and outlet of each hydronic heat exchanger.
   5. At inlet and outlet of each hydronic heat recovery unit.
   6. At inlet and outlet of each thermal storage tank.
C. Thermometer Wells: Install in piping tee where thermometers are indicated, in vertical
position. Fill well with oil or graphite and secure cap.

3.02 INSTALLATION OF PRESSURE GAGES

A. Install pressure gages in piping tee with pressure gage valve, located on pipe at most readable position.

B. Install in the following locations, and elsewhere as indicated:
   1. At suction and discharge of each pump.
   2. At discharge of each pressure-reducing valve.
   3. At building water service entrance.
   4. At chilled water and condenser water inlets and outlets of chillers.

C. Pressure Gage Needle Valves: Install in piping tee with snubber. Install syphon in lieu of snubber for steam pressure gages.

3.03 INSTALLATION OF TEST PLUGS

A. Test Plugs: Install in piping tee where indicated, located on pipe at most readable position. Secure cap.

3.04 INSTALLATION OF FLOW-MEASURING ELEMENTS AND METERS

A. Locations: Install flow measuring elements in the following locations and elsewhere as indicated.
   1. At discharge of each pump.
   2. At inlet of each hydronic coil in built-up central systems.

B. Differential-Pressure-Type Flow Elements: Install minimum straight lengths of pipe upstream and downstream from element as described by the manufacturer's installation instructions.

C. Install wafer orifice-type element between 2 Class 125 pipe flanges, ANSI B16.1 (cast iron) or ANSI B16.24 (bronze).

D. Install connections for attachments to portable flow meters in a readily accessible location.

3.05 INSTALLATION OF CALIBRATED BALANCE VALVES

A. Install calibrated balance valves in the following locations and elsewhere as indicated.
   1. At each fan coil unit.
   2. At each unitary water source heat pump.
   3. At each 3-way valve.

3.06 ADJUSTING AND CLEANING

A. Adjusting: Adjust faces of meters and gauges to proper angle for best visibility.

B. Cleaning: Clean windows of meters and gages and factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touch-up paint.

3.07 CONNECTIONS
A. Piping installation requirements are specified in other sections of Division 23. The drawings indicate the general arrangement of piping, fittings, and specialties. The following are specific connection requirements:

B. Install meters and gages piping adjacent to machine to allow servicing and maintaining of machine.

END OF SECTION 23 0519
SECTION 23 0520
VARIABLE FREQUENCY DRIVES AND MOTORS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This specification is to cover a complete Variable Frequency motor Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor.

B. The drive manufacturer shall supply the drive and all necessary controls as herein specified. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of twenty years. All VFDs installed on this project shall be from the same manufacturer.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. Institute of Electrical and Electronic Engineers (IEEE)

2. Underwriters laboratories
   a. UL508C

3. National Electrical Manufacturer’s Association (NEMA)
   a. ICS 7.0, AC Adjustable Speed Drives

4. IEC 16800 Parts 1 and 2

B. Manufacturers: Manufacturer shall have been engaged in the production of this type of equipment for a minimum of ten years. The following manufacturer’s products are approved, subject to the requirements of this engineering specification. Naming of manufacturers does not imply that their standard construction is acceptable nor does it imply that their products are automatically approved. A manufacturer who is not the basis of design is required to submit proposed equipment along with a comparison letter addressing every item in the specification and stating compliance with the specifications.


1. It is required that the Variable Frequency Drives be supplied by the local manufacturer’s representative who has expertise in the HVAC systems and controls and who shall provide and coordinate start-up and any future service.

2. The VFD manufacturer shall have been engaged in the production of this type of equipment for a minimum of ten years. Variable Frequency Drives must be manufactured in the USA.

3. Alternate manufacturer’s requests must be submitted in writing at least 10 working days prior to bid. Approval does not relieve supplier of specification requirements.

4. VFDs that are manufactured by a third party and “brand labeled” shall not be acceptable.

5. Or approved equal as defined in Section 01095.

VARIABLE FREQUENCY DRIVES AND MOTORS
23 0520 - 1
D. Failure analysis: VFD manufacturer shall have an analysis laboratory to evaluate the failure of any component. The failure analysis lab shall allow the manufacturer to perform complete electrical testing, x-ray of components, and de-cap or delaminate of components and analyze failures within the components.

E. Qualifications:

1. VFDs and options shall be UL listed as a complete assembly. VFDs that require the customer to supply external fuses for the VFD to be UL listed are not acceptable. VFDs with requiring additional branch circuit protection are not acceptable. The base VFD shall be UL listed for 100 KAIC without the need for input fusing.
2. CE Mark – The VFD shall conform to the European Union Electro-Magnetic Compatibility directive, a requirement for CE marking. The VFD shall meet product standard EN 61800-3 for the First Environment restricted level.

1.03 SUBMITTALS

A. Submittals shall include the following information:

1. Outline dimensions, conduit entry locations and weight.
2. Customer connection and power wiring diagrams.
3. Complete technical product description include a complete list of options provided. Any portions of the specifications not complied with must be clearly indicated or the supplier and contractor shall be liable to provide all components required to meet the specification.
4. Compliance to IEEE 519 – harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD).

   a. The VFD manufacturer shall provide calculations; specific to the installation, showing total harmonic voltage distortion is less than 5%. Input filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with the IEEE electrical system standard 519. All VFDs shall include a minimum of 5% equivalent impedance reactors, no exceptions.

PART 2 - PRODUCTS

2.01 VARIABLE FREQUENCY DRIVES (VFD)

A. The VFD package as specified herein shall be enclosed in a UL Listed Type enclosure, (NEMA rated enclosures are not acceptable) completely assembled and tested by the manufacturer in an ISO9001 facility. The VFD tolerated voltage window shall allow the VFD to operate from a line of +30% nominal, and -35% nominal Voltage as a minimum.

   1. Environmental operating conditions: 0 – 40°C continuous. Altitude 0 to 3300 feet above sea level, up to 95% humidity, non-condensing. All circuit boards shall have conformal coating.
   2. Enclosure shall be rated UL type 1 and shall be UL listed as a plenum rated VFD.

B. All VFDs shall have the following features:

   1. All VFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.
2. The keypad shall include Hand-Off-Auto selections and manual speed control. There shall be fault reset and "Help" buttons on the keypad. The Help button shall include "on-line" assistance for programming and troubleshooting.

3. There shall be a built-in time clock in the VFD keypad. The clock shall have a battery back-up with 10 years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. If the battery fails, the VFD shall automatically revert to hours of operation since initial power up. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter sets and output relays. The VFD shall have a digital input that allows an override to the time clock (when in the off mode) for a programmable time frame. There shall be four (4) separate, independent timer functions that have both weekday and weekend settings. Capacitor backup is not acceptable.

4. The VFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to set-point without safety tripping or component damage (flying start).

5. The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430-150 for 4-pole motors.

6. The VFD shall have 5% equivalent impedance internal reactors to reduce the harmonics to the power line and to add protection from AC line transients. The 5% equivalent impedance may be from dual (positive and negative DC bus) reactors, or 5% AC line reactors. VFDs with only one DC reactor shall add an AC line reactor.

7. The VFD shall include a coordinated AC transient protection system consisting of 4-120 joule rated MOV's (phase to phase and phase to ground), a capacitor clamp, and 5% equivalent impedance internal reactors.

8. The VFD shall provide a programmable proof of flow Form-C relay output (broken belt / broken coupling). The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay outputs shall include programmable time delays that will allow for drive acceleration from zero speed without signaling a false under load condition.

C. All VFDs to have the following adjustments:

1. Three (3) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed.

2. Two (2) PID Set-point controllers shall be standard in the drive, allowing pressure or flow signals to be connected to the VFD, using the microprocessor in the VFD for the closed loop control. The VFD shall have 250 ma of 24 VDC Auxiliary-power and be capable of loop powering a transmitter supplied by others. There shall be two parameter sets for the first PID that allow the sets to be switched via a digital input, serial communications or from the keypad for night setback, summer/winter set-points, etc. There shall be an independent, second PID loop that can utilize the second analog input and modulate one of the analog outputs to maintain set-point of an independent process (i.e. valves, dampers, etc.). All set-points, process variables, etc. to be accessible from the serial communication network.

3. Two (2) programmable analog inputs shall accept current or voltage signals.

4. Two (2) programmable analog outputs (0-20ma or 4-20 ma). The outputs may be programmed to output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, and other data.

5. Six (6) programmable digital inputs.

6. Three (3) programmable digital Form-C relay outputs. The relays shall include programmable on and off delay times and adjustable hysteresis. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; continuous current rating 2 amps RMS. Outputs shall be true Form-C type contacts; open collector outputs are not acceptable.

7. Run permissive circuit - There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad, time-clock control, or
serial communications) the VFD shall provide a dry contact closure that will signal the
damper to open (VFD motor does not operate). When the damper is fully open, a
normally open dry contact (end-switch) shall close. The closed end-switch is wired to a
VFD digital input and allows motor operation. Two separate safety interlock inputs shall
be provided. When either safety is opened, the motor shall be commanded to coast to
stop, and the damper shall be commanded to close.
8. Two independently adjustable accel and decel ramps with 1 – 1800 seconds adjustable
time ramps.
9. The VFD shall include a motor flux optimization circuit that will automatically reduce
applied motor voltage to the motor to optimize energy consumption and audible motor
noise.
10. The VFD shall include a carrier frequency control circuit that reduces the carrier
frequency based on actual VFD temperature that allows higher carrier frequency without
de-rating the VFD or operating at high carrier frequency only at low speeds.
11. The VFD shall include password protection against parameter changes.

D. The Keypad shall include a backlit LCD display. The display shall be in complete English words
for programming and fault diagnostics (LED and alpha-numeric codes are not acceptable). All
VFD faults shall be displayed in English words.

E. All applicable operating values shall be capable of being displayed in engineering (user) units.
A minimum of three operating values from the list below shall be capable of being displayed at
all times. The display shall be in complete English words (alpha-numeric codes are not
acceptable):

1. Output Frequency
2. Motor Speed (RPM, %, or Engineering units)
3. Motor Current
4. Drive Temperature
5. DC Bus Voltage
6. Output Voltage

F. The VFD shall include a fireman’s override input. Upon receipt of a contact closure from the
fireman’s control station, the VFD shall operate in one of two modes: 1) Operate at a
programmed predetermined fixed speed or operate in a specific fireman’s override PID
algorithm that automatically adjusts motor speed based on override set point and feedback .
The mode shall override all other inputs (analog/digital, serial communication, and all keypad
commands), except customer defined safety run interlock, and force the motor to run in one of
the two modes above. “Override Mode” shall be displayed on the keypad. Upon removal of
the override signal, the VFD shall resume normal operation.

G. Serial Communications

1. The VFD shall have an RS-485 port as standard. The standard protocols shall be
Modbus, BACnet, Johnson Controls N2 bus, and Siemens Building Technologies FLN.
Each individual drive shall have the protocol in the base VFD. The use of third party
gateways and multiplexers is not acceptable. All protocols shall be “certified” by the
governing authority (i.e. BTL Listing for BACnet). Use of non-certified protocols is not
allowed.
2. The BACnet connection shall be an RS485, MS/TP interface operating at 9.6, 19.2, 38.4,
or 76.8 Kbps. The connection shall be tested by the BACnet Testing Labs (BTL) and be
BTL Listed. The BACnet interface shall conform to the BACnet standard device type of
an Applications Specific Controller (B-ASC). The interface shall support all BIBBs
defined by the BACnet standard profile for a B-ASC including, but not limited to:

a. Data Sharing – Read Property – B.
b. Data Sharing – Write Property – B.

e. Device Management – Communication Control – B.

3. Serial communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, accel/decel time adjustments, and lock and unlock the keypad. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The DDC shall also be capable of monitoring the VFD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible.

H. EMI / RFI filters. All VFDs shall include EMI/RFI filters. The VFD shall comply with standard EN 61800-3 for the First Environment, restricted level with up to 100’ of motor cables. No Exceptions. Certified test lab test reports shall be provided with the submittals.

I. All VFDs through 60HP shall be protected from input and output power miss-wiring. The VFD shall sense this condition and display an alarm on the keypad. The VFD shall not be damaged by this condition.

J. OPTIONAL FEATURES – Optional features to be furnished and mounted by the drive manufacturer. All optional features shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508 label. The bypass enclosure door and VFD enclosure must be interlocked such that input power is turned off before either enclosure can be opened. The VFD and Bypass as a package shall have a UL listed short circuit rating of 100,000 amps and shall be indicated on the data label.

1. A complete factory wired and tested bypass system consisting of an output contactor and bypass contactor, service (isolation) switch and VFD input fuses are required. Bypass designs, which have no VFD only fuses, or that incorporate fuses common to both the VFD and the bypass will not be accepted

2. Door interlocked pad-lockable circuit breaker that will disconnect all input power from the drive and all internally mounted options.

K. The following operators shall be provided:

1. Bypass Hand-Off-Auto
2. Drive mode selector and light
3. Bypass mode selector and light
4. Bypass fault reset
5. Bypass LDC display, 2 lines, for programming and status / fault / warning indications
6. Motor protection from single phase power conditions - The Bypass system must be able to detect a single phase input power condition while running in bypass, disengage the motor in a controlled fashion, and give a single phase input power indication. Bypass systems not incorporating single phase protection in Bypass mode are not acceptable.

7. The system (VFD and Bypass) tolerated voltage window shall allow the system to operate from a line of +30%, -35% nominal Voltage as a minimum. The system shall incorporate circuitry that will allow the drive or bypass contactor to remain “sealed in” over this voltage tolerance at a minimum.

8. The Bypass system shall NOT depend on the VFD for bypass operation. The bypass shall be completely functional in both Hand and Automatic modes even if the VFD has been removed from the enclosure for repair / replacement.

9. Serial communications – the bypass and VFD shall be capable of being monitored and or controlled via serial communications. Provide communications protocols for ModBus;
10. BACnet Serial communication bypass capabilities shall include, but not be limited to; bypass run-stop control; the ability to force the unit to bypass; and the ability to lock and unlock the keypad. The bypass shall have the capability of allowing the DDC to monitor feedback such as, bypass current (in amps), bypass kilowatt hours (resettable), bypass operating hours (resettable), and bypass logic board temperature. The DDC shall also be capable of monitoring the bypass relays output status, and all digital input status. All bypass diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote bypass fault reset shall be possible. The following additional bypass status indications and settings shall be transmitted over the serial communications bus – keypad “Hand” or “Auto” selected, and bypass selected. The DDC system shall also be able to monitor if the motor is running under load in both VFD and bypass (proof of flow) in the VFD mode over serial communications or Form-C relay output. A minimum of 40 field parameters shall be capable of being monitored in the bypass mode.

11. Run permissive circuit - there shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad, time-clock control, or serial communications) the VFD and bypass shall provide a dry contact closure that will signal the damper to open (VFD motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a VFD system input and allows motor operation. Two separate safety interlock inputs shall be provided. When either safety is opened, the motor shall be commanded to coast to stop, and the damper shall be commanded to close.

12. The bypass control shall monitor the status of the VFD and bypass contactors and indicate when there is a welded contactor contact or open contactor coil. This failed contactor operation shall be indicated on the Bypass LCD display as well as over the serial communications protocol.

13. The bypass control shall include a programmable time delay for bypass start and keypad indication that this time delay is in process. This will allow VAV boxes to be driven open before the motor operates at full speed in the bypass mode. The time delay shall be field programmable from 0 – 120 seconds.

14. The bypass control shall be programmable for manual or automatic transfer to bypass. The user shall be able to select via keypad programming which drive faults will generate an automatic transfer to bypass and which faults require a manual transfer to bypass.

15. There shall be an adjustable motor current sensing circuit for the bypass and VFD mode to provide proof of flow indication. The condition shall be indicated on the keypad display, transmitted over the building automation protocol and on a relay output contact closure.

16. The bypass controller shall have six programmable digital inputs, and five programmable Form-C relay outputs.

17. The relay outputs from the bypass shall programmable for any of the following indications.

   a. System started
   b. System running
   c. Bypass override enabled
   d. Drive fault
   e. Bypass fault
   f. Bypass H-O-A position
   g. Motor proof of flow (broken belt)
   h. Overload
   i. Bypass selected
   j. Bypass run
   k. System started (damper opening)
   l. Bypass alarm
   m. Over temperature
18. The digital inputs for the system shall accept 24VAC or 24VDC. The bypass shall incorporate internally sourced power supply and not require an external control power source. The bypass power board shall supply 250 ma of 24 VDC for use by others to power external devices.

19. Customer Interlock Terminal Strip – provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in VFD or Bypass mode. The remote start/stop contact shall operate in VFD and bypass modes. The terminal strip shall allow for independent connection of up to four (4) unique safety inputs.

20. The user shall be able to select the text to be displayed on the keypad when the safety opens. Example text display indications include “Fire-stat”, “Freeze-stat”, “Over pressure” and “Low pressure”. The user shall also be able to determine which of the four (4) safety contacts is open over the serial communications connection.

21. Class 10, 20, or 30 (selectable) electronic motor overload-protection shall be included.

2.02 MOTORS

A. Motors shall be NEMA TEFC; T-FRAME mounted on an adjustable steel base.

B. Motors shall be tested to IEEE standard 112 test method B and rated per NEMA MG1, Part 31 "Inverter Fed Motors".

C. Motors shall be specifically designed to meet or exceed all (EPAct) requirements for energy efficiency and include Class ‘F’ insulation.

D. Motors shall be as manufactured by Baldor or approved equal as defined in Section 01095.

E. Motor shall have factory installed Aegis bearing protection rings.

F. Motors shall meet the electrical characteristics as specified for voltage, rpm, and efficiencies.

G. Motors shall be designed to be installed at any distance from their respective variable frequency drives

H. Warranty on motors: Warranty shall be 24 months from the date of certified start-up, not to exceed 30 months from the date of manufacturer. The warranty shall include all parts, labor, travel time and expenses.

I. Installation of motors: Installation should be done in accordance with the manufacturer’s recommendations and per NEC and all local codes.

PART 3 - EXECUTION

3.01 HARMONIC LINE DISTORTION

A. Compliance of system to IEEE 519-1992

1. The VFD manufacturer shall, at the request of the engineer, provide computerized calculation, specific to this installation, showing total harmonic voltage distortion (THD) per IEEE std. 519-1992. Guide for Harmonic Control and Reactive Compensation for Static Power Converters. The acceptance of this calculation must be completed prior to VFD installation.

2. If the voltage THD exceeds 5%, the VFD manufacturer is to recommend the additional equipment required to reduce the THD to an acceptable level.
3.02 UNACCEPTABLE FEATURES

A. The following design and/or construction features will not be acceptable for use on this particular project:

1. Drive efficiencies of less than 97% at full rating are not acceptable.
2. Phase Control Rectifiers (Thyristors) or other such devices causing line notching are not acceptable.
3. 6-step output is not acceptable.
4. Drives that do not have adjustable carrier frequencies.
5. Function and/or fault indications which are in code or require reference to an operating manual or any method not using direct reading English words are not acceptable.

3.03 EXTRA MATERIALS

A. Spare Parts: The VFD and bypasses shall be furnished with one spare set of all fuses for each size and type of fuse.

3.04 INSTALLATION

A. Installation shall be the responsibility of the mechanical contractor. The contractor shall install the drive in accordance with the requirements of the VFD manufacturer’s installation manual.

3.05 START-UP

A. Certified factory start-up shall be provided for each drive by a factory certified service center. A certified start-up form shall be filled out for each drive with a copy provided to the owner, and a copy kept on file at the manufacturer.

3.06 PRODUCT SUPPORT

A. Factory trained application engineering and service personnel that are thoroughly familiar with the VFD products offered shall be locally available at both the specifying and installation locations. A toll free 24/365 technical support line shall be available.

B. A computer based training CD or 8-hour professionally generated video (VCR format) shall be provided to the owner at the time of project closeout. The training shall include installation, programming and operation of the VFD, bypass and serial communication.

3.07 WARRANTIES

A. Warranty shall be 24 months from the date of certified start-up, not to exceed 30 months from the date of shipment. The warranty shall include all parts, labor, travel time and expenses.

END OF SECTION 23 0514
SECTION 23 0523
VALVES

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes general duty valves common to most mechanical piping systems.
1. Special purpose valves are specified in individual piping system specifications.

1.02 RELATED SECTIONS

A. Division 23 Section "HVAC Identification" for valve tags and charts.

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract, Division 1 Specification Sections, and Section 23 0510 "Basic HVAC Requirements."
1. Product data, including body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions.
2. Provide valve schedule showing manufacturer's figure numbers and sizes.

1.04 QUALITY ASSURANCE

A. Single Source Responsibility: Comply with the requirements specified in Division 1 Section "Materials and Equipment," under "Source Limitations."
B. American Society of Mechanical Engineers (ASME) Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.
C. Manufacturer’s Standardization Society (MSS) of the Valve and Fittings Industry Compliance: Comply with the various MSS Standard Practices referenced.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves for shipping as follows:
1. Ensure valves are dry and internally protected against rust and corrosion.
2. Protect valve ends against damage to threads, flange faces, and weld-end preps.
3. Set valves in best position for handling. Set globe and gate valves closed to prevent ratting; set ball and plug valves open to minimize exposure of functional surfaces; and block swing check valves in either closed or open position.

B. Storage: Use the following precautions during storage:
1. Do not remove valve end protectors unless necessary for inspection; then reinstall for storage.
2. Protect valves from weather. Store valves indoor. Maintain valve temperature higher than the ambient dew point temperature. If outdoor storage is necessary, support valves off the ground or pavement in watertight enclosures.
PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products from one of the manufacturers listed in valve schedule.

2.02 VALVE FEATURES, GENERAL

A. Valve Design: Rising stem or rising outside screw and yoke stems.
   1. Non-rising stem valves may be used where headroom prevents full extension of rising stems.

B. Pressure and Temperature Ratings: As scheduled and required to suit system pressures and temperatures.

C. Sizes: Same size as upstream pipe, unless otherwise indicated.

D. Operators: Provide the following special operator features:
   1. Hand wheels, fastened to valve stem, for valves other than quarter turn.
   2. Lever handles, on quarter-turn valves 6-inches and smaller, except for plug valves. Provide plug valves with square heads; provide one wrench for every 10 plug valves.
   3. Chain-wheel operators, for valves 2-1/2 inch and larger, install 72 inches or higher above finished floor elevation. Extend chains to an elevation of 5'-0" above finished floor elevation.
   4. Provide gear drive operators, on quarter-turn valves 8-inch and larger.

E. Extended Stems: Where insulation is indicated or specified provide extended stems arranged to receive insulation.

F. End Connections: As indicated in the valve specifications.
      a. Caution: Where soldered end connections are used, use solder having a melting point below 840 deg. F for gate, globe, and check valves; below 421 deg. F for ball valves.

2.03 GATE VALVES

A. Gate Valves, 2-Inch and Smaller: MSS SP-80; Class 150, body and union bonnet of ASTM B62 cast bronze; with threaded or solder ends, solid disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron hand wheel. Do not use solder end valves for hot water heating or steam piping applications.
2.04 BALL VALVES

A. Ball Valves, 2 Inches and Smaller: Rated for 150 psi saturated stem pressure, 400 psi WOG pressure; two- or three-piece construction; with bronze body conforming to ASTM B 62, full port only, chrome-plated brass ball, replaceable "Teflon" or "TFE" seats and seals, blowout-proof stem, and vinyl covered steel handle. Provide solder ends for condenser water, chilled water, and domestic hot and cold water service; threaded ends for heating hot water and low-pressure steam.

1. Ball Valves - 1 Inch and Smaller:

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>THREADED ENDS</th>
<th>SOLDER ENDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conbraco (Apollo)</td>
<td>70-100</td>
<td>70-200</td>
</tr>
<tr>
<td>Crane</td>
<td>9302</td>
<td>9322</td>
</tr>
<tr>
<td>Nibco</td>
<td>T-580-70</td>
<td>S-580-70</td>
</tr>
<tr>
<td>Stockham</td>
<td>S-216 BR-R-T</td>
<td>S-216-BR-R-S</td>
</tr>
<tr>
<td>Watts</td>
<td>B-6000</td>
<td>B-6001</td>
</tr>
<tr>
<td>Milwaukee</td>
<td>BA-100</td>
<td>BA-150</td>
</tr>
<tr>
<td>KITZ</td>
<td>58</td>
<td>59</td>
</tr>
</tbody>
</table>

“X” means not available. Provide lead-free products.

2. Ball Valves - 1-1/4 Inch to 2 Inch:

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>THREADED ENDS</th>
<th>SOLDER ENDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conbraco (Apollo)</td>
<td>82-100</td>
<td>82-200</td>
</tr>
<tr>
<td>Nibco</td>
<td>T-590-Y</td>
<td>S-590-Y</td>
</tr>
<tr>
<td>Stockham</td>
<td>S-216 BR-R-T</td>
<td>S-216-BR-R-S</td>
</tr>
<tr>
<td>Watts</td>
<td>B-6800</td>
<td>B-6801</td>
</tr>
<tr>
<td>KITZ</td>
<td>62</td>
<td>63</td>
</tr>
</tbody>
</table>

“X” means not available. Provide lead-free products.
“X” means not available. Provide lead-free products. For grooved end connections, use Victaulic Style 721.

2.05 PLUG VALVES

A. Plug Valves, 2-Inch and Smaller: Rated at 150 psi WOG; bronze body, with straightaway pattern, square head, and threaded ends.
   1. Lunkenheimer: 454 or equal.
   2. Homestead: 611 (Semi Steel Body) or equal.

B. Plug Valves, 2-1/2 Inch and Larger: MSS SP-78; rated at 175 psi WOG; lubricated plug type, with semi steel body, single gland, wrench operated and flanged ends.
   1. Powell: 2201 or equal.
   2. Homestead: 605 or equal.

2.06 GLOBE VALVES

A. Globe Valves, 2-Inch and Smaller: MSS SP-80; Class 125; body and screwed bonnet of ASTM B 62 cast bronze; with threaded or solder ends, brass or replaceable composition disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron hand wheel. Provide Class 150 valves meeting the above where system pressure requires.

<table>
<thead>
<tr>
<th>CLASS 125 MANUFACTURER</th>
<th>CLASS 125 THREADED</th>
<th>CLASS 150 SOLDER</th>
<th>THREADED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crane</td>
<td>1</td>
<td>1310</td>
<td>17TF</td>
</tr>
<tr>
<td>Milwaukee</td>
<td>502</td>
<td>1502</td>
<td>590</td>
</tr>
<tr>
<td>Nibco</td>
<td>T-211-B</td>
<td>S-211-B</td>
<td>T-235-Y</td>
</tr>
<tr>
<td></td>
<td>T-211-Y</td>
<td>S-211-Y</td>
<td></td>
</tr>
<tr>
<td>KITZ</td>
<td>11</td>
<td>12</td>
<td>10</td>
</tr>
</tbody>
</table>

“X” means not available. Provide Lead-free products.

B. Globe Valves, 2-1/2-Inch and Larger: MSS SP-85; Class 125 iron body and bolted bonnet conforming to ASTM A 126, Class B; with outside screw and yoke, bronze mounted, flanged ends, and "Teflon" impregnated packing, and two-piece backing gland assembly.

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>STRAIGHT BODY</th>
<th>ANGLE BODY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crane</td>
<td>351</td>
<td>353</td>
</tr>
<tr>
<td>Milwaukee</td>
<td>F2981</td>
<td>F2986</td>
</tr>
<tr>
<td>Nibco</td>
<td>F-718-B</td>
<td>F-818-B</td>
</tr>
<tr>
<td>KITZ</td>
<td>76</td>
<td>X</td>
</tr>
</tbody>
</table>

“X” means not available. Provide Lead-free products.

2.07 BUTTERFLY VALVES

A. General - Where butterfly valves are used as shutoff for termination, or equipment removal or repair, select ductile iron lug type valves, bi-directional, dead-end service rated to the full working pressure of the valve. Select wafer type valves for other applications. Provide gear operators on butterfly valves 8" and larger. Valve bodies to
have extended necks to provide for 2-1/4" insulation as needed. Butterfly valves 12 inch and smaller rated to 200 psi, 14 inch and larger 150 psi.

Butterfly Valves 2-1/2 Inches and Larger:
The following are model numbers for wafer-type, with nickel-plated ductile-iron disc:

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>LEVER</th>
<th>GEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crane</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Nibco</td>
<td>WD-20103</td>
<td>WD-20105</td>
</tr>
<tr>
<td>Milwaukee</td>
<td>MW-222E</td>
<td>MW-322E</td>
</tr>
<tr>
<td>KITZ</td>
<td>DJ Series</td>
<td>DJ Series</td>
</tr>
</tbody>
</table>


The following are model numbers for lug-type, with nickel-plated ductile-iron disc:

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>LEVER</th>
<th>GEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crane</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>Nibco</td>
<td>LD-20103</td>
<td>LD-20105</td>
</tr>
<tr>
<td>Milwaukee</td>
<td>ML-222E</td>
<td>ML-322E</td>
</tr>
<tr>
<td>KITZ</td>
<td>DJ Series</td>
<td>DJ Series</td>
</tr>
</tbody>
</table>

Grooved Ends: Victaulic Series 300 and 704. Provide lead-free products.

The following are model numbers for wafer-type, with aluminum-bronze disc:

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>LEVER</th>
<th>GEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crane</td>
<td>42</td>
<td>42</td>
</tr>
<tr>
<td>Nibco</td>
<td>WD-20003</td>
<td>WD-20005</td>
</tr>
<tr>
<td>Milwaukee</td>
<td>CW-223E</td>
<td>CW-323E</td>
</tr>
<tr>
<td>KITZ</td>
<td>DJ Series</td>
<td>DJ Series</td>
</tr>
</tbody>
</table>

Grooved Ends: Victaulic Series 300A, 700A, and 703A. Provide lead-free products.

The following are model numbers for lug-type, with aluminum-bronze disc:

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>LEVER</th>
<th>GEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center Line</td>
<td>Series LT</td>
<td>Series LT</td>
</tr>
<tr>
<td>Crane</td>
<td>44</td>
<td>44</td>
</tr>
<tr>
<td>Nibco</td>
<td>LD-20003</td>
<td>LD-20005</td>
</tr>
<tr>
<td>Milwaukee</td>
<td>CL-223E</td>
<td>CL-323E</td>
</tr>
<tr>
<td>KITZ</td>
<td>DJ Series</td>
<td>DJ Series</td>
</tr>
</tbody>
</table>

Grooved Ends: Victaulic Series 300A, 700A, and 703A. Provide lead-free products.
2.08 CHECK VALVES

A. Swing Check Valves, 2-Inch and Smaller: MSS SP-80; Class 125, cast-bronze body and cap conforming to ASTM B 62; with horizontal swing, Y-pattern, and bronze disc; and having threaded or solder ends. Provide valves capable of being reground while the valve remains in the line. Provide Class 150 valves meeting the above specifications, with threaded end connections, where system pressure requires or where Class 125 valves are not available.

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>CLASS 125 THREADED ENDS</th>
<th>CLASS 125 SOLDER ENDS</th>
<th>CLASS 125 THREADED ENDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crane</td>
<td>37</td>
<td>1342</td>
<td>137</td>
</tr>
<tr>
<td>Milwaukee</td>
<td>509</td>
<td>1509</td>
<td>510</td>
</tr>
<tr>
<td>Nibco</td>
<td>T-413</td>
<td>S-413</td>
<td>T-433</td>
</tr>
<tr>
<td>KITZ</td>
<td>22</td>
<td>23</td>
<td>29</td>
</tr>
</tbody>
</table>

“X” means not available. Provide lead-free products. For grooved connections, use Victaulic Series 712.

B. Swing Check Valves, 2-1/2 Inch and Larger: MSS SP-71; Class 125 (Class 175 FM approved for fire protection piping systems), cast iron body and bolted cap conforming to ASTM A 126, Class B; horizontal wing, and bronze disc or cast-iron disc with bronze disc ring; and flanged ends. Provide valves capable of being refitted while the valve remains in the line.

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>CLASS 125</th>
<th>CLASS 175</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crane</td>
<td>373</td>
<td>X</td>
</tr>
<tr>
<td>Milwaukee</td>
<td>F2974</td>
<td>X</td>
</tr>
<tr>
<td>Nibco</td>
<td>F-918</td>
<td>X</td>
</tr>
<tr>
<td>KITZ</td>
<td>78</td>
<td>X</td>
</tr>
</tbody>
</table>

“X” means not available. Provide lead-free products. For grooved connections, use Victaulic Series 712.

C. Lift Check Valves, 2-Inch and Smaller: Class 125; cast-bronze body and cap conforming to ASTM B 62; horizontal or angle pattern, lift-type valve, with stainless steel spring, bronze disc holder with renewable "Teflon" disc, and threaded ends. Provide valves capable of being refitted and ground while the valve remains in the line.

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>HORIZONTAL</th>
<th>ANGLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jenkins</td>
<td>655-A</td>
<td>X</td>
</tr>
<tr>
<td>Lunkenheimer</td>
<td>233</td>
<td>X</td>
</tr>
</tbody>
</table>

“X” means not available. Provide lead-free products.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine valve interior through the end ports for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks used to prevent disc movement during shipping and handling.
B. Actuate valve through an open-close and close-open cycle. Examine functionally significant features, such as guides and seats made accessible by such actuation. Following examination, return the valve closure member to the shipping position.

C. Examine threads on both the valve and the mating pipe for form (i.e., out-of-round or local indentation) and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.

E. Prior to valve installation, examine the piping for cleanliness, freedom from foreign materials, and proper alignment.

3.02 VALVE ENDS SELECTION

A. Select valves with the following ends or types of pipe/tube connections:
   1. Copper Tube Size, 2-Inch and Smaller: Solder ends, except provide threaded ends for heating hot water and low-pressure steam service.
   2. Steel Pipe Sizes, 2-Inch and Smaller: threaded or grooved end.
   3. Steel Pipe Sizes 2-1/2 Inch and Larger: grooved end or flanged.

3.03 VALVE INSTALLATIONS

A. General Application: Refer to piping system specification sections for specific valve applications and arrangements. Use gate, ball, and butterfly valves for shut-off duty. Use globe, plug, and ball valves for throttling duty.

B. Locate valves for easy access and provide separate support where necessary. Where concealed, install behind access panel with valve located for complete accessibility for servicing.

C. Install valves and unions for each fixture and item of equipment. Arrange valves to allow equipment removal without system shutdown. Unions are not required on flanged devices.

D. Install valves in horizontal piping with stem at or above the center of the pipe.

E. Install valves in a position to allow full stem movement.

F. Installation of Check Valves: Install for proper direction of flow as follows:
   1. Swing Check Valves: Horizontal position with hinge pin level.
   2. Lift Check Valve: With stem upright and plumb.

G. Where shut-off valves are installed in a confined space such as in a wall or furring, install ball valves with operating handle parallel with face of wall.

H. Where valves are located in walls, do not install more than 6'-0" from finished floor. Where valves are located above ceiling, install valve centered on access point and not greater than 24" above access point.

3.04 SOLDER CONNECTIONS

A. Cut tube square and to exact lengths.
B. Clean end of tube to depth of valve socket with steel wool, sand cloth, or a steel wire brush to a bright finish. Clean valve socket in same manner.

C. Apply proper soldering flux in an even coat to inside of valve socket and outside of tube.

D. Open gate and glove valves to full open position.

E. Remove the cap and disc holder of swing check valves having composition discs.

F. Insert tube into valve socket, making sure the end rests against the shoulder inside valve. Rotate tube or valve slightly to ensure even distribution of the flux.

G. Apply heat evenly to outside of valve around joint until solder will melt upon contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

H. Use 95-5 tin/antimony ‘lead-free’ solder for all solder joints unless indicated otherwise.

3.05 THREADED CONNECTIONS

A. Note the internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.

B. Align threads at point of assembly.

C. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).

D. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

3.06 FLANGED CONNECTIONS

A. Align flange surfaces parallel.

B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

3.07 FIELD QUALITY CONTROL

A. Tests: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust or replace packing to stop leaks; replace valves if leak persists.

3.08 ADJUSTING AND CLEANING

A. Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare valves to receive finish painting or insulation.

3.09 VALVE PRESSURE/TEMPERATURE CLASSIFICATION SCHEDULES

A. Below schedules are for standard installation conditions. Variations or special valves and/or conditions set forth in other Division 22 Sections shall take precedence.

1. VALVES, 2-INCH AND SMALLER
### SERVICE GATE GLOBE BALL CHECK

<table>
<thead>
<tr>
<th>Service</th>
<th>Gate</th>
<th>Globe</th>
<th>Ball</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condenser Water</td>
<td>125</td>
<td>125</td>
<td>150</td>
<td>125</td>
</tr>
<tr>
<td>Chilled Water</td>
<td>125</td>
<td>125</td>
<td>150</td>
<td>125</td>
</tr>
<tr>
<td>Domestic HW &amp; CW</td>
<td>125</td>
<td>125</td>
<td>150</td>
<td>125</td>
</tr>
<tr>
<td>Heating Hot Water</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>Low-Pressure Steam</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
</tr>
</tbody>
</table>

### 2. VALVES, 2-1/2 INCH AND LARGER

<table>
<thead>
<tr>
<th>Service</th>
<th>Gate</th>
<th>Globe</th>
<th>Butterfly</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condenser Water</td>
<td>125</td>
<td>125</td>
<td>200</td>
<td>125</td>
</tr>
<tr>
<td>Chilled Water</td>
<td>125</td>
<td>125</td>
<td>200</td>
<td>125</td>
</tr>
<tr>
<td>Domestic Hot and Cold Water</td>
<td>125</td>
<td>125</td>
<td>200</td>
<td>125</td>
</tr>
<tr>
<td>Heating Hot Water</td>
<td>125</td>
<td>125</td>
<td>200</td>
<td>125</td>
</tr>
<tr>
<td>Low-Pressure Steam</td>
<td>125</td>
<td>125</td>
<td>200</td>
<td>125</td>
</tr>
</tbody>
</table>

END OF SECTION 23 0523
PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Extent of supports and anchors required by this section is indicated on drawings or in other Division-23 sections and include the following:
   1. Horizontal-Piping Hangers and Supports;
   2. Vertical-Piping Clamps;
   3. Hanger-Rod Attachments;
   4. Building Attachments;
   5. Saddles and Shields;
   6. Miscellaneous Materials;
   7. Anchors;
   8. Equipment Supports.

1.02 RELATED SECTIONS

A. This section is part of each Division-23 section making reference to or requiring supports and anchors specified herein.

B. Supports and anchors furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division-23 sections.

C. Section 03 3000: Cast-in-Place Concrete.

1.03 QUALITY ASSURANCE

A. Codes and Standards:
   1. Code Compliance: Comply with applicable plumbing codes pertaining to product materials and installation of supports and anchors.
   2. UL and FM Compliance: Provide products which are UL-listed and FM approved.
   3. MSS Standard Compliance:
      a. Provide pipe hangers and supports of which materials, design, and manufacturer comply with MSS SP-58.
      b. Select and apply pipe hangers and supports, complying with MSS SP-69.
      c. Fabricate and install pipe hangers and supports, complying with MSS SP-89.
      d. Terminology used in this section is defined in MSS SP-90.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer’s technical product data, including installation instructions for each type of support and anchor.

PART 2 - PRODUCTS

2.01 MANUFACTURED UNITS
A. Hangers and support components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58.

1. Components shall have galvanized coatings where installed for piping and equipment that will not have field-applied finish.

2. Pipe attachments shall have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.

B. Thermal Hanger Shield Inserts: 100-psi average compressive strength, waterproofed calcium silicate, encased with a sheet metal shield. Insert and shield shall cover entire circumference of the pipe and shall be of length indicated by manufacturer for pipe size and thickness of insulation.

2.02 HORIZONTAL-PIPING HANGERS AND SUPPORTS

A. General: Except as otherwise indicated, provide factory fabricated horizontal-piping hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems.

1. Adjustable Steel Clevis Hangers: MSS Type 1.


2.03 VERTICAL-PIPING CLAMPS

A. General: Except as otherwise indicated, provide factory fabricated vertical-piping clamps complying with MSS SP-58, of one of the following types listed, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated clamps for copper-piping systems.

B. Two-Bolt Riser Clamps: MSS Type 8.

2.04 HANGER-ROD AND BUILDING ATTACHMENTS

A. General Hanger Rod Attachment: Refer to structural drawings for requirements of hanger rod and building attachments. If a specific attachment that is required is not detailed on the structural drawings, one of the following attachments may be submitted for review by the structural engineer prior to installation. Except as otherwise indicated, provide factory fabricated hanger-rod attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachment to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.

B. General Building Attachment: Except as otherwise indicated, provide factory fabricated building attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building...
attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems.

1. Concrete Inserts: MSS Type 18.
2. Center Beam Clamps: MSS Type 21.
5. Malleable Beam Clamps: MSS Type 30.
6. Steel Brackets: One of the following for indicated loading:

2.05 SADDLES AND SHIELDS

A. General: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.

B. Protection Shields: MSS Type 40; provide high density insert of same thickness of insulation.

2.06 MANUFACTURERS OF HANGERS AND SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide hangers and supports of one of the following:
   1. B-Line Systems, Inc.
   2. Tolco, Inc.
   3. Elcen Metal Products Co.
   5. ITT Grinnel Corp.

2.07 MISCELLANEOUS MATERIALS

A. Steel Plates, Shapes and Bars: ASTM A36.

B. Cement Grout: Portland cement (ASTM C150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

C. Pipe Alignment Guides: Factory fabricated, of cast semisteel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base with two-section guiding spider that bolts tightly to pipe. Length of guides shall be as recommended by manufacturer to allow indicated travel.

D. Pipe Roll Stand: Factory fabricated cast iron stand, size as required, with insulation installed on piping.

2.08 ISOLATORS

A. Isolators: Provide factory-fabricated isolators of size required.

B. Spring Isolators: Refer to Section 23 0548 VIBRATION CONTROL.

C. Manufacturers: Semco "Trisolator" or Potter-Roemer PR-ISO.
PART 3 - EXECUTION

3.01 INSPECTION
A. Examine substrates and conditions under which supports and anchors are to be installed. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION
A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachment.

B. Prior to installation of hangers, supports, anchors and associated work, installer shall meet at project site with Contractor, installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and Architect/Engineer for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

3.03 INSTALLATION OF BUILDING ATTACHMENTS
A. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.

3.04 INSTALLATION OF HANGERS AND SUPPORTS
A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and type as installed for adjacent similar piping.

C. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

D. Provisions of Movement: Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors.
E. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

F. Pipe Slopes: Install hangers and supports to provide required pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 Pressure Piping Codes are not exceeded.

G. Bare Piping: Install isolators for all bare domestic water and bare hydronic piping.

H. Insulated Piping: Comply with the following installation requirements.
   1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.
   2. Shields: Where low-compressive-strength insulation or vapor barriers are indicated on cold or chilled water piping, install coated protective shields. Provide rigid insulation reinforcement at shields.

I. Hangers and supports to be capable to resist the minimum seismic forces indicated in drawings.

3.05 EQUIPMENT SUPPORTS

A. Concrete housekeeping bases will be provided as work of Division 3.

B. Furnish to Contractor, scaled layouts of all required bases, with dimensions of bases, and location to column center lines. Furnish templates, anchor bolts, and accessories, necessary for base construction.

3.06 ADJUSTING AND CLEANING

A. Hanger Adjustment: Adjust hangers so as to distribute loads equally on attachments.

B. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.

C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

D. Touch-Up Painting: Immediately after erection of anchors and supports, clean field welds and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA-1 requirements for touch-up of field-painted surfaces.
   1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

E. For galvanized surfaces clean welds bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION 23 0529
SECTION 23 0548

VIBRATION CONTROL FOR HVAC

PART 1 - GENERAL

1.01 DESIGN REQUIREMENTS

A. It is the intent of this Specification to provide the necessary design for the avoidance of excessive noise or vibration in the building due to the operation of machinery or equipment, or due to interconnected piping, ductwork, or conduit and to seismically restrain piping, ductwork and equipment per the applicable codes against seismic forces in any direction.

1. All isolators shall:
   a. Be provided by a single manufacturer.
   b. Be designed or treated for resistance to corrosion. Structural steel bases shall be cleaned of welding slag and coated with an SCAQMD compliant primer.
   c. Be selected to perform their function without undue stress or overloading. All isolators shall have a method for leveling and have a 1/4" thick ribbed neoprene acoustical pad under the spring baseplate.
   d. Be installed in a manner to prevent the transmission of vibration to the structure. No rigid connections between rotating or oscillating equipment or piping and the building will be permitted.
   e. Be designed to be non-resonant with equipment forcing frequencies or support structure natural frequencies.

2. Anchor floor mounted isolated equipment to concrete housekeeping pads of sufficient size to accommodate the anchorage of seismic restraints. Housekeeping pads shall be anchored to the structure as specified by the Structural Engineer of Record.

3. Each fan and motor assembly shall be supported on a single structural steel frame. Flexible duct connections shall be provided at inlet and discharge ducts.

4. Where called for in the specifications or on the drawings, all structural steel bases, including concrete pouring form bases, shall be designed and fabricated by the isolation manufacturer. Isolation manufacturer shall be a licensed fabricator for the City of Los Angeles, California.

5. Unless otherwise indicated, all equipment mounted on vibration bases shall have a minimum operating clearance of 1" between structural steel base and floor or support base beneath. The minimum operating clearance between concrete inertia bases and housekeeping pads shall be 1 inch. Check clearance space after installation to ensure that no debris has been left to possibly short circuit isolation bases.

6. Where necessary due to height limitations, provide height saving brackets.

7. Design isolators for positive anchorage against uplift and overturning.

1.02 MANUFACTURERS

A. Acceptable Isolation Manufacturer:

1. M. W. Sausse’ & Co., Inc. (Vibrex)
2. Mason Industries, Inc
3. Or Approved Equal

B. Purchased and/or fabricated equipment must be designed and manufactured with provision for positive anchorage against seismic forces.

C. Seismic restraints for pipes and ducts shall be as per the SMACNA Guidelines for seismic Restraint of Mechanical Systems and shall be approved by DSA.

D. Seismic restraints for equipment and piping shall be designed to meet the criteria of the current California Code of Regulations.

E. The manufacturer of Vibration Isolation and Seismic Control Equipment shall have the following responsibilities:
   1. Determine adequate vibration isolation and seismic restraint sizes and locations.
   2. Provide piping and equipment isolation systems and seismic restraints as scheduled and/or specified.
   3. Provide installation instructions and drawings to assure proper installation and performance.

1.03 SUBMITTALS

A. Make Submittals in Accordance with:

B. Submit Shop Drawings and Manufacturer's Literature
   1. Specific vibration isolators and seismic restraints to be utilized showing compliance with the specifications.
   2. Isolation frame construction for each machine including dimensions, structural member sizes, support points and restraint locations and details.
   3. Methods for isolation and restraint of suspended piping, ductwork, and equipment.
   5. Seismic restraint calculations signed and stamped by an engineer licensed in the State of California and experienced in the design of isolation and seismic restraint for flexibly mounted equipment.

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATOR TYPES

A. "RMS" shall be a laterally stable un-housed spring isolator. Spring, top plate, and baseplate assembly shall be welded. Mounting shall comply with all requirements stated in paragraph above.

B. "RMSG" shall be the same as "RMS" above, but shall include height saving brackets for attachment to the equipment frame or isolation base.

C. "RMSP-EQ" shall be the same as "RMS" above except that the spring shall be enclosed in a welded steel cylinder with uplift restraints for horizontal and vertical seismic control.

D. "RMLS-EQ" shall be the same as "RMS" above, and shall be equipped with a steel housing designed for seismic restraint and with vertical limit stops to prevent the equipment changing from its loaded height should it be necessary to remove a portion
of its weight. This housing may also be used as rigid blocking during rigging so that the installed height and the operating height of the isolated equipment remain the same. O.S.H.P.D. pre-approval # OPA-0029.

E. "RMLS-SB" shall be a steel frame constructed of structural wide flange members unless shown otherwise and shall be rectangular in shape. The depths of the steel members shall not be less than one tenth (1/10) of the longest span between base supports or designed for a maximum beam deflection of .005". If the latter method is used, submittals shall include calculations showing the necessary moment of inertia. All steel members shall be coped and fitted, or constructed using the overlap insert method to assure a structural strength that is greater than the individual member strength. The steel frame is placed directly on top of the RMLS-EQ type isolators. O.S.H.P.D. Pre-approved isolator/seismic restraints.

F. "RMU-EQ-SH": shall be an individual semi-housed steel spring isolator complete with vertical motion limit stops incorporating seismic restraints, leveling, and ribbed neoprene pad bonded to the base-plate. O.S.H.P.D. pre-approval # OPA-0098.

G. "AS" shall be air spring isolators and shall incorporate the following:
   1. A complete vibration isolation system consisting of a minimum of three air springs and a total of three height sensing valves. If there are two or more air springs per location, they shall be connected to the outlet of the height control valve in parallel. An associated interconnecting air supply system is required which is not included in this work.
   2. The air spring shall operate at its normal operating height and the maximum pressure shall not exceed the manufacturer's recommended rating of 100 PSI. The system shall maintain an elevation of +/- 1/8", once adjusted.
   3. The type air spring to be utilized shall be based upon the required natural frequency as indicated in the schedule. In order to avoid instability, auxiliary height saving brackets, housings, etc. may be utilized, subject to approval.

H. "RP-EQ" shall be a rubber pad type elastomer mounting, consisting of a steel bearing plate with 1/4" thick neoprene ribbed acoustical pad. Maximum loading shall be 60 PSI. Proper anchorage for seismic loads shall be indicated on drawings.

I. FUD-EQ shall be rubber-in-shear isolators incorporating mounting bolts for bolting to equipment base, a bottom steel plate for bolting isolator to sub base or structure, and built in seismic restraints.

J. "RMXA" shall be a rectangular steel housing that shall be bolted to the overhead structure and designed to allow up to 30 degrees rod misalignment. Hanger shall consist of a steel spring located in a molded neoprene retaining cup with hanger rod bushing.

K. "PRMXA" - Same as type "RMXA" with the addition of a steel load transfer plate so that the equipment or piping operating height is the same as the installed height.

L. "HXA" -Same as type "RMXA" with the addition of a neoprene element in series to isolate the upper connection.

M. "PHXA" - Same as type "HXA" with the addition of a steel load transfer plate so that the equipment or piping operating height is the same as the installed height.

N. "HSS" - shall be a 'rubber in shear' isolator element contained within a rectangular steel housing.
2.02 RAIL AND BASE TYPES

A. "RMR" spring rail isolator. Rails shall have springs of proper size and constant, installed between a continuous structural steel channel (upper member) and a continuous flat steel plate (bottom member) in such manner, quantity, and location that efficient uniform deflection and loading to the structure is assured. Rails shall be furnished with Vibrex hold down stabilizers to restrict excessive amplitudes. Cross bracing must be used when necessary for seismic stability.

B. "RMB" shall be the same as "RMR" above except that it shall be designed as an integral fan and motor base with an adjustable motor slide base.

C. "RMSR" shall be a set of wide flange structural steel rails supplied with height saving brackets to reduce the mounting height of the equipment. The maximum allowable deflection of any point on the loaded frame relative to the unloaded frame shall be 0.005". A wide flange section depth greater than 1/10 the supporting span between isolators will be accepted as satisfying the deflection requirement.

D. "RMSB" shall be a steel frame constructed of structural wide flange members unless shown otherwise and shall be rectangular in shape. The depths of the steel members shall not be less than one tenth (1/10) of the longest span between base supports or designed for a maximum beam deflection of .005". If the latter method is used, submittals shall include calculations showing the necessary moment of inertia. All steel members shall be coped and fitted, or constructed using the overlap insert method to assure a structural strength that is greater than the individual member strength. Adjustable motor slide bases shall be included when required for centrifugal fan applications. The steel bases shall have an operating clearance of one (1") inch above the supporting structure. Where bases are used to mount pumps, the bases shall be large enough to support the pipe elbows if required.

E. "RMSBI" shall be a steel frame inertia base with all welded members and constructed of structural channel shapes. The base shall be designed for a thickness or inertia mass to equipment weight ratio as shown on the schedule with a minimum thickness of six (6") inches. The bases shall include a template and anchor bolts to anchor the equipment. Inertia bases shall have 1/2" (#4) rebar spaced a maximum of 12" on centers in each direction and located 1-1/2" from the bottom of the base. Adjustable motor slide bases shall be included when required for centrifugal fan applications. Bases shall be supplied with height saving brackets to reduce the mounting height of the equipment.

F. "RMUAB-EQ" shall be a steel frame made of structural angle with type “RMU-EQ-SH” O.S.H.P.D. pre-approved combination isolator/restraints.

G. "RMLSR" shall be a set of multiple wide flange structural steel rails supplied with type RMLS-EQ vibration isolator/seismic restraints and height saving brackets to reduce the mounting height of the equipment. The maximum allowable deflection of any point on the loaded frame relative to the unloaded frame shall be 0.005". A wide flange section depth greater than 1/10 the supporting span between isolators will be accepted as satisfying the deflection requirement.

H. Type "RMLSB" shall be a steel frame constructed of structural wide flange members unless shown otherwise and shall be rectangular in shape. The depths of the steel members shall not be less than one tenth (1/10) of the longest span between base supports or designed for a maximum beam deflection of .005". If the latter method is used, submittals shall include calculations showing the necessary moment of inertia. All steel members shall be coped and fitted, or constructed using the overlap insert...
method to assure a structural strength that is greater than the individual member strength. Frame shall be supplied complete with height saving brackets and type RMLS-EQ, O.S.H.P.D. pre-approved isolator/seismic restraints.

1. Type RMLS-SB is the same as type “RMLSB” but rather than utilizing height saving brackets the steel frame is placed directly on top of the RMLS-EQ type isolators.

2.03 CURB TYPES

A. Type "VIC-EQ-SS" shall be a factory fabricated combination roof mounting curb and vibration isolation base for rooftop package units over 25 tons. The curb assembly shall be designed so that it can be re-roofed without disturbing the HVAC equipment. Curbs must be designed so that roofing material cannot cover access to isolators. The vibration isolation portion of the assembly shall be constructed of structural steel and designed to mate with the bottom of the rooftop unit. System shall include factory fabricated duct supports and any required bracing welded in place. The sheet metal weather proofing curb portion shall be supplied complete with a wood-nailerstrip to facilitate flashing by the roofing contractor. Internal vibration isolator/seismic restraints shall be OSHPD pre-approved number OPA-0029 as manufactured by MW Sausse' & company, inc. Required anchorage calculations shall be supplied with submittal package. When required, curb shall include an optional acoustical package for sound reduction.

B. Type "VIC-EQ" shall be a factory fabricated combination roof mounting curb and vibration isolation base for rooftop package units up to 20 tons. Steel members and cross bracing shall all be welded. The assembly shall be shipped and installed in one piece complete with curb, weather-seal, removable OSHPD pre-approved isolator/restraints #OPA-0098, exterior accessible leveling device, and minimum 14 gage galvanized steel top section to match the unit. Curb shall be fabricated of minimum 12 gage galvanized steel designed to carry the seismic loads to the supporting structure. System shall include factory fabricated duct supports welded in place as well as insulated panels when required. Required anchorage and lower curb structural calculations shall be supplied with submittal package. When required, curb shall include an optional acoustical package for sound reduction. Curb shall be manufactured to match roof slope if specified in drawings.

2.04 SEISMIC RESTRAINTS

A. Shall be capable of safely accepting external forces as specified in the applicable codes without failure. Restraints shall maintain equipment, duct, and piping in a captive position during an earthquake. Restraints shall not short circuit vibration isolation systems or transmit objectionable vibration or noise under normal operating conditions. Seismic restraints shall be provided on all equipment as scheduled on the drawings. Submit calculations by a Licensed Structural Engineer Registered in State of California to verify snubber capacities.

B. Type "3500" seismic restraint shall be constructed of steel plate, concentric steel pipes, and structural members in an all welded assembly. All contact points shall be cushioned with minimum 1/4" thick resilient pad. Restraints shall be O.S.H.P.D pre-approved type OPA-0029.

C. Type "3200" seismic restraint shall be all directional type with interlocking steel members constructed of structural angle and A-36 threaded rod. All contact points shall
PART 3 - EXECUTION

3.01 GENERAL

A. Install in accordance with manufacturer's written instructions. Vibration isolators must not be installed in a manner that will result in piping stress or misalignment.

B. The structural steel or concrete inertia base shall be placed in position and supported temporarily by blocks or shims, as appropriate, prior to the installation of the equipment or isolators. The isolators shall be installed without raising the equipment and frame assembly.

C. After the entire installation is complete and under full operational load, the isolator shall be adjusted so that the load is transferred from the blocks or shims to the isolator. When all isolators are properly adjusted, the blocks or shims shall be barely free and shall be removed.

D. Once the equipment is in operation, install and anchor the seismic restraints with proper operating clearances as indicated on drawings.

E. HVAC equipment shall be isolated from the building structure by vibration isolators as scheduled on the drawings.

F. All piping 1 1/4" and over located in mechanical equipment rooms, and for a minimum of fifty (50) feet or 100 pipe diameters whichever is greater, from connection to vibrating mechanical or electrical equipment, shall be isolated from the building structure by means of vibration isolators as identified above.

G. All HVAC piping and vertical risers shall be isolated from the building structure by means of vibration isolators and guides.

H. All piping and ductwork to be isolated shall freely pass through walls and floors without contact. Penetration points shall be sleeved or otherwise formed to allow passage of piping or ductwork and maintain adequate clearance (Minimum of 2 inches all around) around the outside surfaces. Any materials used to fill the clearance space shall be permanently flexible so that vibration will not pass through it.

I. No rigid connections between equipment and building structure, including electrical conduit and refrigerant lines, shall be made that degrades the vibration isolation system herein specified. Inform other following trades, such as plastering, or electrical, to avoid any contact which would short-circuit the vibration isolation.

J. Bring to the Architect's attention prior to installation any conflicts with other trades which will result in unavoidable rigid contact with equipment or piping as described herein, due to inadequate space or other unforeseen conditions. Corrective work necessitated by conflicts after installation shall be at the contractor's expense.

K. Bring to the Architect's attention any discrepancies between the specifications and field conditions or changes required due to specific equipment selection, prior to installation.
Corrective work necessitated by discrepancies after installation shall be at the contractor's expense.

L. Obtain inspection and approval of any isolation installation to be covered or enclosed, prior to such closure.

M. Thrust restraints shall consist of spring hangers with the same deflection as specified for the spring mountings. Thrust restraints shall be attached to the fan at the centerline of air discharge opening.

N. Correct, at no additional cost, all installations that are deemed defective in workmanship or materials.

3.02 PIPING ISOLATORS

A. All piping except fire standpipe systems are included under this section.

B. Isolate piping within 50 feet of rotating equipment and pressure reducing stations.

C. The isolators shall be installed with the isolator hanger box attached to, or hung as close as possible to, approved locations on the supporting structure.

D. The isolators shall be suspended from substantial structural members, not from slab diaphragm unless specifically permitted.

E. Hanger rods shall be aligned to clear the hanger box.

F. Horizontal floor supported piping shall be isolated by type "RMLS-EQ", with a minimum static deflection of 1.0 inch or the same deflection as isolated equipment to which pipe is connected, whichever is greater.

G. Vertical riser pipe support and restraint system shall consist of type "RMS" springs and type "PG-EQ" guides. Install vertical riser guides so that clearances are maintained around concentric pipes in the guides. Install vertical restraints on the floor location as shown on drawings.

H. Pipe anchors, where required, shall utilize resilient pipe anchors, type "RPA" or equivalent, to avoid direct contact of piping with building.

I. Pipe Extension and Alignment connectors: Provide connectors at pump suction and discharge, riser take offs, cooling and heating coils, and elsewhere as required to accommodate thermal expansion and misalignment.

J. Seismic restraint spacing shall be in accordance with applicable codes.

3.03 INSPECTION

A. On completion of installation of all vibration isolation and seismic control devices herein specified, the local representative of the isolation materials manufacturer shall inspect the completed system and report in writing any installation error, improperly selected isolation devices, or other faults in the system that could affect the performance of the system. The contractor shall submit a report to the Architect, including the above report with consequent steps taken to properly complete the isolation work.

END OF SECTION 23 0548
SECTION 23 0553
HVAC IDENTIFICATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Extent of HVAC identification work required by this section is indicated on drawings or specified in other Division-23 sections, and includes the following:
   1. Painted Identification Materials;
   2. Plastic Pipe Markers;
   3. Plastic Tape;
   4. Underground-Type Plastic Line Marker;
   5. Plastic Duct Markers;
   6. Valve Tags;
   7. Diagram and Schedule Frames;
   8. Engraved Plastic-Laminate Signs;
   9. Plastic Equipment Markers;
   10. Plasticized Tags.

1.02 RELATED SECTIONS

A. This section is part of each Division-23 section making reference to identification devices specified herein.
B. HVAC identification furnished as part of factory-fabricated equipment is specified as part of equipment assembly in other Division-23 sections.
C. Refer to Division-26 Sections for identification requirements of electrical work; not work of this section.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.
B. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.
C. Schedules and Diagrams:
   1. Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule.
   2. Submit temperature control diagrams and Sequence of Operation on bond paper suitable for framing.
D. Maintenance Data: Include product data and schedules in maintenance manuals; in accordance with requirements of Division 1 and Division-23 Section 23 0511 "Supplementary HVAC Requirements".

1.04 QUALITY ASSURANCE
A. Codes and Standards:
   1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
   2. No adhesive type identification markers will be accepted. All markers and tags shall be permanently attached to pipe, etc.
   3. All identification markers installed exterior of buildings shall be ultra-violet resistant.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide HVAC identification materials of one of the following:
   1. Allen Systems, Inc.
   3. Industrial Safety Supply Co., Inc.
   4. Seton Name Plate Corp.

2.02 HVAC IDENTIFICATION MATERIALS

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division-23 sections. Where more than single type is specified for application, selections is Installer's option, but provide single selection for each product category.

2.03 PLASTIC PIPE MARKERS

A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1.

B. Insulation: Furnish 1" thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subject to fluid temperatures of 125°F (52°C) or greater. Cut length to extend 2" beyond each end of plastic pipe marker.

C. Small Pipes: For external diameters less than 6" (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
   1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
   2. Laminated or bonded application of pipe marker to pipe (or insulation).
   3. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4" wide; full circle at both ends of pipe marker, tape lapped 1-1/2".

D. Large Pipes: For external diameters of 6" and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:
   1. Laminated or bonded application of pipe marker to pipe (or insulation).
   2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2" wide; full circle at both ends of pipe marker, taped lapped 3".
   3. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.
E. Lettering: Manufacturer’s standard pre-printed nomenclature which best describes piping system in each instance, as selected by Architect/Engineer in cases of variance with names as shown or specified.

1. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as a separate unit of plastic.

2.04 PLASTIC TAPE

A. General: Provide manufacturer’s standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.

B. Width: Provide 1-1/2” wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6”, 2-1/2” wide tape for larger pipes.

C. Color: Comply with ANSI A13.1, except where another color selection is indicated.

2.05 UNDERGROUND-TYPE PLASTIC LINE MARKER

A. General: Manufacturer’s standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6” wide x 4 mils thick. Provide tape with printing which most accurately indicates the type of service of buried pipe.

1. Provide multi-ply tape consisting of solid aluminum foil core between 2-layers of plastic tape.

2.06 VALVE TAGS

A. Brass Valve Tags: Provide 19-gage polished brass valve tags with stamped-engraved piping system abbreviation in 1/4” high letters and sequenced valve numbers 1/2” high, and with 5/32” hole for fastener.

1. Provide 1-1/2” diameter tags, except as otherwise indicated.
2. Fill tag engraving with black enamel.

B. Valve Tag Fasteners: Provide manufacturer’s standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

C. Access panel markers: Provide manufacturer’s standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

D. Access Panel Markers: Provide manufacturer’s standard 1/16” thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8” center hole to allow attachment.

2.07 DIAGRAM AND SCHEDULE FRAMES

A. General: For each page of schedule and/or diagrams, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

2.08 ENGRAVED PLASTIC-LAMINATE SIGNS
A. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver’s standard letter style of the sizes and wording indicated, white with black core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

B. Thickness: 1/16" for units up to 20 sq. in. or 8" length; 1/8" for larger units.

C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.09 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations and other designations used in HVAC identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of HVAC systems and equipment.

1. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Boiler No. 3, Air Supply No. 1H, Standpipe F12).

2.10 EQUIPMENT MARKERS

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.

1. Data:
   a. Manufacturer, product name, model number, and serial number.
   b. Capacity, operating and power characteristics, and essential data.
   c. Labels of tested compliances.

2. Location: Accessible and visible.

3. Fasteners: As required to mount on equipment.

B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.

1. Terminology: Match schedules as closely as possible.
2. Data.
3. Name and plan number.
   a. Equipment service.
   b. Design capacity.
   c. Other design parameters such as pressure drop, entering and leaving conditions, and speed.

4. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine sub-core, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.

1. Data: Instructions for operation of equipment and for safety procedures.
2. Engraving: Manufacturer’s standard letter style, of sizes and with terms to match equipment identification.
3. Retain and edit subparagraph above or first subparagraph below.
4. Thickness: 1/16 inch for units up to 20 sq. in. or 8 inches in length, and 1/8 inch for larger units.
5. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

D. Access Panel and Door Markers: 1/16-inch thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.
   1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.11 PLASTIC DUCT MARKERS

A. Engraved, color-coded laminated plastic. Include direction and quantity of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finishes, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.02 PIPING SYSTEM IDENTIFICATION

A. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:
   1. Plastic pipe markers, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot-non-insulated pipes.

B. Locate pipe markers as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.
   1. Near each valve and control device.
   2. Near each branch; mark each pipe at branch, where there could be question of flow pattern.
   3. Near locations where pipes pass through walls, floors ceilings, or enter non-accessible enclosures.
   4. At access doors, manholes similar access points which permit view of concealed piping.
   5. Near major equipment items and other points of origination and termination.
   6. Spaced intermediate at maximum spacing of 50’ along each piping run, except reduce spacing to 25’ in congested areas of piping and equipment.
   7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.
3.03 UNDERGROUND PIPING IDENTIFICATION

A. General: During back-filling/top-soiling of each exterior underground piping systems, except sanitary sewer and storm drainage install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16", install single line marker.

3.04 VALVE IDENTIFICATION

A. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units. List each tagged valve on valve schedule for each piping system.

B. Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by Architect/Engineer.

3.05 HVAC EQUIPMENT IDENTIFICATION

A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of HVAC equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:

1. Fuel-burning units including boilers, furnaces, heaters.
2. Pumps, compressors, chillers, condensers and similar motor-driven units.
3. Fans and blowers.
4. Packaged HVAC central-station or zone-type units.
5. Split air conditioner indoor and outdoor units
6. Single Duct terminal units and all equipment in ceiling space.
7. (In addition to the equipment tag, install an identification tag for VAV units in locations approved by architect to indicate where each unit is installed above the ceiling. Coordinate the Installation location, type, size and color of this tag with the architect.)

B. Lettering Size: Minimum 1/4" high lettering for name of unit where viewing distance is less than 2'-0", 1/2" high for distances up to 6'-0", and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering.

C. Test of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

3.06 ADJUSTING AND CLEANING

A. Adjusting: Relocate any HVAC identification device which has become visually blocked by work of this division or other divisions.

B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

END OF SECTION 23 0553
PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives and measurement and reporting of sound and vibration levels, including the following:

1. Balancing airflow and water flow within distribution systems, including sub-mains, branches, and terminals, to indicated quantities according to specified tolerances.
2. Test, adjust and balance hydronic system based on the requirements of the existing variable flow chilled and heating water systems.
3. Adjusting total HVAC systems to provide indicated quantities.
5. Setting quantitative performance of HVAC equipment.
6. Verifying that automatic control devices are functioning properly.
7. Reporting results of the activities and procedures specified in this Section.

B. Related Sections include the following:

1. Testing and adjusting requirements unique to particular systems and equipment are included in the Sections that specify those systems and equipment.
2. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment Sections.

1.03 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including sub-mains, branches, and terminals, according to design quantities.

C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

E. Report Forms: Test data sheets for recording test data in logical order.

F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
K. Test: A procedure to determine quantitative performance of a system or equipment.
L. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.
N. T&B: Testing, adjusting, and balancing
O. T&B Agency: An independent entity certified by AABC to perform testing and balancing work.
P. TBE: AABC certified test and balance engineer.
Q. TBT: AABC certified test and balance technician.
R. HVAC: Heating, ventilating, and air conditioning.
S. BAS: Building automation systems.
T. Contract documents: the mechanical drawings and test and balance specification
U. NC: noise criteria
V. RC: room criteria
W. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.04 SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation T&B of AABC certification of T&B agency and personnel, including a sample copy of the AABC "National Performance Guaranty." If not submitted within the timeframe specified, the engineer has the right to choose an AABC agency at the Contractor's expense.
B. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit T&B strategies and step-by-step procedures as specified in "Preparation" Article. Include a complete set of report forms intended for use on this Project.
C. System Readiness Checklists: Within 60 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article to be used and filled out by systems Installers verifying that systems are ready for T&B.
D. Examination Report: Within 60 days of Contractor's Notice to Proceed, provide a summary report of the examination review required in Part 3 "Examination", if issues are discovered that may preclude the proper testing and balancing of the systems.
E. Certified T&B reports: Within 14 days of completion of balancing work, submit AABC-certified T&B report.
   1. Submit one copy of the final T&B Report directly to the design professional of record. Provide five additional copies to the contractor.
F. Warranty: Submit 6 copies of special warranty specified in the "Warranty" Article below.

G. Provide a summary of any discrepancies found in the system, by Air balance contractor to each system as described hereafter. Include a complete list of deficiencies and problems found in system being tested and balanced. Add this report to final submittal package.

1.05 QUALITY ASSURANCE

A. T&B Agency Qualifications: Engage a T&B entity certified by AABC.
   1. T&B Field Supervisor: Employee of the T&B Agency who is certified by AABC.
   2. T&B Technician: Employee of the T&B Agency and who is certified by AABC as a TBT.

B. Testing, Adjusting, and Balancing Conference: Meet with the Owner's and the Architect's representatives on approval of the testing, adjusting, and balancing strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of testing, adjusting, and balancing team members, equipment manufacturers' authorized service representatives, HVAC controls Installer, and other support personnel. Provide 7 days' advance notice of scheduled meeting time and location.
   1. Agenda Items: Include at least the following:
      a. Submittal distribution requirements.
      c. Testing, adjusting, and balancing plan.
      d. Work schedule and Project site access requirements.
      e. Systems readiness checklists.
      f. Coordination and cooperation of trades and subcontractors.
      g. Coordination of documentation and communication flow.

C. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:
   1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
   2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.

D. Testing, Adjusting, and Balancing Reports: Use standard forms from AABC "National Standards for Testing, Adjusting, and Balancing."

E. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards.

F. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.06 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire T&B period. Cooperate with Owner during T&B operations to minimize conflicts with Owner's operations.
B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during T&B operations to minimize conflicts with Owner’s operations.

1.07 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.

B. Notice: Provide 7 days advance notice for each test. Include scheduled test dates and times.

C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

D. Review Division 23 contract documents to assure that the design has considered all required components necessary for a complete and successful testing, adjusting and balancing of the system as described hereafter. Prepare a report for this examination of contract documents and propose any additional components required to complete the scope of work this section no later than 45 days after the award of the contract.

1.08 WARRANTY

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

B. National Project Performance Guarantee: Provide a guarantee on AABC “National Standards” forms stating that AABC will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:

1. The certified Agent has tested and balanced systems according to the Contract Documents.

2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 -PRODUCTS (Not Applicable)

PART 3 -EXECUTION

3.01 EXAMINATION

A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems’ designs that may preclude proper testing, adjusting, and balancing of systems and equipment.

   1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.

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.
1. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation. Note the locations of devices that are not accessible for testing and balancing.

C. Examine approved submittal data of HVAC systems and equipment.

D. Examine project record documents described in Division 1 Section "Project Record Documents.

E. Examine ceiling plenums and under-floor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, clean permanent filters are installed, and equipment with functioning controls is ready for operation.

G. Examine Architect's and Engineer's 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.

H. Examine equipment performance data, including fan and pump curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

I. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.

J. Examine system and equipment test reports.

K. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

L. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

M. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

N. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected, configured by the controls contractor, and functioning.

O. Examine strainers to verify that mechanical contractor has replaced startup screens with permanent screens and that all strainers have been cleaned.

P. Examine 2-way valves for proper installation for their intended function.
Q. Examine 3-way valves for proper installation for their intended function of diverting or mixing fluid flows.

R. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

S. Examine air vents to verify that mechanical contractor has removed all air from all hydronic systems.

T. Examine equipment for installation and for properly operating safety interlocks and controls.

U. Prior to examination of the vibration isolation system, verify that all system and equipment installations are complete and that testing, adjusting, and balancing specified in the contract documents have been performed.

V. Examine all vibration isolation system. All vibration isolated equipment and piping must be inspected and examined before startup and shall include the following:

1. Verify that all isolators are installed in accordance with manufacturer’s recommendations.

2. Verify that piping, duct, and conduit penetrations through mechanical equipment room envelope are sealed, and if required, rigid contact with building structure does not exist.

3. Steel isolation bases must be inspected for cracked welds, excessive bending or twisting of steel members.

4. Concrete isolation bases must be examined for cracked concrete. Isolator retainer brackets must be checked for looseness. The concrete base must be flat and true in plane.

5. Elastomer isolators must be examined for cracks in the rubber and for loose bonds between the rubber and steel plates or other steel components. Adequate clearance must be provided between bolts and the side of the bolt holes to prevent short-circuiting.

6. Steel spring isolators must be examined for loose or missing bolts, nuts or lock washers. Check for spring overloading or underloading, completely collapsed spring coils, and cocked springs. Note if rubber or glass fiber pad between the bottom plate of the steel spring and the concrete slab or supporting structure is present.

7. Housed steel springs must be examined for proper centering of the springs, clearance between the cast housing and rubber snubber, and the steel spring for tilted or cocked springs.

8. When the specifications require that the isolators be bolted to the concrete slab or other supporting structure, the bolts may be isolated by means of rubber bushings and rubber washers.

9. Inspect isolators with restraint devices to make sure that all shims have been removed and supportive nuts have been properly adjusted to allow for free floating of the isolated system.

10. Seismic restraints shall not prevent the proper functioning of vibration isolation system.

11. Pneumatic isolators must be inspected for overload or underload by checking the air pressure gauge against manufacturer’s submittals or catalog. The pneumatic isolator system should include the isolator, strainer, oil separator, height regulator, and air pressure gauge. Inspect the vicinity of the isolator. Note if the isolator is exposed to damage from vehicle or other traffic.

12. Carefully inspect the space under all isolated bases to assure that these spaces are clean and free of debris to prevent short-circuiting.
13. Check to ensure that all shipping bolts associated with spring isolators have been removed.
14. Inspect all flexible piping, hoses, and expansion joints as to type, length and location as called for by the specifications. Examine flexible hose for excessive elongation.
15. Inspect all electrical and control connections to ensure that they do not restrain the movement of the vibration isolated equipment.
16. Inspect all fabric connections between fans and ductwork to ensure that a fabric "bellows" exists when the fans are operating.
17. Each piece of vibration isolated machinery must be free of any structural tie or rigid connection that may "short circuit" the isolation system. All limit stops, shipping bolts, and leveling bolts on all isolators must be inspected to ensure that they are not "short circuiting" the isolation system.
18. Hanger isolators should be free of misalignment and over / under loading. Under no circumstances the isolator rod should be allowed to make rigid contact with the hanger housing.
19. Report deficiencies as discovered to the appropriate parties.

W. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices operate by the intended controller.
2. Dampers and valves are in the position indicated by the controller.
3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multi-zone units, mixing boxes, and variable-air-volume terminals.
4. Automatic modulating and shutoff valves, including 2-way valves, are properly connected.
5. Thermostats are located to avoid adverse effects of sunlight, drafts, and cold walls.
6. Sensors are located to sense only the intended conditions.
7. Sequence of operation for control modes is according to the Contract Documents.
8. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to design values.

X. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.02 PREPARATION

A. Prepare a testing, adjusting, and balancing plan that includes strategies and step-by-step procedures that includes the following:

1. Equipment and systems to be tested.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Prepare system-readiness checklists, as described in the "AABC National Standards for Total System Balance," for use by systems installers in verifying system readiness for T&B. These shall include, at a minimum, the following:

1. Airside:
a. Ductwork is complete with terminals installed.
b. Volume, smoke and fire dampers are open and functional.
c. Clean filters are installed.
d. Fans are operating, free of vibration, and rotating in correct direction.
e. Variable-frequency controllers' start-up is complete and safeties are verified.
f. Automatic temperature-control systems are operational.
g. Ceilings are installed.
h. Windows and doors are installed.
i. Suitable access to balancing devices and equipment is provided.

2. Hydronics:
   a. Piping is complete with terminals installed.
   b. Water treatment is complete.
   c. Systems are flushed, filled and air purged.
   d. Strainers are pulled and cleaned.
   e. Control valves are functioning per the sequence of operation.
   f. Shutoff and balance valves have been verified to be 100 percent open.
   g. Pumps are started and proper rotation is verified.
   h. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
   i. Variable-frequency controllers' start-up is complete and safeties are verified.
   j. Suitable access to balancing devices and equipment is provided.

3. General
   a. Permanent electrical power wiring is complete.
   b. Equipment and duct access doors are securely closed.

3.03 GENERAL TESTING AND BALANCING PROCEDURES
A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" and in this Section.
B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for T&B procedures.
C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS
A. Prepare test reports for both fans and outlets. Obtain approved submittals and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
B. Prepare single-line schematic diagram of systems "as-built" for the purpose of identifying HVAC components.
C. For variable-air-volume systems, develop a plan to simulate diversity.
D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
F. Verify that motor starters are equipped with properly sized thermal protection.
G. Check condensate drains for proper connections and functioning.
H. Check for proper sealing of air-handling-unit components.
I. Check the airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
J. Check dampers for proper position to achieve desired airflow path.
K. Check for airflow blockages.

3.05 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
1. Measure total airflow.
   a. Set outside air, return air and relief air dampers for proper position that simulates minimum outdoor air conditions.
   b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
   c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
   d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:
   a. Measure static pressure directly at the fan outlet or through the flexible connection.
   b. Measure static pressure directly at the fan inlet or through the flexible connection.
   c. Measure static pressure across each component that makes up the air-handling system.
   d. Report any artificial loading of filters at the time static pressures are measured.

3. 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. Adjust volume dampers for main duct, sub-main ducts, and major branch ducts to indicated airflows.
1. Measure airflow of sub-main and branch ducts.
2. Adjust sub-main and branch duct volume dampers for specified airflow. Re-measure each sub-main and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.
1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure airflow at all inlets and outlets.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after all have been adjusted.
D. Verify final system conditions.
   1. Re-measure and confirm minimum outdoor air, return and relief airflows are within design. Readjust to design if necessary.
   2. Re-measure and confirm total airflow is within design.
   3. Re-measure all final-fan operating data, RPMs, volts, amps, static profile.
   4. Mark all final settings.
   5. Test system in economizer mode. Verify proper operation and adjust, if necessary.
   6. Measure and record all operating data.
   7. Record final fan-performance data.

3.06 FUNDAMENTAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Obtain approved submittals and any manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
   1. Check liquid level in expansion tank.
   2. Check that makeup water has adequate pressure to highest vent.
   3. Check that control valves are in their proper position.
   4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
   5. Verify that motor starters are equipped with properly sized thermal protection.
   6. Check that air has been purged from the system.

3.07 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Adjust pumps to deliver total design GPM.
   1. Measure total water flow.
      a. Position valves for full flow through coils.
      b. Measure flow by main flow meter, if installed.
      c. If main flow meter is not installed determine flow by pump total dynamic head (TDH) or exchanger pressure drop.
   2. Measure pump TDH as follows:
      a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
      b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
      c. Convert pressure to head and correct for differences in gauge heights.
      d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
      e. With all valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

B. Adjust flow measuring devices installed in mains and branches to design water flows.
   1. Measure flow in main and branch pipes.
   2. Adjust main and branch balance valves for design flow.
   3. Re-measure each main and branch after all have been adjusted.

C. Adjust flow measuring devices installed at terminals for each space to design water flows.
   1. Measure flow at all terminals.
   2. Adjust each terminal to design flow.
   3. Re-measure each terminal after all have been adjusted.
   4. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
   5. Perform temperature tests after all flows have been balanced.

D. For systems with pressure-independent valves at the terminals:
   1. Measure differential pressure and verify that it is within manufacturer’s specified range.
   2. Perform temperature tests after all flows have been verified.

E. For systems without pressure-independent valves or flow measuring devices at the terminals:
   1. Measure and balance coils by either coil pressure drop or temperature method.
   2. If balanced by coil pressure drop, perform temperature tests after all flows have been verified.

F. Verify final system conditions as follows:
   1. Re-measure and confirm that total water flow is within design.
   2. Re-measure all final pumps’ operating data, TDH, volts, amps, static profile.
   3. Mark all final settings.

G. Verify that all memory stops have been set.

3.08 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

B. Adjust the variable-flow hydronic system as follows:
   1. Verify that the differential-pressure sensor is located per the contract documents.
   2. Determine if there is diversity in the system.

C. For systems with no diversity:
   2. Prior to verifying final system conditions, determine the system differential-pressure set point.
   3. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent
and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.

4. Mark all final settings and verify that all memory stops have been set.

D. For systems with diversity:
1. Determine diversity factor.
2. Simulate system diversity by closing required number of control valves, as approved by the design engineer.
4. Open control valves that were shut. Close a sufficient number of control valves that were previously open to maintain diversity, and balance the terminals that were just opened.
5. Prior to verifying final system conditions, determine the system differential-pressure set point.
6. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
7. Mark all final settings and verify that all memory stops have been set.

3.09 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

A. Follow general procedures for hydronic systems.
B. Balance the primary circuit flow first.
C. Balance the secondary circuits after the primary circuits are complete.

3.10 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:
1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop for major (more than 20 GPM) equipment coils, excluding unitary equipment such as reheat coils, unit heaters, fan-coil units, etc.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.

B. Measure, adjust, and record the following data for each electric heating coil:
1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:
1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:
3.11 TEMPERATURE TESTING

A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of 2 successive 8-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

3.12 PROCEDURES FOR VIBRATION MEASUREMENTS

A. Perform vibration measurements when other building and outdoor vibration sources are at a minimum level and will not influence measurements of equipment being tested.

1. Turn off equipment in the building that might interfere with testing.
2. Restrict people from occupying areas where human activity may affect accuracy of measurements.
3. Note all exterior vibration sources; i.e. trains, roadway traffic, adjacent construction activities, etc.

B. Attach and secure the vibration transducer in accordance with the latest edition of the AABCS&V Procedural Standards for Measurement of Sound and Vibration.

C. Measure and record, on all pumps and fans over 3 hp, and all chillers and compressors over 5 hp, at discrete frequencies or in 1/3 octave bands as follows:

1. Discrete vibration levels from 1 to 200 Hz in 1 Hz increments, or
2. In each 1/3 octave band from 12.5 Hz to 100 Hz.

D. Measure and record equipment vibration, bearing vibration, equipment base vibration, and on building structure adjacent to equipment. Record velocity and displacement readings in the radial vertical, radial horizontal and axial planes, where measurements can be performed safely.

1. Pumps:
   a. Pump Bearing: Drive end and opposite end.
   b. Motor bearing: Drive and opposite end.
   c. Pump Base: Top and side, within 6” of each isolator.
   d. Building: Floor adjacent to pump/motor, within 6” of each isolator.

2. Fans and HVAC Equipment with Fans:
   a. Fan Bearing: Drive end and opposite end.
   b. Motor Bearing: Drive and opposite end.
   c. Equipment Base: Top and side, within 6” of each isolator.
   d. Building: Floor adjacent to fan/motor, within 6” of each isolator.

3. Chillers and HVAC Equipment with Compressors:
   a. Compressor Bearing: Drive end and opposite end.
   b. Motor Bearing: Drive end and opposite end.
   c. Equipment Base: Top and side, within 6” of each isolator.
   d. Building: Floor adjacent to equipment, within 6” of each isolator.
E. Vibration Measurement Reports:
   1. Date and time of test
   2. Equipment designation, location, equipment speed, motor speed and motor horsepower.
   3. Measured acceleration (in units of g’s, inches/sec²), and measured velocity (in units of inches/sec) and measured displacement (in units of inches).

3.13 PROCEDURES FOR SOUND LEVEL MEASUREMENTS

A. Close windows and doors to the space.

B. Perform measurements when the space is not occupied, or when the occupant noise levels from other spaces in the building and outside are at a minimum, or do not affect sound readings.

C. Clear the space of temporary sound sources so unrelated disturbances will not be measured. Turn off all sound sources (personal computers, printers, fax machines, etc) in the space that may affect sound readings.

D. Position testing personnel during measurements to achieve a direct line-of-sight between the sound source and the sound-level meter.

E. Take sound measurements at a height approximately 48 inches above the floor and at least 36 inches from a wall, column, or any other large surface capable of altering the measurements.

F. Take sound measurements in dB (linear or flat), with the slow time constant, in the octave bands from 31.5 to 8000 Hz.

G. Take sound measurements with the HVAC systems off to establish the background levels and take sound measurements with the HVAC systems operating. Calculate the difference between measurements. Apply a correction factor depending on the difference and adjust measurements.

H. Perform sound testing in all occupied space horizontally and vertically adjacent to all mechanical equipment rooms and all mechanical chases.

I. Perform sound testing at 10% of locations on the project for each type of the following spaces. For each space type tested, select a measurement location that has the greatest anticipated sound level. If testing multiple locations for each space type, select at least one location that is near and at least one location that is remote from the predominant sound source.
   1. Private office.
   2. Open office area.
   3. Conference room.
   4. Auditorium/large meeting room/lecture hall.
   5. Classroom/training room.
   6. Library open space.
   7. Public areas (such as, lobbies, hallways, break rooms).
   8. Perform sound testing in all spaces with a design criterion of NC or RC 25 or less.

J. Sound Measurement Reports: Record sound measurements on appropriate test forms, indicating the decibel levels measured in for both “background” and “HVAC system operating” readings. Record each tested location on a separate NC or RC chart. Record the following on the forms.
1. Date and time of test.
2. Equipment operational parameters – speed / frequency at time of measurements.
3. Indoor measurements - space location within building including floor level and room / space number.
4. Outdoor measurements – location identifier such as location relative to equipment, building, or property line.
5. Indicate where measurements meet or exceed design criteria

3.14 CONTROL VERIFICATION

A. In conjunction with system balancing perform the following:
   1. Work with the temperature control contractor to ensure the system is operating within the design limitations, and gain a mutual understanding of intended control performance.
   2. Confirm that the sequences of operation are in compliance with the approved drawings. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.
   3. Verify that controllers are calibrated and function as intended.
   4. Verify that controller set-points are as specified.
   5. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).
   6. Verify the operation of lockout or interlock systems.
   7. Verify the operation of all valve and damper actuators.
   8. Verify that all controlled devices are properly installed and connected to the correct controller.
   9. Verify that all controlled devices travel freely and are in the position indicated by the controller: open, closed, or modulating.
   10. Verify the location and installation of all sensors to ensure they will sense only the intended temperatures, humidity, or pressures. Note conditions that would adversely affect control functions.
   11. Record controller settings and note variances between set points and actual measurements.
   12. Confirm interaction of electrically operated switch transducers.
   13. Verify main control supply-air pressure and observe compressor and dryer operations.
   14. Record voltages of power supply and controller output. Determine if the system operates on a grounded or non-grounded power supply.
   15. Note operation of electric actuators using spring return for proper fail-safe operations.

B. Reporting
   1. The report shall include a summary of verifications performed, remaining deficiencies, and any variations from specified conditions.

3.15 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:
   1. Supply, Return, and Exhaust Fans: Minus 10 to plus 10 percent.
   2. Fresh air intake: 0 to plus 5%.
   3. Air Outlets and Inlets: Minus 10 to plus 10 percent.
   4. Heating-Water Flow Rate: Minus 5 to plus 5 percent.
   5. Cooling-Water Flow Rate: Minus 5 to plus 5 percent.
B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.16 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article above, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.17 FINAL REPORT

A. General: Computer printout in letter-quality font, on standard bond paper, in a fine quality 3-ring binder, tabulated and divided into sections by tested and balanced systems.

B. The final report for sound and vibration measurement shall be in accordance with the requirements of the current edition of the AABC Procedural Standards for Measurement of Sound and Vibration.

C. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.

1. Include a list of the instruments used for procedures, along with proof of calibration.

D. Final Report Contents: In addition to the certified field report data, include the following:

1. Fan curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.

E. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:

1. Title page.
2. Name and address of testing, adjusting, and balancing Agent.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address and field technician responsible for the project.
9. Signature of testing, adjusting, and balancing Agent who certifies the report.
10. Summary of contents, including the following:
    a. Design versus final performance.
b. Notable characteristics of systems.
c. Description of system operation sequence if it varies from the Contract Documents.

11. Nomenclature sheets for each item of equipment.
12. Data for terminal units, including manufacturer, type size, and fittings.
13. Notes to explain why certain final data in the body of reports vary from design values.
14. Test conditions for fans and pump performance forms, including the following:
   a. Settings for outside-, return-, and exhaust-air dampers.
   b. Conditions of filters.
   c. Cooling coil, wet- and dry-bulb conditions.
   d. Face and bypass damper settings at coils.
   e. Fan drive settings, including settings and percentage of maximum pitch diameter.
   f. Inlet vane settings for variable-air-volume systems.
   g. Settings for supply-air, static-pressure controller.
   h. Other system operating conditions that affect performance.

F. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Balancing stations.

G. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data: Include the following:
   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. Sheave dimensions, center-to-center and amount of adjustments in inches.
   j. Number of belts, make, and size.
   k. Number of filters, type, and size.

2. Motor Data: Include the following:
   a. 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. Sheave dimensions, center-to-center and amount of adjustments in inches.

3. Test Data: Include design and actual values for the following:
   a. Total airflow rate in CFM.
   b. Total system static pressure in inches W.G.
   c. Fan rpm.
d. Discharge static pressure in inches W.G.

e. Filter static-pressure differential in inches W.G.

f. Preheat coil static-pressure differential in inches W.G.

g. Cooling coil static-pressure differential in inches W.G.

h. Heating coil static-pressure differential in inches W.G.

i. Outside airflow in CFM.

j. Return airflow in CFM.

k. Outside-air damper position.

l. Return-air damper position.

m. Vortex damper position.

H. Apparatus-Coil Test Reports: For apparatus coils, include the following:

1. Coil Data: Include the following:
   a. System identification.
   b. Location.
   c. Coil type.
   d. Number of rows.
   e. Fin spacing in fins per inch.
   f. Make and model number.
   g. Face area in sq. ft.
   h. Tube size in NPS.
   i. Tube and fin materials.
   j. Circuiting arrangement.

2. Test Data: Include design and actual values for the following:
   a. Airflow rate in CFM.
   b. Average face velocity in FPM.
   c. Air pressure drop in inches W.G.
   d. Outside-air, wet- and dry-bulb temperatures in deg F.
   e. Return-air, wet- and dry-bulb temperatures in deg F.
   f. Entering-air, wet- and dry-bulb temperatures in deg F.
   g. Leaving-air, wet- and dry-bulb temperatures in deg F.
   h. Water flow rate in GPM.
   i. Water pressure differential in feet of head or psig.
   j. Entering-water temperature in deg F.
   k. Leaving-water temperature in deg F.
   l. Refrigerant expansion valve and refrigerant types.
   m. Refrigerant suction pressure in psig.
   n. Refrigerant suction temperature in deg F.
   o. Inlet steam pressure in psig.

I. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data: Include the following:
   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. Sheave dimensions, center-to-center and amount of adjustments in inches.

2. Motor Data: Include the following:
   a. 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. Sheave dimensions, center-to-center and amount of adjustments in inches.
g. Number of belts, make, and size.

3. Test Data: Include design and actual values for the following:
a. Total airflow rate in CFM.
b. Total system static pressure in inches W.G.
c. Fan RPM.
d. Discharge static pressure in inches W.G.
e. Suction static pressure in inches W.G.

J. Round and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data: Include the following:
a. System and air-handling unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches W.G.
e. Duct size in inches.
f. Duct area in sq. ft.
g. Design airflow rate in CFM.
h. Design velocity in FPM.
i. Actual airflow rate in CFM.
j. Actual average velocity in FPM.
k. Barometric pressure in psig.

K. Air-Terminal-Device Reports: For terminal units, include the following:
1. Unit Data: Include the following:
a. System and air-handling unit identification.
b. Location and zone.
c. Test apparatus used.
d. Area served.
e. Air-terminal-device manufacturer.
f. Air-terminal-device number from system diagram.
g. Air-terminal-device type and model number.
h. Air-terminal-device size.
i. Air-terminal-device effective area in sq. ft.
2. Test Data: Include design and actual values for the following:
a. Airflow rate in CFM.
b. Air velocity in FPM.
c. Preliminary airflow rate as needed in CFM.
d. Preliminary velocity as needed in FPM.
e. Final airflow rate in CFM.
f. Final velocity in FPM.
g. Space temperature in deg F.

L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
1. Unit Data: Include the following:
a. System and air-handling unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flow-meter type.

2. Test Data: Include design and actual values for the following:
a. Airflow rate in CFM.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psig.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

M. Instrument Calibration Reports: For instrument calibration, include the following:

1. Report Data: Include the following:
a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.18 ADDITIONAL TESTS

A. Within 90 days of completing testing, adjusting, and balancing. Perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

C. Duct Leakage Testing:

1. Perform duct pressure/leakage testing on newly constructed ductwork.
2. Verify that proper test methods are used and that leakage rates are within specified tolerances per section 23 3113.
3. Report any deficiencies observed.

END OF SECTION 20 593
SECTION 23 0700

HVAC INSULATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Extent of HVAC insulation required by this section is indicated on drawings and schedules, and by requirements of this section, and includes the following:

1. Piping Systems Insulation:
   a. Fiberglass.
   b. Calcium Silicate.
   c. Flexible Unicellular.

2. Ductwork System Insulation:
   a. Fiberglass
   b. Flexible Unicellular.

3. Equipment Insulation:
   a. Fiberglass
   b. Calcium Silicate
   c. Flexible Unicellular.

4. Acoustical Insulation
   a. Fiberglass

1.02 RELATED SECTIONS

A. Refer to Division 23 Section "Supports and Anchors" for protection saddles, protection shields, and thermal hanger shields; not work of this section.

B. Refer to Division 23 Section "HVAC Identification" for installation of identification devices for piping, ductwork, and equipment; not work of this section.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of HVAC insulation. Submit schedule showing manufacturer's product number, K-value, thickness, and furnished accessories for each HVAC system requiring insulation.

B. Maintenance Data: Submit maintenance data and replacement material lists for each type of HVAC insulation. Include this data and product data in maintenance manual.

1.04 QUALITY ASSURANCE

A. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

B. As a minimum, insulation shall meet installed conductance as set forth in Title 24 California Code of Regulations (CCR) 2013 Building Energy Efficiency Standards or as indicated in contract documents, whichever is greater.

1.05 DELIVERY, STORAGE, AND HANDLING
A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:

1. Armstrong World Industries, Inc.
2. CertainTeed Corp.
3. Knauf Fiber Glass GmbH.
4. Manville Products Corp.
5. Owens-Corning Fiberglas Corp.
6. Rubatex Corp.

2.02 PIPING INSULATION MATERIALS


B. Calcium Silicate Piping Insulation: ASTM C533, Type I. Owens-Corning Fiberglass Corp. "Kaylo Asbestos Free" or equivalent.

C. Flexible Unicellular Piping Insulation: ASTM C534, Type I. Armstrong World Industries, Inc. or Rubatex Corp. meeting ASTM E-84 25/50 index.

D. Jackets for Piping Insulation: ASTM C921, Type I (Vapor Barrier) for piping with temperatures below ambient. (Type II (Water Vapor Permeable) for piping with temperatures above ambient. Type I may be used for all piping at Installer's option.

1. Encase pipe fittings insulation with one-piece pre-molded PVC fitting covers, fastened as per manufacturer's recommendations. Zeston PVC Insulated fitting covers or equivalent.

2. Encase exterior piping insulation with aluminum jacket with weather-proof construction.

E. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.

F. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.

G. All Insulation shall be U.L. listed showing flame spread not greater than 25, nor smoke greater than 50, per NFPA 90A.

2.03 DUCTWORK INSULATION MATERIALS

A. Flexible Fiberglass Ductwork Insulation: ASTM C553, Type I, Class B-2, Owens-Corning Fiberglas Inc. un-faced duct wrap insulation, Type 100 or equivalent.

1. Nominal thickness or equivalent to provide installed R-value as follows:
   a. 1.5" thick - Installed R = 4.2
b. 2.0" thick - Installed R = 5.6

B. Flexible Fiberglass Ductwork Insulation: ASTM C612, with ASTM C921 Type I vapor barrier jacket. Owens/Corning Fiberglas All Service Wrap Insulation, Type 100 or equivalent:
   1. Nominal thickness or equivalent to provide an installed R-value as follows:
      a. 1.5" thick - Installed R = 4.2
      b. 2.0" thick - Installed R = 5.6

C. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

D. Rooftop ductwork and ductwork that are not in conditioned space or indirectly conditioned spaces are to be insulated with material to achieve minimum installed R value equal to 8.0 to meet the 2013 Building Energy Efficiency Standards. For double wall rooftop ductwork see HVAC drawings.

E. Ductwork Insulation Compounds: Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

F. All Insulation shall be U.L. listed showing flame spread not greater than 25, nor smoke greater than 50, per NFPA 90A.

2.04 EQUIPMENT INSULATION MATERIALS

A. Flexible Fiberglass Equipment Insulation: ASTM C553, Type II, Class F-1, Owens-Corning Fiberglass, Inc., Type 701 1.5 lbs/Ft3.

B. Calcium Silicate Equipment Insulation: ASTM C533, Type I, Block; Owens/Corning Fiberglass, Inc., Kaylo Asbestos Free, U-Grooved block insulation.

C. Jacketing Material for Equipment Insulation: Provide canvas jacketing material, not less than 7.8 ounces per square yard, or metal jacket at Installer's option, except as otherwise indicated.

D. Equipment Insulation Compounds: Provide adhesives, cements, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.

E. Equipment Insulation Accessories: Provide staples, bands, wire, wire netting, tape corner angles, anchors and stud piping as recommended by insulation manufacturer for applications indicated.

F. All Insulation shall be U.L. listed showing flame spread not greater than 25, nor smoke greater than 50, per NFPA 90A.

2.05 ACOUSTICAL INSULATION

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which HVAC insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 HVAC PIPING SYSTEM INSULATION

A. Insulation Omitted: Omit insulation on the following:
   1. Hot piping within radiation enclosures
   2. Hot unions, flanges, strainers, flexible connections and expansion joints.

B. Cold Piping (40°F to ambient):
   1. Application Requirements: Insulate the following cold HVAC piping systems:
      a. HVAC chilled water supply and return piping.
      b. Air conditioner condensate drains piping.
   2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:
      a. Fiberglass: 1” thick for pipe sizes up to and including 4”, 1-1/2” thick for pipe sizes over 4”.
      b. Flexible Unicellular: 1/2” thick for pipe sizes up to 1-1/2” (A.C. condensate piping only).

C. Hot Low Pressure Piping (to 250°F):
   1. Application Requirements: Insulate the following hot low pressure HVAC piping systems (steam piping up to 15 psi, water piping up to 250°F (121°C).
      a. HVAC heating water supply and return piping.
   2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:
      a. Fiberglass: 1” thick for pipe sizes up to and including 1”, 1-1/2” thick for pipe sizes 1-1/2”; 2” thick for piping over 2”.

3.03 DUCTWORK SYSTEM INSULATION

A. Insulation Omitted:
   1. Do not insulate outside air and exhaust air ductwork unless otherwise indicated.
   2. Do not insulate exhaust air ductwork unless otherwise indicated.
   3. All ductwork specified to be insulated that is located in mechanical rooms, located on roofs, or where exposed in conditioned spaces or to weather shall be internally lined under Section 15891 "Metal Ductwork"; unless noted otherwise in these specifications or on the drawings.

B. Insulate the following with flexible fiberglass insulation, un-faced, 1.5” thickness unless otherwise noted. Firmly wrap insulation around duct work with all joints lapped a minimum of 2 inches. Secure insulation to ducts by means of 16 gauge soft-annealed galvanized wire spaced 12 inches on centers at loose ends.
   1. Warm air heating ductwork in concealed spaces, unless in ceiling plenum provide all service wrap insulation.
2. Return air ductwork in non-conditioned concealed spaces unless in ceiling supply plenum uses all service wrap insulation.
3. Return air ductwork located in return air ceiling plenums outside air ductwork supplying fan coil units.

C. Insulate the following with Flexible Fiberglass insulation with all service vapor barrier facing, 1.5" thickness unless noted otherwise.
1. HVAC hot/cold mixed air ductwork between fan discharge or HVAC unit discharge, and room terminal unit.
2. Outdoor air intake ductwork between air entrance and indoor fan inlet or indoor HVAC unit inlet.
3. Installation:
   a. Neatly wrap insulation around ducts with all joints tightly butted together.
   b. Seal transverse joints with vapor barrier facing tab overlapping all joints 2-inches and secure with vapor barrier adhesive or outward-clinch stapes on 4-inches centers.
   c. Seal longitudinal joints with 4-inch wide vapor barrier adhesive tape.
   d. Secure insulation to underside of ducts, 100 percent coverage, with ductwork insulation adhesive.
   e. In addition to adhesive, on underside of ducts 24-inches or greater in width, use mechanical fasteners on maximum 12-inch centers.
   f. Seal all penetrations of vapor barrier facing with vapor barrier mastic.

D. Insulate the following with Rigid Fiberglass Insulation, 2.0" thickness unless noted otherwise.
1. HVAC and unit housings not pre-insulated at the factory or where lining has been specifically omitted.
2. Installation: Fasten to ductwork with adhesive and pins per manufacturer's recommendations. Butt all joints and provide 16 gage corner angles at corners. Seal all joints with approved duct tape.

E. Contractor's Option: Contractor may provide duct liner as set forth in Section 15891, using equivalent installed "R" values; in lieu of external duct wrap or rigid insulation as specified above unless ductwork is specifically indicated as being unlined.

F. Hot Ductwork:
1. Application Requirements: Insulate range and hood exhaust ductwork with PABCO "Super Fire Temp" asbestos free, non-combustible fireproofing board.
   a. Provide 1 to 4 hour fire rating as indicated.
   b. Install per manufacturer's instructions.

3.04 EQUIPMENT INSULATION

A. Cold Equipment (Below Ambient Temperature):
1. Application requirements: Insulate the following cold equipment:
   a. Refrigeration equipment, including chillers, tanks and pumps.
   b. Drip pans under chilled equipment.
   c. Cold and chilled water pumps.
   d. Pneumatic water tanks.
2. Insulate each item of equipment specified above with one of the following types and thicknesses of insulation:
a. Fiberglass: 2" thick for cold surfaces above 35°F and 3" thick for surfaces 35°F and lower.

B. Hot Equipment (Above Ambient Temperature):
1. Application Requirements: Insulate the following hot equipment:
   a. Boilers (not pre-insulated at factory).
   b. Water heaters.
   c. Hot water expansion tanks.
   d. Hot water pumps.
2. Insulate each item of equipment specified above with one of the following types and thicknesses of insulation.
   a. Fiberglass: 2" thick, except 3" thick for low-pressure boilers and steam-jacketed heat exchangers.

C. Breeching and Stacks:
1. Application Requirements: Insulate the following breechings and stacks:
   a. Breechings between heating equipment outlet and stack or chimney connection, except for double wall or factory insulated breechings.

3.05 INSTALLATION OF PIPING INSULATION

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

B. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.

C. Install insulation materials with smooth and even surfaces. Insulated each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

D. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.

E. Maintain integrity of vapor barrier jackets on pipe insulation, and protect to prevent puncture or other damage.

F. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.

G. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.

H. Butt pipe insulation against pipe hanger insulation inserts. For hot pipes, apply 3" wide vapor barrier tape or band over the butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3" wide vapor barrier tape or band.

3.06 INSTALLATION OF DUCTWORK INSULATION

A. General: Install insulation products in accordance with manufacturer’s written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
B. Install insulation materials with smooth and even surfaces.
C. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
D. Maintain integrity of vapor barrier on ductwork insulation, and protect it to prevent puncture and other damage.
E. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated.
F. Lined Ductwork: Except as otherwise indicated, omit insulation on ductwork where internal insulation or sound absorbing linings have been installed.
G. Ductwork Exposed to Weather: Where external insulation has been specifically indicated, protect outdoor insulation from weather by installing outdoor protective finish or jacketing as recommended by manufacturer.
H. Corner Angles: Except for oven and hood exhaust duct insulation, install corner angles on external corners of insulation on ductwork in exposed finished spaces before covering with jacketing.

3.07 INSTALLATION OF EQUIPMENT INSULATION

A. General: Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.
B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gaping joints and excessive voids resulting from poor workmanship.
C. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.
D. Do not apply insulation to equipment, breechings, or stacks while hot.
E. Apply insulation using the staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.
F. Coat insulated surfaces with layer of insulating cement, trowel in workmanlike manner, leaving a smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.
G. Cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least 2". Apply over vapor barrier where applicable.
H. Do not insulate boiler manholes, hand-holes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.
I. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.
J. Equipment exposed to Weather: Protect outdoor insulation from weather by installation of weather-barrier mastic protective finish, or jacketing, as recommended by the manufacturer.
3.08 ACOUSTICAL INSTALLATION

A. Install within confines of roof curbs for roof mounted air handlers and air conditioning units, and elsewhere as indicated on drawings

B. Cut to fit snugly within curb and around duct at duct penetrations, 4" minimum thickness.

3.09 PROTECTION AND REPLACEMENT

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 23 0700
SECTION 23 1116

ESCUTCHEONS, DIELECTRIC FITTINGS, UNIONS AND STRAINERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This Section specifies piping specialties and installation methods common to more than one section of Division 23.

1.02 RELATED SECTIONS

A. This section applies to all piping systems specified in Division 23.
B. Valves are specified in a separate section and in individual piping system Sections of Division 23.
C. Fire Barrier Penetration Seals are specified in Section 22 1100.

1.03 SUBMITTALS

A. Refer to Division 01 and Section 23 0510 “Basic HVAC Requirements” for administrative and procedural requirements for submittals.
B. Product Data: Submit product data on the following items:
   1. Escutcheons
   2. Dielectric Unions and Fittings
   3. Mechanical Sleeve Seals
   4. Strainers

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect flanges, fittings, and specialties from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer Uniformity: Conform to the requirements specified in Basic Mechanical Requirements, under "Product Options."
B. Manufacturer: Subject to compliance with requirements, provide piping materials and specialties from one of the following:
   1. Pipe Escutcheons:
      a. McGuire
      b. BrassCraft
      c. Pasco
   2. Dielectric Waterway Fittings:
      a. Epco Sales, Inc.
      b. Victaulic Company of America
   3. Dielectric Unions:
"L" TOWER BUILDING  
SEISMIC AND CODE UPGRADES  
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a. Eclipse, Inc.  
b. Perfection Corp.  
c. Watts Regulator Co.

4. Strainers: 
a. Armstrong Machine Works  
b. Hoffman Specialty ITT; Fluid Handling Div.  
c. Metraflex Co.  
d. R-P&C Valve; Div. White Consolidated Industries, Inc.  
e. Spirax Sarco  
f. Trane Co.  
g. Victaulic Co. of America. (low pressure applications only).  
h. Watts Regulator Co.

5. Mechanical Sleeve Seals: 
a. Thunderline Corp.

2.02 PIPE AND FITTINGS

A. Refer to the individual piping system specification sections in Division 23 for specifications on piping and fittings relative to that particular system.

2.03 JOINING MATERIALS

A. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.

B. Brazing Materials: Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials appropriate for the materials being joined.

C. Soldering Materials: Refer to individual piping system specifications for solder appropriate for each respective system.

D. Gaskets for Flanged Joints: Gasket material shall be full-faced for cast-iron flanges and raised-face for steel flanges. Select materials to suit the service of the piping system in which installed and which conform to their respective ANSI Standard (A21.11, B16.20, or B16.21). Provide materials that will not be detrimentally affected by the chemical and thermal conditions of the fluid being carried.

2.04 PIPING SPECIALTIES

A. Escutcheons: Chrome-plated, stamped steel, hinged, split-ring escutcheon, with set screw. Inside diameter shall closely fit pipe outside diameter or outside of pipe insulation where pipe is insulated. Outside diameter shall completely cover the opening in floors, walls, or ceilings.

B. Unions: Malleable-iron, Class 150 for low pressure service and class 250 for high pressure service; hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.

C. Dielectric Unions: Provide dielectric unions with appropriate end connections for the pipe materials in which installed (screwed, soldered, or flanged), which effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion.

D. Dielectric Waterway Fittings: Electroplated steel or brass nipple, with an inert and non-corrosive, thermoplastic lining.
E. **Y-Type Strainers:** Provide strainers full line size of connecting piping, with ends matching piping system materials. Screens shall be Type 304 stainless steel, with 3/64” perforations at 225 holes per square inch.
   1. Provide strainers with 125 psi working pressure rating for low-pressure applications, and 250 psi pressure rating for high-pressure application.
   2. Threaded Ends, 2” and Smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with pipe plug.
   3. Threaded Ends, 2-1/2” and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.
   4. Flanged Ends, 2-1/2” and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.
   5. Butt Welded Ends, 2-1/2” and Larger for Low Pressure Application: Schedule 40 cast carbon steel body, bolted screen retainer with off-center blowdown fitted with pipe plug.
   6. Butt Welded Ends, 2-1/2” and Larger for High Pressure Application: Schedule 80 cast carbon steel body, bolted screen retainer with off-center blowdown fitted with pipe plug.
   7. Grooved Ends, 2-1/2” and Larger: Tee pattern, ductile-iron or malleable-iron body and access end cap, access coupling with EDPM gasket.

F. **Mechanical Sleeve Seals:** Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

**PART 3 - EXECUTION**

### 3.01 ESCUTCHEONS

A. Install escutcheons at all exposed penetrations of piping through walls, ceilings, and floors in rooms with finish surfaces.

### 3.02 FITTINGS AND SPECIALTIES

A. Install strainers on the supply side of each control valve, pressure reducing or regulating valve, solenoid valve, and elsewhere as indicated.

B. Install unions adjacent to each valve, and at the final connection to each piece of equipment, and elsewhere as indicated.

C. Install Flanges in piping 2-1/2” and larger, where indicated, adjacent to each valve, and at the final connection to each piece of equipment.

D. Install dielectric fittings to connect piping materials of dissimilar metals in wet piping systems (water, steam).

**END OF SECTION 23 1116**
“L” TOWER BUILDING
SEISMIC AND CODE UPGRADES
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ESCUTCHEONS, DIELECTRIC FITTINGS, UNIONS AND STRAINERS
231116 - 4
SECTION 23 2100
BASIC HVAC PIPING MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This Section specifies piping materials and installation methods common to more than one section of Division 23 and includes joining materials, fire stop sealants, and basic piping installation instructions.

1.02 RELATED SECTIONS

A. The following sections contain requirements that relate to this section:
   1. Division 23 Section "Basic HVAC Requirements" applies to the work of this Section.
   2. Piping materials and installation methods peculiar to individual systems are specified within their respective system specification sections of Division 02 and 23.
   3. Valves are specified in a separate section and in individual piping system sections of Division 23.
   4. Expansion Compensation is specified within the respective system specification section of Division 23.
   5. Division 23 "Supports and Anchors".
   6. Division 23 "HVAC Identification".
   7.

1.03 SUBMITTALS

A. Refer to Division 1 and "Basic HVAC Requirements" for administrative and procedural requirements for submittals.

B. Product Data: Submit product data on fire stop sealants.

1.04 QUALITY ASSURANCE


B. Soldering and Brazing procedures shall conform to ANSI B9.1 Standard Safety Code for Mechanical Refrigeration.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Provide factory-applied plastic end-caps on each length of pipe and tube, except for concrete, corrugated metal, hub-and-spigot, and clay pipe. Maintain end-caps through shipping, storage and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.
B. Protect stored pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed structural capacity of the floor.

C. Protect flanges, fittings, and specialties from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

A. Refer to the individual piping system specification sections in Division 23 for specifications on piping and fittings relative to that particular system.

B. Weld-O-Lets: Welding Weld-O-Lets may be used in lieu of tees where branch connection pipe size is two or more pipe sizes smaller than main header size.

2.02 JOINING MATERIALS

A. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.

B. Brazing Materials: Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials appropriate for the materials being joined.

C. Soldering Materials: Refer to individual piping system specifications for solder appropriate for each respective system.

D. Soldering materials shall not contain lead.

E. Gaskets for Flanged Joints: Gasket material shall be full-faced for cast-iron flanges and raised-face for steel flanges. Select materials to suit the service of the piping system in which installed and which conform to their respective ANSI Standard (A21.11, B16.20, or B16.21). Provide materials that will not be detrimentally affected by the chemical and thermal conditions of the fluid being carried.

2.03 SLEEVES AND SEALS

A. Sleeves:
   1. Sheet-Metal Sleeves: 5" and Smaller, 20 gage galvanized sheet metal; 6" and Larger, 10 gage, galvanized sheet metal, round tube closed with welded longitudinal joint.
   2. Steel Sleeves: Schedule 40 galvanized, welded steel pipe, ASTM A53, Grade A.
   3. Galvanized steel telescoping type: Galvanized sheet metal per manufacturer's standards.
   4. Polyethylene Sleeves: Manufacturer's standard product.

B. Mechanical Sleeve Seals: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
2.04 FIRESTOP SEALANT

A. Fire stopping material shall be asbestos-free and capable of maintaining an effective barrier against flame and gases in compliance with the following requirements:
   1. Flame Spread: 25 or less, ASTM E 84.
   2. Smoke Development: 50 or less, ASTM E 84.

B. Material when installed shall have the same fire rating as the assembly in which it is being installed.

2.05 PIPING ISOLATION

A. Manufacturer’s standard product for providing sound and electrolysis isolation.

PART 3 - EXECUTION

3.01 PREPARATION

A. Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris for both inside and outside of piping and fittings before assembly.

3.02 INSTALLATIONS

A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated. Refer to individual system specifications for requirements for coordination drawing submittals.

B. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated otherwise.

C. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

D. Install piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated on the Drawings.

E. Install piping tight to slabs, beams, joists, columns, walls and other permanent elements of the building. Provide space to permit insulation applications, with 1" clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

F. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.

G. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4" ball valve, and short 3/4" threaded nipple and cap.

H. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals.

I. Coordinate to provide curb, minimum 4" above finish floor, for all pipe shafts or floor openings for multiple pipes.
J. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, or floors, the fire rated integrity shall be maintained.

3.03 PIPE SUPPORTS AND HANGERS

A. All pipe Supports and Hangers shall be per requirements of specification section 23 0529 “Supports and Hangers”.

3.04 FITTINGS AND SPECIALTIES

A. Use fittings for all changes in direction and all branch connections.
B. Remake leaking joints using new materials.
C. Install Y-type strainers with blow-down valves on the supply side of each control valve, pressure reducing or regulating valve, solenoid valve, and elsewhere as indicated.
D. Install unions adjacent to each valve, and at the final connection to each piece of equipment and plumbing fixture having 2” and smaller connections, and elsewhere as indicated.
E. Install Flanges in piping 2-1/2” and larger, where indicated, adjacent to each valve, and at the final connection to each piece of equipment.
F. Install dielectric unions to connect piping materials of dissimilar metals in dry piping systems (gas, compressed air, vacuum).
G. Install dielectric fittings to connect piping materials of dissimilar metals in wet piping systems (water, steam).

3.05 JOINTS

A. Steel Pipe Joints:
   1. Pipe 2" and Smaller: Thread pipe with tapered pipe threads in accordance with ANSI B2.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint lubricant or sealant suitable for the service for which the pipe is intended on the male threads at each joint and tighten to leave not more then 3 threads exposed.

B. Pipe Larger than 2":
   a. Weld pipe joints (except for exterior water service pipe) in accordance with ASME Code for Pressure Piping, B31.
   b. Weld pipe joints of exterior water service pipe in accordance with AWWA C206.
   c. Install flanges on all valves, apparatus, and equipment. Weld pipe flanges to pipe ends in accordance with ASME B31.1.0 Code for Pressure Piping. Clean flange faces and install gaskets. Tighten bolts to torque specified by manufacturer of flange and flange bolts, to provide uniform compression of gaskets.

C. Non-ferrous Pipe Joints:
   2. Thoroughly clean tube surface and inside surface of the cup of the fittings, using every fine emery cloth, prior to making soldered or brazed joints. Wipe tube and
fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.

3. Mechanical Joints: Flared compression fittings may be used for refrigerant lines 3/4" and smaller.

D. Joints for other piping materials are specified within the respective piping systems sections.

3.06 INSTALLATION OF SLEEVES

A. Provide pipe sleeves for pipes to pass through walls, floor and roofs. Diameter of sleeve to be 1-inch larger than the outside diameter of pipe or pipe and covering of insulated pipe. Galvanized steel telescoping type sleeves or polyethylene may be used. Where seepage may occur, use steel pipe sleeves.

B. All pipe sleeves through floors other than floors on grade shall extend 2-inches above finished floor and shall be caulked with mineral wool. Provide collar where polyethylene sleeve is used.

C. Where required in existing construction, or where sleeves have been omitted, openings for pipe may be core drilled in floors and/or walls or partitions, providing prior acceptance of such core drilling is obtained from the Architect. Holes core drilled through floors above grade shall be provided with sleeves extending 2-inches above finish floor as hereinbefore specified.

D. Seal with resilient sealant: Dow Corning "Fire Stop" or approved equal.

3.07 INSTALLATION OF FIRE STOP SEALANT

A. Firestopping shall be provided at, but not limited to, duct, and piping penetrations through floor slabs and through time rated partitions or firewalls.

B. Install firestopping materials in accordance with the manufacturer's instructions and the following requirements.

1. Filling: Firestopping materials shall completely fill the void spaces.

C. Coordination: Coordinate the work with other trades. Firestopping materials at penetrations of insulated pipes and ducts shall be applied prior to insulation, unless the insulation meets the requirements specified for firestopping.

D. Surface Preparation: Surfaces to be in contact with firestopping materials shall be free of dirt, grease, oil, loose material, rust, or other substances that may affect proper fitting or the required fire resistance.

3.08 INSTALLATION OF PIPE ISOLATION

A. Provide sound and electrolysis isolation on all uninsulated, pipes, Semco "Trisolators" or Potter-Roemer "Prisolators".

3.09 INSTALLATION OF PIPE FLASHING

A. Pipe flashing assemblies, "Semco" Fig. 1100-4, as required, seal the joint between flashing and pipe with waterproofing compound. Install counterflashing sleeve to cover a minimum of 3/4-inch to top of lead flashing, making the top joint permanently watertight.
3.10 TESTING OF PIPING

A. Provide notification of test at least three working days prior to tests on all or part of any piping system. Do not allow or cause any piping system to be insulated, covered, concealed or enclosed until such systems have been tested and reviewed.

B. Provide all necessary materials (including temporary isolation valves or caps), pumps, testing media and labor for testing. Temporarily remove any device in piping system, which will not withstand test pressure specified, and reinstall same after successful testing. Test time begins to accrue after full test pressure is achieved.

C. Testing and inspection of all piping systems and associated equipment for leaks shall be accomplished after installation and cleaning and prior to placing into service. Flanges, threaded joints and all welds shall be left unpainted and uninsulated until the piping systems have been approved.

D. A rigid visual inspection of each specific piping system shall be made prior to conducting tightness tests, to ascertain that all appurtenances and equipment are provided, properly connected and supported, and in all respects ready for testing.

E. Equipment such as pumps, chillers, tanks, heat exchangers, flexible hose, safety valves and similar equipment shall not be subjected to the piping system test pressure. Equipment shall either be disconnected from the piping or be isolated by valves or blanks during testing and reinstalled after acceptance by the Owner.

F. Indicating pressure gauges mounted locally may be tested with the lines provided the test pressure does not exceed the scale range.

G. Orifice plates, rotometers, displacement meters and other line inserts shall either not be installed until completion of all testing, or shall be removed prior to any tests and reinstalled after test has been accepted by the Owner.

H. The application of pressure to a system shall be under control at all times, so that in no case shall the test pressure be exceeded by more than 6 percent.

I. Gauges used for testing shall be tested for accuracy as directed or approved by the Owner, and then installed as close as possible to the low point of the piping system.

J. Do not apply test pressure until the piping system and its contents approach the same temperature.

K. While piping is under test, exercise care that excessive pressure does not occur due to increase in ambient temperature.

L. Control Valves:
   1. Control valves which are installed with block and by-pass valve shall have the block valve closed, the by-pass valve opened, and a temporary pipe piece inserted in place of the control valve (or a test blank may be installed on each side of the control valve) until all flushing and testing of all lines of that system is completed and accepted by the Owner, after which they shall be reinstalled.
   2. Control valves installed without block or by-pass valves shall be replaced by a pipe piece during flushing and testing of the system. After acceptance of the flushing they shall be reinstalled.
M. Minimum piping test pressures shall be as noted in tabulation; or they shall be 150 percent of design pressure for the specific system being tested, whichever is higher.

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>TEST MEDIUM</th>
<th>TESTING PRESSURE (PSIG)</th>
<th>DURATION (HOURS)</th>
<th>ACCEPTABLE TOLERANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>Water</td>
<td>150</td>
<td>4</td>
<td>None. Except temperature change.</td>
</tr>
</tbody>
</table>

N. Conduct hydrostatic tests with water at a temperature below 100 degrees F.
1. Fill the system slowly with water and vent at highest points to expel the air before pressurizing.
2. Carefully examine all joints for leaks or defects.
3. Provide connections as required to accomplish the above.

O. Keep accurate test records of each line or system tested and provide copies of same to Owner after acceptance. Each test shall include:
1. Identification of piping system and test number.
2. Testing medium.
3. Test pressure.
4. Date of test acceptance.

3.11 ADJUSTMENTS

A. At the completion of the Work, completely adjust all valves and equipment for their proper use and rating.

END OF SECTION 23 2100
"L" TOWER BUILDING
SEISMIC AND CODE UPGRADES
RIO HONDO COLLEGE

BASIC HVAC PIPING MATERIALS AND METHODS
23 2100-8
SECTION 23 2113

HYDRONIC PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This Section includes piping systems for hot water heating, chilled water cooling, make-up water for these systems, blow-down drain lines, and condensate drain piping. Piping materials and equipment specified in this Section include:

1. Pipes, fittings, and specialties;
2. Special duty valves;
3. Hydronic specialties.

1.02 RELATED SECTIONS

A. The following sections contain requirements that relate to this Section:

1. Division 23 Section 23 2111 "Earthwork for Mechanical Systems"
2. Division 23 Section 23 2100 "Basic Piping Materials and Methods"
3. Division 23 Section 23 0523 "Valves"
4. Division 23 Section 23 0519 "Meters and Gages"
5. Division 23 Section 23 0529 "Supports and Anchors"
6. Division 23 Section 23 0553 "Mechanical Identification"
7. Division 23 Section 23 0700 "Mechanical Insulation"
8. Division 23 Section 23 2123 "HVAC Pumps"
9. Division 23 Section 23 9000 "Testing, Adjusting and Balancing"
10. Division 23 Section 25 0000 "Building Automation System"

1.03 DEFINITIONS

A. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).

1.04 SYSTEM DESCRIPTION

A. General: The hydronic piping systems are the "water-side" of an air-and-water or all-water heating and air conditioning system. Hydronic piping systems specified in this Section include 4-pipe, hot water and chilled water piping system and condenser water piping system. These systems are classified by ASHRAE as Low Water Temperature, Forced and Re-circulating Systems.

B. 4-Pipe System: The 4-pipe systems includes independent chilled water and hot water supply and return piping mains in a closed loop, connecting the Campus central plant chilled water and hot water to the terminal heat transfer units. Design flow rates and water temperatures are specified in the various equipment specifications and schedules. Control sequences and temperature reset schedules are specified in the temperature control specifications.
1.05 SUBMITTALS

A. Product Data, including rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties and accessories, and installation instructions for each hydronic specialty and special duty valve specified.
   1. Furnish flow and pressure drop curves for diverting fittings and calibrated plug valves, based on manufacturer's testing.

B. Maintenance Data for hydronic specialties and special duty valves, for inclusion in operating and maintenance manual specified in Division 1 and Division 23 Section "Basic HVAC Requirements."

C. Reports specified in Part 3 of this Section.

1.06 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the provisions of the following:
   1. ASME B 31.9 "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.
   2. Fabricate and stamp air separators and compression tanks to comply with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

1.07 DELIVERY AND STORAGE

A. Delivery and storage as specified in Division 23 Section "Basic Piping Materials and Methods".

1.08 SEQUENCING AND SCHEDULING

A. Coordinate the size and location of concrete equipment pads. Cast anchor bolt inserts into pad. Concrete, reinforcement, and formwork requirements are specified in Division 3.

B. Coordinate the installation of pipe sleeves for foundation wall penetrations.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide hydronic piping system products from one of the following:
   1. Grooved Mechanical Joint Pipe, Fittings, and Couplings:
      a. Victaulic Company of America.
      c. Grinnell Mechanical Products.
   2. Calibrated Plug Valves:
      a. Bell & Gossett ITT; Fluid Handling Div.
      b. Victaulic Company of America.
      c. Taco, Inc.
   3. Pressure Reducing Valves:
      a. Bell & Gossett ITT; Fluid Handling Div.
b. Amtrol, Inc.
c. Armstrong Pumps Inc.
d. Wilkins
e. Watts Regulator Co.

4. Pump Discharge Valves:
   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett ITT; Fluid Handling Div.
   d. Taco, Inc.
   e. Victaulic Tri-Service

5. Safety Relief Valves:
   a. Amtrol, Inc.
   b. Bell & Gossett ITT; Fluid Handling Div.
   c. Spirax Sarco
   d. Watts Regulator Co.

6. Air Separators:
   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett ITT; Fluid Handling Div.
   d. Taco, Inc.

7. Compression Tanks:
   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett ITT; Fluid Handling Div.
   d. Taco, Inc.

8. Diaphragm-Type Compression Tanks:
   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.

9. Pump Suction Diffusers:
   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett ITT; Fluid Handling Div.
   d. Taco, Inc.
   e. Victaulic Company of America

10. Chemical Feeder:
    a. Culligan USA
    b. Vulcan Laboratories, Subsidiary of Clow Corp.
    c. York-Shipley, Inc.

11. Air Vents (manual and automatic):
    b. Bell & Gossett ITT; Fluid Handling Div.
    c. Hoffman Specialty ITT; Fluid Handling Div.
    d. Spirax Sarco.

12. Diverting Fittings:
    a. Amtrol, Inc.
    b. Armstrong Pumps, Inc.
    c. Bell & Gossett ITT; Fluid Handling Div.
d. Taco, Inc.

13. Dielectric Waterway Fittings:
   a. Victaulic Company of America.

14. Dielectric Unions:
   a. Perfection Corp.
   b. Watts Regulator Co.

15. Y-Pattern Strainers:
   b. Hoffman Specialty ITT; Fluid Handling Div.
   c. Metraflex Co.
   d. Spirax Sarco.
   e. Trane Co.
   f. Victaulic Co. of America
   g. Watts Regulator Co.

16. Basket Strainers:
   a. Crane Co.
   b. Metraflex Co.
   c. Spirax Sarco
   d. Victaulic Company of America

17. Escutcheons:
   a. See Division 23 Section "Basic Piping Materials and Methods".

18. Pipe Vibration Isolation:
   a. Refer to Section 23 0548.

2.02 PIPE AND TUBING MATERIALS

A. General: Refer to Part 3 Article "PIPE APPLICATIONS" for identification of where the below materials are used.

B. Drawn Temper Copper Tubing: ASTM B88, Type L.

C. Annealed Temper Copper Tubing: ASTM B88, Type K.

D. Steel Pipe: ASTM A135, Schedule 40, black steel pipe, plain ends.

E. Victaulic approved ASTM A135 or A795 Schedule 5 (0.065 wall thickness) may be used with the Victaulic Press Fit System in treated systems.

2.03 FITTINGS

A. Cast-Iron Threaded Fittings: ANSI B16.4, Class 125, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.


C. Steel Fittings: ASTM A234, seamless or welded, for welded joints.

D. Grooved Mechanical Fittings: ASTM A536, Grade 65-45-12 Ductile Iron; ASTM A47 Grade 32510 Malleable Iron; ASTM A53, Type F, or Types E or S, Grade B fabricated steel; or ASTM A106, Grade B steel fittings with grooves or shoulders designed to accept grooved end couplings.
E. Grooved Mechanical Couplings: Consist of ductile or malleable iron housing, a synthetic rubber gasket of a central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

F. Victaulic Press Fit coupling and fitting housings shall be formed of precision cold drawn steel to ASTM A513 with self-contained synthetic O ring in coupling/fitting ends.


H. Cast-Iron Threaded Flanges: ANSI B16.1, Class 125; raised ground face, bolt holes spot faced.

I. Cast Bronze Flanges: ANSI B16.25, Class 150; raised ground face, bolt holes spot faced.

J. Steel Flanges and Flanged Fittings: ANSI B16.5, including bolts, nuts, and gaskets of the following material group, end connection and facing:
   2. End Connections: Butt Welding.
   3. Facings: Raised Face.


L. Dielectric Unions: Threaded or soldered end connections for the pipe materials in which installed; constructed to isolate dissimilar metals, prevent galvanic action, and prevent corrosion.

M. Flexible Connectors: Stainless steel bellows with woven flexible bronze wire reinforcing protective jacket; minimum 150 psig working pressure, maximum 250 degree F operating temperature. Connectors shall have flanged or threaded end connections to match equipment connected; and shall be capable of 3/4 inch misalignment.

N. Flexible Connections: Grooved mechanical flexible couplings, equal to Victaulic Style 77, may be used in strict accordance with manufacturer's instructions.

2.04 PIPE VIBRATION ISOLATION

A. Flexible Connection: Refer to Section 23 0548.

B. Flexible connections in heating water lines rated for continuous temperature of 240 degrees F. at 100 PSI.

C. Joints employing limit bolts shall have grommets in bolt holes. Flexible connections at pumps installed with axis parallel to pump shaft.

2.05 JOINING MATERIALS

A. Solder Filler Metals: ASTM B32, 95-5 Tin-Antimony, for heating hot water and low pressure steam piping.

B. Brazing Filler Metals: AWS A5.8, Classification BAg 1 (Silver).

C. Welding Materials: Comply, with Section II, Part C. ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.
D. Gasket Material: Thickness, material, and type suitable for fluid to be handled, and design temperatures and pressures.

2.06 GENERAL DUTY VALVES

A. General duty valves (i.e., gate, globe, check, ball, and butterfly valves) are specified in Division 23 Section "Valves." Special duty valves are specified below by their generic name; refer to Part 3 Article "VALVE APPLICATION" for specific uses and applications for each valve specified.

2.07 SPECIAL DUTY VALVES

A. Calibrated Plug Valves: 125 psig water working pressure, 250 degree F maximum operating temperature, bronze-body plug-valve with calibrated orifice. Provide with connections for portable differential pressure meter with integral check valves and seals. Valve shall have integral pointer and calibrated scale to register degree of valve opening. Valves 2 inch and smaller shall have threaded connections and 2-1/2 inch valves shall have flanged connections.

B. Pump Discharge Valves: 175 psig working pressure, 300 degree F maximum operating temperature, cast-iron body, bronze disc and seat, stainless steel stem and spring, and "Teflon" packing. Valves shall have flanged connections and straight or angle pattern as indicated. Features shall include non-slam check valve with spring-loaded weighted disc, and calibrated adjustment feature to permit regulation of pump discharge flow and shutoff.

C. Pressure Reducing Valves: Manufacturer based upon Cla-Val Model 50-01. Equal Products by Bell & Gossett. Diaphragm operated, cast-iron or brass body valve, with low inlet pressure check valve, inlet strainer removable without system shut-down, and noncorrosive valve seat and stem. Select valve size, capacity, and operating pressure to suit system. Valve shall be factory-set at operating pressure and have the capability for field adjustment.

D. Safety Relief Valves: 125 psig working pressure and 250 degree F maximum operating temperature; designed, manufactured, tested, and labeled in accordance with the requirements of Section IV of the ASME Boiler and Pressure Vessel Code. Valve body shall be cast-iron with all wetted internal working parts made of brass and rubber. Select valve to suit actual system pressure and Btu capacity.

E. Combined Pressure/Temperature Relief Valves: Diaphragm operated, cast-iron or brass body valve, with low inlet pressure check valve, inlet strainer removable without system shut-down, and noncorrosive valve seat and stem. Select valve size, capacity, and operating pressure to suit system. Valve shall be factory-set at operating pressure and have the capability for field adjustment. Safety relief valve designed, manufactured, tested, and labeled in accordance with the requirements of Section IV of the ASME Boiler and Pressure Vessel Code. Valve body shall be cast-iron, with all wetted internal working parts made of brass and rubber; 125 psig working pressure and 250 degree F maximum operating temperature. Select valve to suite actual system pressure and Btu capacity. Provide with fast fill feature for filling hydronic system.

F. Automatic Flow Control Valves: Class 150, cast iron housing, stainless steel operating parts; threaded connections for 2 inch and smaller, flanged connections for 2-1/2 inch and larger. Factory set to automatically control flow rates within plus or minus 5 percent design, while compensating for system operating pressure differential. Provide
quick disconnect valves for flow measuring equipment. Provide a metal identification tag with chain for each valve, factory marked with the zone identification, valve model number, and rate flow in GPM.

G. Victaulic grooved end venturi may also be used with Victaulic Style 300 Butterfly Valve for setting flow. Installed in complete compliance with manufacturer's requirements.

2.08 HYDRONIC SPECIALTIES

A. Manual Air Vent: Manufacturer based upon Hoffman Model 500. Equal products by Bell & Gossett or Watts Regulator Bronze body and nonferrous internal parts; 150 psig working pressure, 225 deg F operating temperature; manually operated with screwdriver or thumbscrew; and having 1/8 inch discharge connection and 1/2 inch inlet connection.

B. Automatic Air Vent: Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150 psig working pressure, 240 degree F operating temperature; and having 1/4 inch discharge connection and 1/2 inch inlet connection.

C. Y-Pattern Strainers; 125 psig working pressure cast-iron body (ASTM A126,Class B),flanged ends for 2-1/2 inch and larger, threaded connections for 2 inch and smaller, bolted cover, perforated Type 304 stainless steel removable basket made of 20 mesh Monel metal screen, and bottom drain connection.

D. Calibrated Flow Valve: Manufacturer based upon Bell & Gossett Circuit Setter.

E. Coil Piping Packages: Manufacturer based upon Bell & Gossett. Equal products by Griswold or Hays.

F. Air Separator: Manufacturer based upon Bell & Gossett Rolairtrol Model RL. Equal products by Amtrol.

G. Expansion Tank: Manufacturer based upon Bell & Gossett. Equal products by Amtrol.

PART 3 -EXECUTION

3.01 PIPE APPLICATIONS

A. Heating water and chilled water piping:
   1. Install Type L, drawn copper tubing with wrought copper fittings and solder joints, or at contractor's option, above ground, within building. Install Type K, annealed temper copper tubing for 2 inch or smaller with joints, below ground.
   2. Install steel pipe with threaded joints and fittings for 2 inch and smaller, and with welded joints for 2-1/2 inch and larger.
   3. Install steel pipe with Victaulic Press Fit fittings and couplings 2" and smaller with approved Schedule 5 pipe on treated systems.

B. Condensate drain piping (cooling coil):
   1. Type L, drawn copper tubing with wrought copper fittings and solder joints. Provide threaded adapter with plug or cap at each 90 degree change in direction for use as cleanout.

3.02 PIPING INSTALLATIONS

A. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Locations and arrangements
of piping take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.

B. Use fittings for all changes in direction and all branch connections.
C. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
D. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
E. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1" clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
F. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
G. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4" ball valve, and short 3/4" threaded nipple cap.
H. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6 inch shall be steel; pipe sleeves 6 inches and larger shall be sheet metal.
I. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, and floors, maintain the fire rated integrity. Refer to Division 7 for special sealers and materials.
J. Install heating and cooling piping at a uniform grade of 1" in 40 feet upward in the direction of flow, where possible, otherwise dead level.
K. Install condensate drain piping at a minimum uniform grade of 1/8" per foot downward.
L. Make reductions in pipe sizes using eccentric reducer fitting installed with the level side up.
M. Install branch connections to mains using Tee fittings in main with take-off out the bottom of the main, except for up-feed risers which shall have take-off out the top of the main line.
N. Install unions in pipes 2 inches and smaller, adjacent to each valve, at final connections each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.
O. Install dielectric unions to join dissimilar metals.
P. Install flanges on valves, apparatus, and equipment having 2-1/2 inch and larger connections.
Q. Install flexible connectors at inlet and discharge connections to fan/coil units and other vibration producing equipment.
R. Install bellows type pipe vibration isolation at inlet and discharge connections to pumps (except in-line pumps) and other vibrating equipment, perpendicular to pump shaft or other vibrating motion, except straight sided isolation shall be installed parallel to pump shaft or vibrating motion.
S. Install strainers on the supply side of each control valve, pressure reducing valve, pressure regulating valve, solenoid valve, in-line pump, and elsewhere as indicated. Install nipple and ball valve in blow down connection of strainers 2 inch and larger.
T. Anchor piping to ensure proper direction of expansion and contraction. Expansion loops and joints are indicated on the Drawings.

U. Install support between all flexible joints when using grooved mechanical couplings for flexible connections. Provide "TRISOLATORS" or equal for un-insulated pipes. Provide insulation protection for insulated pipe.

3.03 HANGERS AND SUPPORTS

A. General: Hangers, supports, and anchors devices are specified in Division 23 Section "Supports and Anchors." Conform to the table below for maximum spacing of supports:

B. Install the following pipe attachments:
   1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet in length.
   2. Adjustable roller hangers and spring-hangers for individual horizontal run 20 feet or longer.
   3. Pipe roller complete - MSS Type 44 for multiple horizontal runs, 20 feet or longer, support on a trapeze.
   4. Spring hangers to support vertical runs.

C. Install hangers with the following minimum rod sizes and maximum spacing:

<table>
<thead>
<tr>
<th>Nom. Pipe Size</th>
<th>Max. Span - Ft.</th>
<th>Min. Rod Sizes-Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7</td>
<td>3/8</td>
</tr>
<tr>
<td>1-1/2</td>
<td>9</td>
<td>3/8</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>3/8</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>1/2</td>
</tr>
<tr>
<td>4</td>
<td>14</td>
<td>5/8</td>
</tr>
<tr>
<td>5</td>
<td>16</td>
<td>5/8</td>
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<tr>
<td>6</td>
<td>17</td>
<td>3/4</td>
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<tr>
<td>8</td>
<td>19</td>
<td>7/8</td>
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<tr>
<td>10</td>
<td>22</td>
<td>7/8</td>
</tr>
<tr>
<td>12</td>
<td>23</td>
<td>7/8</td>
</tr>
</tbody>
</table>

D. Support vertical runs at each floor.

3.04 PIPE JOINT CONSTRUCTION

A. Soldered Joints: Comply with the procedures contained in the AWS "Soldering Manual."

B. Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads. Join pipe fittings and valves as follows:
   1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
   2. Align threads at point of assembly.
   3. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).
   4. Assemble joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.
a. Damaged Threads: Do not use pipe with threads which are corroded or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

C. Welded Joints: Comply with the requirement in ASME Code B31.9 - "Building Services Piping."

D. Flanged Joints: Align flanges surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.

E. Grooved Joints: Assemble joints in accordance with fitting manufacturers written instructions.

F. Press Fit Joints: Assemble joints in accordance with manufacturer's latest published recommendations.

3.05 VALVE APPLICATIONS

A. General Duty Valve Applications: The Drawings indicate valve types to be used. Where specific valve types are not indicated the following requirements apply:
   2. Throttling duty: use globe, ball, and butterfly valve.
   3. Install shut-off duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, and elsewhere as indicated.
   4. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, elsewhere as indicated.

B. Install calibrated plug valves on the outlet of each heating or cooling element and elsewhere as required to facilitate system balancing.

C. Install check valves on each pump discharge and elsewhere as required to control flow direction.

D. Install pressure reducing valves on hot water generators, and elsewhere as required to regulate system pressure.

3.06 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in the system, at heat transfer coils, and elsewhere as required for system air venting.

3.07 FIELD QUALITY CONTROL

A. Preparation for Testing: Prepare hydronic piping in accordance with ASME B31.9 and as follows:
   1. Leave joints including welds un-insulated and exposed for examination during the test.
   2. Provide temporary restraints for expansion joints which cannot sustain the reactions due to test pressure. If temporary restraints are not practical, isolate expansion joints from testing.
   3. Flush system with clean water. Clean strainers.
   4. Isolate equipment that is not to be subjected to the test pressure from the piping. If a valve is used to isolate the equipment, its closure shall be capable of sealing
against the test pressure without damage to the valve. Flanged joints at which blinds are inserted to isolate equipment need not be tested.

5. Install relief valve set at a pressure no more than 1/3 higher than the test pressure, to protect against damage by expansion of liquid or other source of over pressure during the test.

B. Testing: Test hydronic piping as follows:

1. Use ambient temperature water as the testing medium, except where there is a risk of damage due to freezing. Another liquid may be used if it is safe for workmen and compatible with the piping system components.

2. Use vents installed at high points in the system to release trapped air while filling the system. Use drains installed at low points for complete removal of the liquid.

3. Examine system to see that equipment and parts that cannot withstand test pressures are properly isolated. Examine test equipment to ensure that it is tight and that low pressure filling lines are disconnected.

4. Subject piping system to a hydrostatic test pressure which at every point in the system is not less than 1.5 times the design pressure. The test pressure shall not exceed the maximum pressure for any vessel, pump, valve, or other component in the system under test.

5. Make a check to verify that the stress due to pressure at the bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength, or 1.7 times the "SE" value in Appendix A of ASME B31.9, Code for Pressure Piping, Building Services Piping.

3.08 ADJUSTING AND CLEANING

A. Clean and flush hydronic piping systems. Remove, clean, and replace strainer screens. After cleaning and flushing hydronic piping system, but before balancing, remove disposable fine mesh strainers in pump suction diffusers.

B. Mark calibrated name plates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.

C. Chemical Treatment: Provide a water analysis prepared by the chemical treatment supplier to determine the type and level of chemicals required for prevention of scale and corrosion. Perform initial treatment after completion of system testing.

3.09 COMMISSIONING

A. Fill system and perform initial chemical treatment.

B. Check expansion tanks to determine that they are not air bound and that the system is completely full of water.

C. Before operating the system perform these steps:

1. Open valves to full open position. Close coil bypass valves.
2. Remove and clean strainers.
3. Check pump for proper rotation. Correct any improper wiring.
4. Set automatic fill valves for required system pressure.
5. Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or to bleed air completely (manual type).
6. Set temperature controls so all coils are calling for full flow.
7. Check operation of automatic bypass valves.
8. Check and set operating temperatures of boilers, chillers, and cooling towers to design requirements.
9. Lubricate motors and bearings.

END OF SECTION 23 2113
PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Rectangular and round metal ducts and plenums for heating, ventilating, and air conditioning system from minus 2" to plus 5" water gage.

1.02 RELATED SECTIONS

A. Refer to other Division 23 Sections for exterior insulation of metal ductwork; not work of this section.
B. Refer to other Division 23 Sections for ductwork accessories; not work of this section.
C. Refer to other Division 23 Sections for fans and air handling units; not work of this section.
D. Refer to other Division 23 Sections for testing, adjusting and balancing of metal ductwork systems; not work of this section.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for metal ductwork materials and products.
B. Record Drawings: At project closeout, submit record drawings of installed metal ductwork and ductwork products, in accordance with requirements of Division 1.
C. Maintenance Data: Submit maintenance data and parts lists for metal ductwork materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual in accordance with requirements of Division 1.

1.04 QUALITY ASSURANCE

A. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with metal ductwork systems similar to that required for project.
B. Codes and Standards:
   1. SMACNA Standards: Comply with SMACNA "HVAC Duct Construction Standards, Metal and Flexible" for fabrication and installation of metal ductwork.
C. Field Reference Manual: Have available for reference at project field office, copy of SMACNA "HVAC Duct Construction Standards, Metal and Flexible".
1.05 DELIVERY, STORAGE, AND HANDLING

A. Protection: Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

B. Storage: Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.01 DUCTWORK MATERIALS

A. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, stains and discolorations, and other imperfections, including those which would impair painting.

B. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A653/A653M, lock forming quality, with G90 zinc coating in accordance with ASTM A653/A653M; and mill phosphatized for exposed locations.

2.02 MISCELLANEOUS DUCTWORK MATERIALS

A. General: Provide miscellaneous materials and products of types and sizes indicated or, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.

B. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 18-degree change of direction per section. Unless specifically detailed otherwise, use 45-degree laterals and 45-degree elbows for branch takeoff connections. Where 90-degree branches are indicated, provide conical type tees.

C. Screws and bolts shall be cadmium plated.

D. Duct Liner: Permacote Linacoustic (rectangular), Permacote Spiracoustic (Round), complying with Thermal Insulation Manufacturer's Association (TIMA) AHC-101; of thickness indicated. 1 inch thick; 2" thick above roofline, unless indicated otherwise. Or approved equal as defined in Section 01095.

E. Duct Liner Adhesive: Comply with ASTM C 916 "Specifications for Adhesives for Duct Thermal Insulation". Adhesive used on the project shall meet the requirements of CalGreen Section 5.504.4.1.

F. Duct Liner Fasteners: Comply with SMACNA HVAC Duct Construction Standards, Article S2.11.

G. Duct Sealant: Non-hardening, non-migrating mastic or liquid elastic sealant, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork. Sealant used on the project shall meet the requirements of CalGreen Section 5.504.4.1.

H. Duct Cement: Non-hardening migrating mastic or liquid neoprene based cement, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for cementing fitting components, or longitudinal seams in
ductwork. Cement used on the project shall meet the requirements of CalGreen Section 5.504.4.1.

I. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

J. Flexible ducts: Manufacturer based upon Casco Model Silent Flex II. Equal products by Thermaflex or approved equal as defined in Section 01095. Insulated flexible ductwork shall be a factory fabricated assembly composed of a high carbon spring steel wire with a non-corrosive zinc coating spiral helix permanently bounded to a spun-bonded nonwoven nylon interior liner, and supporting a fiberglass insulating blanket with a polyethylene jacket vapor barrier. Working pressure: + 1-1/2” W.G. minimum, complying with UL 181; with factory installed metal collar connectors, maximum length 6 feet. Suspend at maximum 3’-0” O.C.

K. Under slab Ducts: For ductwork placed in concrete slabs, or under slabs on grade, fabricate ductwork of one of the following materials:
   1. Galvanized Steel.

2.03 FABRICATION

A. Shop-fabricate ductwork in 4, 8, 10 or 12-ft lengths, unless otherwise indicated or required to complete runs. Preassemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match-mark sections for reassembly and coordinated installation.

B. Shop-fabricate ductwork of gages and reinforcement complying with SMACNA "HVAC Duct Construction Standards".

C. 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 associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. Limit angular tapers to 30 degrees for contracting tapers and 20 degrees for expanding tapers.

D. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division 23 Section "Ductwork Accessories" for accessory requirements.

E. Fabricate ductwork with duct liner in each section of duct where indicated. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining and adhesive, and fasten with mechanical fasteners.

2.04 FACTORY-FABRICATED LOW PRESSURE DUCTWORK

A. General: At Installer’s option, provide factory-fabricated duct and fittings, in lieu of shop-fabricated duct and fittings.

B. Material: Galvanized sheet steel complying with ASTM A517, lock forming quality, with ASTM A525, G90 zinc coating, mill phosphatized.

C. Gage: 28-gage minimum for round and oval ducts and fittings, 4” through 24” diameter.
D. Elbows: One-piece construction for 90 degrees and 45 degree elbows 14" and smaller. Provide multiple gore construction for larger diameters with standing seam circumferential joint.

E. Divided Flow Fittings: 90-degree tees, constructed with saddle tap spot welded and bonded to duct fitting body.

F. Manufacturers: Subject to compliance with requirements, provide factory-fabricated ductwork of one of the following or equal:
   1. Semco Mfg., Inc.
   2. United Sheet Metal Div. United McGill Corp.
   3. Or approved equal.

PART 3 - EXECUTION

3.01 INSPECTION

A. General: Examine areas and conditions under which metal ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF METAL DUCTWORK

A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight (5% leakage for systems rated 3" and under; 1% for systems rated over 3") and noiseless (no objectionable noise) systems capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" 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. Support vertical ducts at every floor.

B. Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.

C. Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

D. Electrical Equipment Spaces: Do not route ductwork through transformer vaults and their electrical equipment spaces and enclosures.

E. Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2". Fasten to duct and substrate.
F. Where ducts pass through fire-rated floors, walls, or partitions, provide fire stopping between duct and substrate.

G. Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.

H. Installation: Install metal ductwork in accordance with SMACNA HVAC Duct Construction Standards.

### 3.03 INSTALLATION OF DUCT LINERS

A. General: Install duct liner in accordance with SMACNA HVAC Duct Construction Standards.

### 3.04 INSTALLATION OF FLEXIBLE DUCTS

A. Maximum Length: For any duct run using flexible ductwork, do not exceed 8'-0" extended length.

B. Installation: Install in accordance with Section III of SMACNA "HVAC Duct Construction Standards, Metal and Flexible".

C. Bends in flexible ducts shall have a radius of not less 1.5 times the internal diameters.

### 3.05 EQUIPMENT CONNECTIONS

A. General: Connect metal ductwork to equipment as indicated; provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery. Provide access doors as indicated.

### 3.06 ADJUSTING AND CLEANING

A. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances, which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

B. Temporary closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, or the period of rough installation, or during storage on the construction site and until final startup of the heating and cooling equipment, provide temporary closure of duct openings and protection of mechanical equipment during construction. All duct and other related air distribution component openings shall be covered with polyethylene film, tape, plastic, sheet metal or other methods acceptable to the enforcing agency which will prevent entrance of dust and debris.

C. Balancing: Refer to Division 23 Section "Testing, Adjusting And Balancing" for air distribution balancing of metal ductwork; not work of this section. Seal any leaks in ductwork that become apparent in balancing process.

END OF SECTION 23 3113
SECTION 23 3300

DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Types of ductwork accessories required for project include the following:
   1. Dampers
      a. Low pressure manual dampers
      b. Control dampers
      c. Counterbalanced relief dampers
   2. Fire and smoke dampers
   3. Turning vanes
   4. Duct hardware
   5. Duct access doors
   6. Flexible connections

1.02 RELATED SECTIONS

A. Refer to other Division 23 Sections for testing, adjusting, and balancing of ductwork accessories; not included in work of this section.
B. Division 23 Section "Metal Ductwork".
C. Division 23 Section "Energy Management and Control System".
D. Division 23 Section "HVAC Identification".

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction; and installation instructions.

1.04 QUALITY ASSURANCE

A. Codes and Standards:
   1. SMACNA Compliance: Comply with applicable portions of SMACNA "HVAC Duct Construction Standards, Metal and Flexible".
   2. Industry Standards: Comply with ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.
   3. UL Compliance: Construct, test, and label fire dampers in accordance with UL Standard 555 "Fire Dampers and Ceiling Dampers".
   4. Fire dampers shall bear California State Fire Marshal Listing Number.
PART 2 - PRODUCTS

2.01 DAMPERS

A. Low Pressure Manual Dampers: Provide dampers of single blade type of multi-blade type, constructed in accordance with SMACNA "HVAC Duct Construction Standards". "Jiffy" type dampers are not acceptable.

2.02 BACKDRAFT DAMPERS

A. General: Provide back-draft dampers of types and sizes indicated. Construct casings of 0.090-thickness aluminum with mitered corners.

B. Blades, 0.025" formed aluminum with extruded vinyl edge seals. Bearings, Zytel. Linkage 1/8" x 1/8" aluminum tie bars concealed in frame.

C. Counterbalance: Zinc plated bar on blades (except top blade). Adjustable for final setting Mill finish

D. Manufacturers: Subject to compliance with requirements, provide dampers of one of the following:
1. Ruskin Manufacturing Co.
2. Air Balance Co.
3. Pottorff Company, Inc.

E. Control Dampers: Refer to Division-23 section "Control Systems" for control dampers; not work of this section.

F. Counterbalanced Relief Dampers: Provide dampers with parallel blades, counterbalanced and factory-set to relieve at indicated static pressure. Construct blades of 16-ga aluminum provide 1/2" diameter ball bearings, 1/2" diameter steel axles spaced on 9" centers. Construct frame of 2" x 1/2" x 1/8" steel channel for face areas 25 sq. ft. and under; 4" x 1-1/2" x 16-ga channel for face areas over 25 sq. ft. Provide galvanized steel finish on frame with aluminum touch-up.

G. Manufacturer: Subject to compliance with requirements, provide dampers of one of the following:
1. Air Balance, Inc.
3. Pottorff Company, Inc.

2.03 FIRE AND SMOKE DAMPERS

A. California State Fire Marshal approved, designed and constructed in accordance with NFPA 90A and UL Standard 555 and bear stamp showing compliance.

B. Fire Dampers: Provide fire dampers, of types and sizes indicated. Construct casings of 11-ga galvanized steel. Provide fusible link rated at 160 to 165 degrees F (71 to 74 degrees C) (unless otherwise indicated.) Provide damper with positive lock in closed position, and with the following additional features.
1. Damper Blade Assembly: Curtain type.

C. Manufacturer: Subject to compliance with requirements, provide fire and smoke dampers of one of the following:
1. Air Balance, Inc.
2.04 TURNING VANES

A. Manufactured Turning Vanes: Provide turning vanes constructed of 1-1/2" wide curved blades set at 3/4" O.C., supported with bars perpendicular to blades set at 2" O.C., and set into side strips suitable for mounting in ductwork.

B. Acoustic Turning Vanes: Provide acoustic turning vanes constructed of airfoil shaped aluminum extrusion with perforated faces and fiberglass fill.

C. Manufacturer: Subject to compliance with requirements, provide turning vanes of one of the following:
   1. Aero Dynen Co.
   2. Airsan Corp.
   3. Anemostat Products Div.; Dynamics Corp. of America
   4. Barber-Colman Co.
   5. Duro Dyne Corp.
   6. Environmental Elements Corp. Subs, Koppers Co., Inc
   8. Register & Grille Mfg. Co., Inc.
   9. Souther, Inc.

2.05 DUCT HARDWARE

A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:
   1. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.
   2. Quadrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

B. Manufacturer: Subject to compliance with requirements, provide duct hardware of one of the following:
   1. Ventfabrics, Inc.
   2. Young Regulator Co.

2.06 DUCT ACCESS DOORS:

A. General: Provide duct access doors where required.

B. Construction: Construct of same or greater gage as ductwork served, provide insulated doors for insulated ductwork. Provide flush frames for un-insulated ductwork, extended frames for externally insulated duct. Provide one side hinged and other side with one handle-type latch for doors 12" high and smaller, 2 handle-type latches for larger doors.

C. Manufacturer: Subject to compliance with requirements, provide duct access doors of one of the following:
   1. Air Balance Inc.
2. Duro Dyne Corp.
3. Register & Grille Mfg. Co., Inc.
5. Ventfabs, Inc.

2.07 FLEXIBLE CONNECTORS

A. General: Provide flexible duct connections wherever ductwork connects to vibration-isolated equipment. Construct flexible connections of neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse and torsional movement, and also capable of absorbing vibration of connected equipment.

B. Manufacturer: Subject to compliance with requirements, provide flexible connections of one of the following:
   1. American/Elgen Co.; Energy Div
   2. Duro Dyne Corp.
   3. Flexaust (The) Co
   4. Ventfabs, Inc.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF DUCTWORK ACCESSORIES

A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

B. Install turning vanes in square or rectangular 90-degree elbows in supply and exhaust air systems, and elsewhere as indicated.

C. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.

D. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.03 FIELD QUALITY CONTROL

A. Operate install ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leak proof performance.

3.04 ADJUSTING AND CLEANING

A. Adjusting: Adjust ductwork accessories for proper settings, install fusible links in fire
dampers and adjust for proper action.
1. Label access doors in accordance with Division 23 Section "HVAC Identification".
2. Final positioning of manual dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing".

B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.05 EXTRA STOCK

A. Furnish extra fusible links to Owner, one link for every 10 installed of each temperature range; obtain receipt.

END OF SECTION 23 3300
SECTION 23 3423

POWER AND GRAVITY VENTILATORS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Types of power and gravity ventilators specified in this section include the following:

1. Power ventilators.
   a. Centrifugal roof ventilators.
   b. In-Line roof ventilators.

2. Gravity ventilators.
   a. Hooded gravity ventilators.

3. Prefabricated roof curbs.

1.02 RELATED SECTIONS

A. Refer to Division 15 Section "Testing, Adjusting, and Balancing" for balancing of power and gravity ventilators; not work of this section.

B. Refer to Division 15 Section "Electrical Requirements for Mechanical Equipment".

C. Refer to Division 16 Sections for the following work; not included in work of this section:

1. Power supply wiring from power source to power connection on ventilators. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

D. Refer to Division 15 Section “Vibration Control”

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for power and gravity ventilators, including specifications, capacity ratings, dimensions, weights, materials, accessories furnished, and installation instructions.

B. Fan curve: Submit manufacturer’s fan curve data for power ventilators.

   1. For belt driven equipment, submit graph of fan curve with system curve that indicates intended-point of operation. The graph shall also indicate manufacturer’s recommended operating range of fan curve.

   2. For direct driven equipment with speed controller, submit graph of fan curve with system curve that indicates intended point of operation. The graph shall also indicate manufacturer’s recommended operating range of fan curve. On the same graph, also provide fan curves representing maximum operating RPM and minimum operating RPM utilizing manufacturer’s speed controller.

   3. For direct driven equipment, submit graph of fan curve with system curve that indicates intended point of operation. The graph shall also indicate manufacturer’s recommended operating range of fan curve.
C. Shop Drawings: Submit assembly-type shop drawings showing unit dimensions, construction details, methods of assembly of components, and field connection details.

D. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to power ventilators. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field installed.

E. Maintenance Data: Submit maintenance data and parts list for each type of power and gravity ventilator, accessory, and control. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Division 1.

F. Exhaust fan unit equipment manufacturer shall furnish calculations showing the estimated sound power levels for each supply air, return air and unit casing radiation for each exhaust fan unit.

G. The results of the tests shall be certified by the testing agency and submitted to the Architect for approval. The report shall include the manufacturer's designation of the tested unit, a complete description of the testing conditions, the measurement procedure, and the calculated PWL values (dB re. 10^{-12} watts), and calculations showing how the sound power levels were obtained from test data.

1.04 QUALITY ASSURANCE

A. Codes and Standards:

1. AMCA Compliance: Provide power ventilators, which have been tested and rated in accordance with AMCA standards, and bear AMCA Certified Rating Seal.

2. UL Compliance: Provide power ventilators, which are designed, manufactured, and tested in accordance with UL 705 "Power Ventilators".

3. NEMA Compliance: Provide motors and electrical accessories complying with NEMA Standards.

PART 2 - PRODUCTS

2.01 POWER VENTILATORS

A. General: Except as otherwise indicated, provide standard prefabricated power ventilator units of type and size indicated, modified as necessary to comply with requirements and as required for complete installation.

2.02 CENTRIFUGAL ROOF VENTILATORS (EXHAUST AND SUPPLY)

A. Centrifugal Roof Ventilators: Provide centrifugal roof type, curb mounted, power ventilators of type, size, and capacity as scheduled, and as specified herein.

B. Type: Centrifugal fan, direct or belt driven as scheduled. Provide aluminum, or fiberglass weatherproof housings as scheduled. Provide square base to suit roof curb.

C. Motors: Provide permanent split-capacitor type motor for direct driven fans; capacitor-start, induction-run type motor for belt driven fans.
D. Electrical: Provide factory-wired non-fusible type disconnect switch at motor in fan housing. Provide thermal overload protection in fan motor. Provide conduit chase within unit for electrical connection.

E. Bird Screens: Provide removable bird screen, 1/2" mesh 16-ga aluminum or brass wire.

F. Dampers: Provide gravity-actuated louvered dampers in curb bases unless noted to provide motorized louvered dampers with linkage in curb base.

G. Manufacturer: Subject to compliance with requirements, provide centrifugal roof ventilators of one of the following:
   1. Cook Co., Loren.
   2. Greenheck Fan Corp.
   3. Or approved equal.

2.03 GRAVITY VENTILATORS

A. General: Except as otherwise indicated, provide standard prefabricated gravity ventilator units of type and size indicated, modified as necessary to comply with requirements, and as required for complete installation.

B. Hooded Gravity Ventilators: Provide gravity ventilators, hooded type, curb mounted, of size, type and capacity as scheduled, and as specified herein.
   1. Type: Stationary, natural draft type. Provide weatherproof housings to match power ventilators in materials and finish. Provide square or rectangular base to suit roof curb.
   2. Bird Screens: Provide removable bird screens, 1/2” mesh, 16-ga aluminum or brass wire.
   4. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
      a. Cook Co., Loren.
      b. Greenheck Fan Corp.
      c. Or approved equal.

2.04 PREFABRICATED ROOF CURBS

A. General: Provide manufacturer's standard shop-fabricated units, modified if necessary to comply with requirements.

B. Fabricate structural framing for units of structural quality, aluminum formed to profiles indicated or, if not indicated, to manufacturer's standard profiles for coordination with roofing, insulation and deck construction. Include 45-degree cant strips and deck flanges with offsets to accommodate roof insulation. Weld corners and seams to form watertight units.

C. Reinforce continuous runs of over 3'-0" length by inserting welded stiffeners of heavy gage with flanges as required to provide sufficient rigidity and strength to withstand maximum lateral forces in addition to superimposed vertical loads.
D. Sloping Roof Decks: For deck slopes of 1/4" per foot and more, fabricate support units to form level top edge.

E. Gage and Height: Fabricate units of metal gage and to height above roof surface as indicated.
   1. Where gage or height is not indicated, fabricate units of 14-ga metal, and nominal height of 14".

F. Insulate units inside structural support wall with rigid glass fiber insulation board of approximately 3-lb. density and 1-1/2" minimum thickness, except as otherwise indicated.

G. Provide support liners where shown.
   1. Use perforated metal for support liners, with approximately 1000, 3/32" diameter holes per sq. ft., to provide sound absorbing surfaces.
   2. Provide sound insulation insert for curbs so indicated. Construct of 1" thick rigid fiberglass panels secured in galvanized steel framework, with rounded edges to minimize airflow resistance.

H. Manufacturer: Subject to compliance with requirements, provide prefabricated roof curbs of the same manufacturer as ventilator.

PART 3 - EXECUTION

3.01 INSPECTION

A. General: Examine areas and conditions under which power and gravity ventilators are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF POWER AND GRAVITY VENTILATORS

A. General: Except as otherwise indicated or specified, install power ventilators in accordance with manufacturer's installation instructions and recognized industry practices to insure that products serve the intended function.

B. Coordinate ventilator work with work of roofing, walls and ceilings, as necessary for proper interfacing.

C. Ductwork: Refer to Division 15 Section "Metal Ductwork." Connect ducts to ventilators in accordance with manufacturer's installation instructions.

D. Roof Curbs: Furnish roof curbs to roofing Installer for installation.

E. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.
   1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 16 Sections. Verify proper
rotation direction of fan wheels. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

F. Remove shipping bolts and temporary supports within ventilators. Adjust dampers for free operation.

3.03 FIELD QUALITY CONTROL

A. Testing: After installation of ventilators has been completed, test each ventilator to demonstrate proper operation of unit at performance requirements specified. When possible, field correct malfunctioning units, and then retest to demonstrate compliance. Replace units, which cannot be satisfactorily corrected.

3.04 ADJUSTING AND CLEANING

A. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.05 SPARE PARTS

A. General: Furnish to Owner, with receipt, one spare set of belts for each belt driven power ventilator.

END OF SECTION 23 3423
SECTION 23 3713
AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Types of outlets and inlets required for project include the following:
   1. Linear slot diffusers and returns.
   2. Ceiling air diffusers, rectangular, square, round.
   3. Wall registers and grilles.

1.02 RELATED SECTIONS

A. Refer to other Division 23 Sections for ductwork and duct accessories required in conjunction with air outlets and inlets; not work of this section.

B. Refer to other Division 23 Sections for balancing of air outlets and inlets; not work of this section.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:
   1. Schedule of air outlets and inlets indicating drawing designation, room location, quantity furnished, model number, size, and accessories furnished.
   2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.
   3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings. Indicate selections on data.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.

C. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 1.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver air outlets and inlets wrapped in factory-fabricated fiberboard type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors, when necessary to store outdoors, store above grade and enclose with waterproof wrapping.
1.05 QUALITY ASSURANCE

A. Codes and Standards:
   2. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

PART 2 - PRODUCTS

2.01 CEILING AIR DIFFUSERS

A. General: Except as otherwise indicated, provide manufacturer’s standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems, which will contain each type of ceiling air diffuser.

2.02 MANUFACTURER

A. Subject to compliance with requirement diffusers of one of the following:
   2. Nailor Industries, Inc.
   3. Titus Air Distribution Products
   4. Anemostat Air Distribution Products

B. Manufacturers and model numbers are listed and/or scheduled to set a standard of quality. Equivalent manufacturers and models accepted by Architect/Engineer may be used. Equivalents must be for review.
   1. Equivalents: Other manufacturers offering a similar product which is in accordance with the design criteria indicated may be submitted upon architect’s written acceptance prior to bidding. The cost to conduct all tests as may be directed by the architect to demonstrate that the equivalent product can achieve the criteria indicated, including all travel costs, shall be borne by the submitting contractor.

2.03 LINEAR SLOT DIFFUSER AND RETURN

A. General: Provide acoustical ceiling air distribution system. Consisting of ceiling slot air diffusers, base-frames, air chambers and entry collars.

B. Air Distribution Base Frames:
   1. Linear air diffusers base frames shall mechanically lock into the grid system. The base frames shall be extruded aluminum sections. Length shall be 48" unless otherwise noted or required.
2. Provide air distribution base frame with full supply air pattern control air weir gates. When used for return air, these air weir gates act as a return airflow control damper. Close air weir gates where return is not necessary.

3. Base frame shall present a substantially uniform appearance through the air slot when used as supply, returns or fully closed. All interior portions of the throat, including the vertical stems of the extrusions, shall be painted flat black to prevent unsightly visual deviations. Paint all exposed surfaces baked white enamel. Base frame shall be compatible with type of ceiling where linear slot diffuser is installed.

4. Base frame shall be provided with spacer channels located on the ceiling module. The spacer channel shall act as the support means for the adjustable full pattern control air weir gates, which are provided throughout the entire length of the base frame.

5. The noise criteria of the air distribution base frame shall be expressed in sound power levels (decibels 10-12 watts) in octave bands 2 through 7 with a room attenuation of 10 decibels and shall not exceed noise-criteria of 30. All data shall be based on tests performed in a certified laboratory.

6. Where noted on drawings or as required, blank-off airtight backside of supply air linear slot where duct connection is not made.

C. Supply or Return Air Chambers:

1. Supply or Return air plenum chambers shall be designed, tested, and fabricated by the same manufacturer that furnishes the base frames. Shop fabricated air chambers not acceptable. Provide with damper at inlet to plenum, which is accessible through face of linear diffuser for adjustment.

2. Provide adjustable air pattern controller that are accessible through the base frame slot for field adjustment of the spread of the air stream. This will be accomplished without the removal of acoustical tile.

3. Provide a round neck air entry collar sized for maximum average air entry velocity of 750 FPM. A volume damper shall be installed at connection to plenum, which is accessible through face of linear diffuser for adjustment.

4. Construct supply air chamber from not less than 26 gauge galvanized steel and will be lined with one-quarter inch 2 lb./cu. ft. density thermal acoustical insulating. All surfaces visible through the slot will be painted flat black.

5. Provide spring clip keepers to securely attach the chamber to the base frame when in operation. These spring clips permit releasing of the air chamber for easy relocation.

6. The supply air chamber shall have been tested as composite assembly with the linear base frame for air distribution and noise level performance. The tests shall be conducted in accordance with ANSI/ASHRAE Standard 70-1991.

7. For return air plenums above the ceiling, install Krueger Model DFRH plenum hood on all linear return air bars.

D. Manufacturer: Krueger Model DFL linear slot diffuser.

2.04 CEILING RETURN AND EXHAUST GRILLES AND REGISTERS
(All constant air volume systems unless otherwise noted.)

A. Registers shall be provided with opposed blade dampers.

B. Concealed Spline - Krueger EGC5 or EGC5-01.

C. Glued on Acoustile - Krueger EGC5 or EGC5-01.

D. Plaster or drywall - Krueger EGC5 or EGC5-01.
2.05 SIDEWALL SUPPLY AND RETURN REGISTERS AND GRILLES

A. Supply register - Krueger 1600.
B. Return register - Krueger 5815.
C. Return grille - Krueger 5815.

2.06 TRANSFER GRILLES

A. Ceiling - Same as return grilles.

2.07 CEILING DIFFUSERS (SUPPLY)

A. Concealed Spline - Krueger 1240-F22
B. Glued on Acoustile - Krueger 1240-F22
C. Plaster or Drywall - Krueger 1240-F22
D. 24" x 24" T-Bar - Krueger 1240-F23

Note: For 24" x 48" T-bar ceilings, coordinate with ceiling installer for auxiliary tees as required to create 24" x 24" space.

2.08 MODULAR CEILING DIFFUSERS

A. Krueger Model 1900SQ and shall have a frame style to interface with the ceiling grid system being used.
B. Manufactured from extruded aluminum. Provided with air pattern control weirs, and an integral deflection rail allowing for one- to four-way direction air flow producing uniform ceiling effect.
C. The air motion in the occupancy zone at maximum cubic feet per minute shall not exceed 50 feet per minute. Inner panel of matching acoustical tile shall provide an airtight joint.
D. Supply, Return and Exhaust Chambers:
   1. Designed and fabricated by the manufacturer of the base frames. Field fabricated chambers will not be accepted. Chamber to be supplied with spring clips to attach to the base frame. Constructed from not less than 26 gauge galvanized steel and lined with 1/4" 2 LBS/CU. FT. density thermal insulation. All surfaces visible through the air slot painted flat black.
   2. Chamber shall be supplied with a factory installed round entry collar for flex duct connection. Collar shall be sized for maximum average air entry velocity of 750 fpm. Chamber must be tested as a composite assembly with the base frame for air distribution and noise level performance by a certified testing laboratory. If used with side inlet, furnish and install vertical pressure equalizing baffle.
2.09 MODULAR CEILING RETURN
(All V.A.V. systems unless otherwise noted.)
A. Krueger Model 1900SQ Return diffuser.
B. Base frame from extruded aluminum. Frame shall have fixed weirs creating a continuous one-inch closed slot. Provide opposite blade volume damper.

2.10 SUPPLY, RETURN AND EXHAUST CONNECTIONS TO METAL LINEAR CEILING
A. Air Factors sheet metal air boot (eight-slot for connecting to back of metal linear ceiling with slot openings with labyrinths, as applicable) for supply, return, and exhaust. Air boot shall lock onto back of ceiling system.

2.11 CIRCULAR CEILING DIFFUSERS
A. Krueger Model RA2 circular diffuser with adjustable inner cone.

PART 3 - EXECUTION

3.01 INSPECTION
A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION
A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended function.
B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.
C. Coordinate ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling module.
D. Supply outlets to provide the required air throw and spread with no apparent drafts or excessive air movement within space being supplied. Contractor to provide necessary accessories to accomplish satisfactory air distribution.
E. Provide felt, cork or rubber gasket between finish-surface and frame to prevent vibration and assure tight fit. Contractor shall be responsible for the correct location of ductwork and outlets.
F. For filler panel type outlets the manufacturer shall coordinate his design with the ceiling suspension system being used. The Contractor and manufacturer shall match up sizes of outlets to properly fit in ceiling systems, between concrete or masonry components, between architectural items before fabrication.
G. When installing removable core type outlets, secure to frame with screws.
H. Secure outlets to ceiling suspension systems as required by Division of the State Architect.
SECTION 23 7513
AIR HANDLING UNITS AND WATER COILS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Section includes factory fabricated Custom Air Handling Units, associated accessories, fan and coil unit

B. Design, performance criteria, controls, and installation requirements for Custom Air Handling Units.

1.02 CODES AND STANDARDS

A. American Bearing Manufacturers Association:
   1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
   2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. Air Movement and Control Association International, Inc.:
   2. AMCA / ANSI Standard 204: Balance Quality and Vibration Levels for Fans
   5. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

C. Air-Conditioning and Refrigeration Institute:
   2. ARI 430 - Central-Station Air-Handling Units.
   3. ARI 610 - Central System Humidifiers for Residential Applications.
   4. ARI Guideline D - Application and Installation of Central Station Air-Handling Units.

D. National Electrical Manufacturers Association:
   1. NEMA MG 1 - Motors and Generators.

E. National Electrical Code:
   1. NFPA 70.

F. Sheet Metal and Air Conditioning Contractors:
   1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

G. Underwriters Laboratories Inc.:
   1. UL 900 - Air Filter Units.
   2. UL - Fire Resistance Directory.
1.03 QUALITY ASSURANCE

A. AMCA Compliance: Test and rate air handling units in accordance with AMCA standards.

B. Damper Leakage: Test in accordance with AMCA 500.

C. NFPA Compliance: Provide air handling unit internal insulation having flame spread rating not over 25 and smoke developed rating no higher than 50; and complying with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.04 RELATED SECTIONS

A. Refer to other Division 15 Sections for vibration control units used in conjunction with air-handling units; not work of this section.

B. Vibration control units required for air handling units is specified in other Division 15 Sections, and is included as work of this section.

C. Refer to other Division 15 Sections for hot and chilled water, natural gas, and condensate drain piping required in conjunction with air handling units; not work of this section.

D. Refer to Division 15 specification Section for “Maximum Sound power Level for Fan Equipment”

1.05 SUBMITTALS

A. Submit assembly-type shop drawings showing unit dimensions, weight loadings, required clearances, construction details, and field connection details.

B. Submittal shall include the following:
   1. Dimensioned plan and elevation view drawings, including motor starter VFDs and control cabinets, required clearances, and location of all field connections.
   2. Summary of all auxiliary utility requirements such as: electricity, water, compressed air, etc. Summary shall indicate quality and quantity of each required utility.
   3. Ladder type schematic drawing of the power and ancillary utility field hookup requirements, indicating all items that are furnished.
   4. Manufacturer’s performance of each unit. Selection shall indicate, as a minimum, the following:
      a. Published Literature: Indicate capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements.
      b. Input data used for selection.
      c. Model number of the unit.
      d. Net capacity.
      e. Rated load amp draw.
      f. Noise levels produced by equipment.
      g. Fan curves.
      h. Approximate unit shipping weight.
i. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.

j. Fans: Performance and fan curves with specified operating point plotted, power, RPM.

k. Sound Power Level Data: Fan outlet and casing radiation at rated capacity.

l. Dampers: Include leakage, pressure drop, and sample calibration curves. Indicate materials, construction, dimensions, and installation details.

m. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring. Indicate factory installed and field installed wiring.

C. Maintenance Data: As part of the submittal package include data on design, inspection and procedures related to preventative maintenance. Including instructions for lubrication, filter replacement, motor and drive replacement, and spare parts lists. Include this data, product data, and shop drawings, in maintenance manuals; in accordance with requirements of Division 1.

D. As part of the submittal package include Manufacturer's Installation Instructions.

E. As part of the submittal package include Manufacturer's Certificate, certifying submitted products meet or exceed specified requirements.

1.06 OPERATION AND MAINTENANCE DATA

A. Operation and Maintenance manuals including but not limited to “Maintenance Data” requirements per paragraph 1.05-c shall be submitted at the time of unit shipment.

1.07 QUALIFICATIONS

A. Manufacturer shall be a company specializing in the design and manufacture of commercial / industrial custom air handling units as specified herein after. Manufacturer shall have been in production of commercial / industrial custom air handling units for a minimum of 15 years.

B. Each unit shall bear an ETL or UL label under UL Standard 1995 indicating the complete unit is listed as an assembly. ETL or UL listing of individual components, or control panels only, is not acceptable.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery air handling units with factory-installed shipping skids and lifting lugs; pack components in factory-fabricated protective containers.

B. Handle air handling units carefully to avoid damage to components, enclosures, and finish. Do not install damaged components; replace and return damaged components to air handling unit manufacturer.

C. Store air handling units in clean dry place and protect from weather and construction traffic.

D. Comply with Manufacturer's rigging and installation instructions for unloading air handling units, and moving them to final location.
1.09 SEQUENCING AND SCHEDULING

A. Coordinate work performed under this section with work performed under the separate installation contract.

1.10 WARRANTY

A. The complete unit shall be covered by a parts warranty issued by the manufacturer covering the first year of operation. This warranty period shall start upon receipt of final acceptance by owner of the start-up forms for the unit or twenty four months after the date of shipment, whichever occurs first.

B. The installing contractor shall provide labor warranty during the unit’s first year of operation.

1.11 EXTRA MATERIAL

A. Furnish in original packaging from manufacturer and label each spare part to match the air handler unit tag the following spare parts for each air handler unit;
   1. One complete set of filters for each air handler.
   2. One set of fan belt for each fan of each air handler.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Provide custom outdoor air handling units as manufactured by Temtrol as the basis-of-design. Approved equal manufacturers would be; Governair, Huntair, Dynamic Air Technology or approved equal as defined in Section 01095 will be considered. Request for substitution shall be approved 30 calendar days before the bid date. All Manufacturers shall meet the specifications, capacities and performance criteria set forth in construction documentations and specifications.

2.02 GENERAL

A. Furnish and install where shown on the plans, mechanical frame style air handling units specifically designed for OUTDOOR application, with construction features as specified below. The units shall be provided and installed in strict accordance with the specifications. All units shall be complete with all components and accessories as specified. Any exceptions must be clearly defined. The contractor shall be responsible for any additional expenses that may occur due to any exception made.

B. All major components such as fans, coils, dampers, etc… shall be provided from sole source inside USA. Provide the list of suppliers and associated lead times for each component.

C. Air handling units shall meet the seismic design requirements set forth in the International Building Code (IBC 2009). Equipment manufacturer shall provide certificate of compliance stating units have been certified for the seismic requirements indicated on the structural drawings and in accordance with ASCE 7-05 / ICC-ES AC-156. Unit certification shall be based on a maximum SDS value of 1.93g. Certification of the Air Handling Equipment shall be through engineering analysis performed by an independent registered professional consulting engineer.
specializing in seismic analysis. The analysis performed shall include structural calculations, static and dynamic finite element analysis and shake table testing in accordance with ASCE-7-05 / ICC-ES-AC-156.A Copy of the Seismic Certification shall also be submitted as part of the submittal requirements for review and approval. The air handler shall be provided with IBC Compliant Labeling.

2.03 FACTORY TESTING AND QUALITY CONTROL

A. Standard Factory Tests: The fans shall be factory run tested to ensure structural integrity and proper RPM. All electrical circuits shall be tested to ensure correct operation before shipment of unit. Units shall pass quality control and be thoroughly cleaned prior to shipment.

2.04 UNIT CONSTRUCTION DESCRIPTION

A. General: Provide factory-fabricated outdoor air handling units with capacity as indicated on the schedule. Units shall have overall dimensions as indicated and fit into the space available with adequate clearance for service as determined by the Engineer. Units shall be completely assembled. Multiple sectioned units shall be shipped as a single factory assembled piece (except where shipping limitations prevent) de-mounted into modular sections in the field by the contractor. Units shall be furnished with sufficient gasket and bolts for reassembly in the field by the contractor. Unit manufacturer shall provide certified ratings conforming to the latest edition of AMCA 210, 310, 500 and ARI 410. All electrical components and assemblies shall comply with NEMA standards. Unit internal insulation must have a flame spread rating not over 25 and smoke developed rating no higher than 50 complying with NFPA 90A, “Standard for the Installation of Air Conditioning and Ventilating Systems.” Units shall comply with NFPA 70, “National Electrical Code,” as applicable for installation and electrical connections of ancillary electrical components of air handling units. Tags and decals to aid in service or indicate caution areas shall be provided. Electrical wiring diagrams shall be attached to the control panel access doors. Operation and maintenance manuals shall be furnished with each unit. Units shall be UL or ETL listed.

B. Unit Base - Floor: Unit perimeter base shall be completely welded and fabricated using heavy gauge structural steel tubing. (Note: bolted bases are not acceptable) C-Channel cross supports shall be welded to perimeter base steel tubing and located on maximum 24” centers to provide support for internal components. Base rails shall include lifting lugs welded to perimeter base at the corner of the unit or each section if de-mounted. Entire base frame is to be painted with a phenolic coating for long term corrosion resistance. Internal walk-on floor shall be thermal break construction, mechanically fastened, caulk seams .120” aluminum treadplate. The outer sub-floor of the unit shall be made from .040 aluminum. The floor cavity shall be spray foam insulated with floor seam gaskets for thermal break and sealed for airtight / watertight construction. Where access is provided to the unit interior, floor openings shall be covered with walk on phenolic coated steel safety grating. Single wall floors with glued and pined insulation and no sub floor are not acceptable. Base frame shall be attached to the unit at the factory.

C. Unit Casing – The construction of the air handling unit shall consist of a (1” x 2”) formed steel frame to form a strong infrastructure steel frame with formed 0.063 aluminum exterior casing panels. The exterior casing panels shall be attached to the
gasket (1 x 2) steel frame with corrosion resistant fasteners. All casing panels shall be completely removable from the unit exterior without affecting the unit's structural integrity. (Units without framed type of construction shall be considered, provided the exterior casing-panels are made from 14 Gauge galvanized steel, maximum panel center lines are less than 20 inches and deflection is less than L/200 @ 9” positive pressure). The air handling unit casing shall be of the “no-through-metal” design. The casing shall incorporate insulating thermal breaks as required so that, when fully assembled, there’s no path of continuous unbroken metal to metal conduction from inner to outer surfaces. Provide necessary support to limit casing deflection to L/200 of the narrowest panel dimension. If panels cannot meet this deflection, additional internal reinforcing is required. All panel seams shall be caulked and sealed for an airtight unit. Leakage rates shall be less than 1% at design static pressure or 9” W.C. whichever is greater.

D. The exterior panel finish shall be painted with a polyester resin coating designed for long term corrosion resistance meeting or exceeding (ASTM B-117) Salt Spray Resistance at 95 degrees F. 2,500 hrs. And (ASTM D-2247) Humidity Resistance at 95 degrees F. 2,500hrs. The color shall be sandstone.

E. Double Wall Liner - Each unit shall have double wall construction with 0.040 aluminum liner in the entire unit. The double wall interior panel shall be removable from the outside if the unit without affecting the structural integrity of the unit.

F. Insulation - Entire unit shall be insulated with a full 3” (R12.5) thick non-compressed fiberglass insulation. The insulation shall have an effective thermal conductivity (C) of 0.24 (BTU in/sq ft F°) and a noise reduction coefficient (NRC) of 0.70 / per inch thick (based on a type "A" mounting). The coefficients shall meet or exceed a 3.0 P.C.F. density material rating. Insulation shall meet the erosion requirements of UL 181 facing the air stream and fire hazard classification of 25/50 (per ASTM-84 and UL 723 and CAN/ULC S102-M88) and meet NFPA 90A and 90B. All insulation edges shall be encapsulated within the panel. All perforated sections shall have Micromat®or equal insulation with non-woven mat facing, 5000 fpm rating and non-hygroscopic fibers as manufactured by Johns Manville or approved equal.

G. Weatherproof construction shall consist of a third waterproof panel over the roof of the double wall panel to make the unit weather tight.

H. Access Doors - The unit shall be equipped with a solid double wall insulated (same as the unit casing), hinged access doors as shown on the plans. The doorframe shall be extruded aluminum, foam filled with a built in thermal break barrier and full perimeter gasket. The door hinge assembly shall be completely adjustable die cast stainless steel. There shall be a minimum of two heavy duty handles per door. Provide ETL, UL 1995, and CAL-OSHA approved tool operated safety latch on all fan section access doors.
   1. Provide thermal break door design.
   2. Access doors in the fan section shall be provided with a 10 x 10 dual thermal pane safety glass window.
2.05 UNIT COMPONENT DESCRIPTION

A. Fans: All fans shall meet the air flow performance specified and shall not exceed the break horsepower or sound power levels specified on the mechanical equipment schedule. Fan performance shall be based on testing and be in accordance with AMCA Standards 210 and 300. All fans shall have a steep pressure/volume curve. Fan shaft shall be turned, ground and polished solid steel rated at maximum RPM below critical speed. Fan wheel and sheaves shall be keyed to the shaft. Fan shall be balanced per ANSI / AMCA 204-96 fan application category BV-3 using a digital signal analyzer at the design RPM with belts and drives in place to a vibration velocity less than or equal to 0.157 inches per second measured horizontal and vertical at each bearing pad. Vibration amplitudes are in inches/second-Peak. All values are filter-in at the fan speed. Fan assemblies shall be designed for heavy-duty industrial applications. Fan framing assemblies shall be fabricated from structural steel. Formed load bearing members are not acceptable. The structural steel shall be electrically welded together to form a rigid integral base. Fan assemblies shall be independently isolated with spring-type vibration isolators. Inlet cones shall be precision spun or die formed. Inlet cones shall be aerodynamically matched to the wheel side plate to provide streamlined airflow in the wheel and ensure full loading of the blades.

1. Plug Fan (PF) SWSI fans: Fans shall be single width single inlet arrangement 3 plenum belt drive fans as indicated on the schedule. Fan blades shall be hollow airfoil in shape, welded to the center and wheel side plates. Fan bearings shall be heavy duty, self-aligning, Dodge concentric “Grip Tight” type with full contact on shaft. Bearings shall be selected for a minimum L-10 life (100,000) hours at maximum horsepower and operating speed for the classification. Rigid support for the inlet bearing must be removable for access to the wheel. Inlet cone shall be precision spun. The fan shall be rated in accordance with AMCA 210 for performance and AMCA 300 for sound.

2. The following fan options shall be provided:
   a. Internally spring isolated fan, motor and drive on a structural steel base complete with flex connection. Formed metal isolation bases will not be acceptable. Provide Amber Booth (Zone 4) seismically restrained isolator type (SWSR or SWERT) with 2 inch deflection.
   b. Provide airflow monitoring device equal to TemFLO device at the inlet of all supply fans. Air monitoring device shall consist of an array of differential pressure flow sensors mounted at opposing 90° positions around the inlet of the plenum fan. Flow sensors shall be manifolds together with pneumatic tubing to form a piezometric ring. Each fan assembly and air monitoring device shall have been tested for airflow vs. differential pressure and calibrated in an AMCA Accredited Laboratory throughout the fans range of operation. 4-20ma low pressure transducer with accuracy of ±1% full span and temperature compensated from 25 to 150°F, shall be mounted on fan inlet plate or fan bulk head wall to provide feedback. Air monitoring device shall not obstruct the fan inlet, be directly mounted across the fan inlet or have any effect on fan air performance or sound power levels. Airflow monitoring device shall have the capability of DC (direct current) output for connection to Building Automation System.
   c. Provide additional air flow stations as specified on control drawings.
      Coordinate with Division 17.

3. Motors shall be NEMA Design B; T-FRAME mounted on an adjustable steel base. All motors shall be tested to IEEE standard 112 test method B and rated
per NEMA MG1, Part 31 “Inverter Fed Motors”. All motors shall be specifically designed to meet or exceed all (EPAct) requirements for energy efficiency and include Class ‘F’ insulation. Motors shall be as manufactured by Baldor, Toshiba, Reliance or equal. Motors shall meet the electrical characteristics as specified for voltage, rpm, and efficiencies in contract document and requirements of section 15030.

4. Variable Pitch drives sheaves shall be furnished on motors up to 10 HP and fixed pitch on 15 HP and above. Fixed pitch sheaves shall be provided on all fans in excess of 2,000 rpm. V-Belt drives shall be selected at 175% motor nameplate horsepower. Option: Unit manufacturer to provide a sheave change after final field balance.

5. VFDs – Variable Frequency Drives shall be per requirements of specification section 23 0520, ABB Model ACH550. Each supply and return fan shall be provided with separate variable frequency drives. Drives shall be factory mounted inside the air handler unit with adequate ventilation provided. The variable frequency drive shall convert 460 volt +/- 10%, three phase, 60 hertz (+/- 2 Hz.) utility power to adjustable voltage/frequency, three phase, A-C power step less motor control from 5% to 105% of base speed. The variable frequency drive (VFD) shall produce an adjustable A-C voltage/frequency output of complete motor speed control and an input power factor near unity over the entire speed range. The VFD shall be automatically controlled by a control signal. The VFD shall be self contained, totally enclosed in a NEMA 1 ventilated cabinet and capable of operation between 0 and 40 ° Celsius. The VFD shall be UL listed. Components used in all options shall be UL listed. The VFD shall have a hand/off/auto operator switch, drive switch with run or stop command and panel mounted digital display capable of indicating unit status, frequency, and fault diagnostics.

B. Heat Transfer Coils – Water Coil
1. All coil assemblies shall be leak tested under water at 315 PSIG and PERFORMANCE is to be CERTIFIED under ARI Standard 410. Coils exceeding the range of ARI standard rating conditions shall be noted.
2. Cooling coils shall be mounted on stainless steel support rack to permit coils to slide out individually from the unit. Provide intermediate drain pans on all stacked cooling coils. The intermediate pan shall drain to the main drain pan through a copper downspout. Water coils shall be constructed of seamless copper tubing mechanically expanded into fin collars. All fins shall be continuous within the coil casing to eliminate carryover inherent with a split fin design. Fins are die formed Plate type.
3. Headers are to be seamless copper with die formed tube holes.
4. Connections shall be male pipe thread (MPT) Schedule 40 Red Brass with 1/8" vent and drain provided on coil header for coil drainage. All coil connections shall be extended to the exterior of the unit casing by the manufacturer. Coils shall be suitable for 250 PSIG working pressure. Intermediate tube supports shall be supplied on coils over 44" fin length with an additional support every 42" multiple thereafter.
5. Water coils shall have the following construction:
   a. 5/8" O.D. x .020" wall copper tube with .028 return bends,
   b. 0.008" aluminum fins,
   c. 16 gauge 304 stainless steel casing.
C. Condensate / Drain Pans - IAQ style drain pans shall be provided under all cooling coils as shown on the drawings. The drain pan shall be fabricated from 16 gauge 304 stainless steel. All pans are to be triple pitched for complete drainage with no standing water in the unit. They shall be insulated minimum 3-inch "Double Bottom" construction with welded corners. Provide stainless steel, 1-1/4” MPT drain connection extended to the exterior of the unit base rail. Units in excess of 159 inches shall have drain connections on both sides. All drain connections shall be piped and trapped separately for proper drainage.

D. Filters - Provide filters of the type indicated on the schedule. Factory fabricated filter sections shall be of the same construction and finish as the unit. Face loaded pre and final filters shall have Type 8 frames as manufactured by BLC, FARR or equal. Filter racks over 72" in length shall require an angle center reinforcement support. Side service filter racks shall be fabricated from no less than 16 gauge galvanized steel and include hinged access doors on both sides of the unit or as indicated on unit drawings. Internal blank-offs shall be provided by the air unit manufacturer as required to prevent air bypass around the filters.

1. Filter Gauge: Each Filter bank shall be furnished with Dwyer Series 2000 filter gauge or equal.
2. Medium Efficiency MERV 8 Pleated filters – Provide 2” filters as specified on filter schedule. The filters shall be as manufactured by AAF, FARR or equal. Filters shall be in compliance with ANSI/UL 900 – Test Performance of Air Filters.

E. Dampers –Temtrol TD-6, Ruskin CD-50 or approved equal. Provide Class 1 rated, ultra low leak dampers (less than 3 CFM/sq ft. @ 1” W.G.) as indicated on the unit drawings. Low leakage dampers shall have extruded aluminum airfoil blades. Flat or formed metal blades are not acceptable. The damper blade shall incorporate santoprene rubber edge seals and zinc plated or stainless steel tubular steel shaft for a non-slip operation. Shaft bearings shall be spherical – non corrosive nylon to eliminate friction and any metal to metal contact. Damper jamb seals shall be UV rated, nylon glass reinforced or stainless steel spring arcs designed for a minimum air leakage and smooth operation. Damper linkage shall be concealed within a 16 gauge galvanized steel frame. Coordinate operator requirement with division 17.

F. AIR MONITORING STATION: The air monitoring station for minimum air flow shall combine the functions of control damper and flow measurement station in one assembly. Air straightener manufactured of 3000 series aluminum alloy honeycomb contained in 5” long 16 gauge galvanized sleeve attached to monitoring blade frame.. Fixed anodized aluminum monitoring blades are mounted in 10” 16 gauge galvanized frame. Control dampers feature airfoil shaped 6063T5 heavy gauge extruded aluminum blades rotating on 1/2" plated steel hex axles, mounted in a 4"x 1" 6063T5, .081” thickness extruded aluminum channel with mounting flanges on both sides of frame. Jamb seals are flexible metal compression type. Blade seals are Ruskiprene seals along control damper blade edges. Bearings are molded synthetic. Linkage is galvanized steel, concealed in the frame.

1. The acceptable range of operation is 300- fpm to 2000- fpm face velocity.
2. The air monitoring station shall be tested to AMCA Standard 611-95 and qualified to bear the AMCA Ratings Seal for Airflow Measurement performance.
3. Minimum outside air flow shall be Ruskin AML6 as the basis of design.
G. Louvers:
   1. Exhaust Air applications - Provide extruded aluminum stationary louvers, drainable type with built in downspouts and bird-screen. Blades shall be housed inside a 16 Ga. galvanized steel frame mounted to the unit exterior. Louver finish, to match exterior unit finish.
   2. Outside Air applications - RUSKIN EME3625D extruded aluminum louvers shall be used at O/A location. Louvers shall be stationary, drainable type with built in downspouts and furnished with bird-screen. Blades shall be vertical and housed inside an aluminum frame mounted to the unit exterior. Louver finish, to match exterior unit finish.

2.06 ELECTRICAL POWER AND CONTROLS

A. Electrical shall be single point power for the entire unit.

B. The unit shall feature a main non-fused disconnect of the proper amp rating to allow shutoff of all electrical motors and control items.

C. All electrical and automatic control devices not previously called out or listed below are to be furnished and installed.

D. All wiring shall be (75°C) Insulated copper wires.

E. The unit shall feature a mounted permanent engraved metal nameplate displaying at a minimum the manufacturer, serial number, model number, CFM, fan HPs, and current and amps voltage. The unit must have an ETL or UL Listing and bear the appropriate mark.

F. Conduit shall consist of a combination of EMT or flexible metal conduit as required. Liquid-tite flexible metal conduit may be used outside the air tunnel for wet locations.

G. The unit shall feature a main non-fused disconnect of the proper amp rating to allow shutoff of all electrical motors and control items.

H. A Recessed compartment shall be furnished on the (end / side) of the unit. The compartment shall be ventilated with supply air from the unit to provide adequate cooling of electrical components mounted within. Access doors(s) shall be furnished on the unit exterior to provide service to all components.

I. Unit Convenience Features
   1. Each section shall be equipped with a vapor-proof 100 watt service light with guard.
   2. Lights shall be controlled by one light switch mounted adjacent to the supply air fan access door.
   3. Furnish a 120 volt GFI duplex convenience outlet on the exterior of the unit. Coordinate with division 16.
   4. All lights, switches and outlets shall be wired to a fused or non-fused disconnect for a separate 120 volt external source. Coordinate with division 16.
J. Smoke Detector – A factory mounted and wired reset ionization type smoke detector(s) located in supply air stream shall be provided.

K. UV Lights:
1. The air handling unit manufacturer shall furnish and install, including interconnecting wiring and safety interlocks, a germicidal UVC irradiation system for each air handler. A heavy-duty UVC germicidal irradiation system using short wave UVC germicidal lamps shall be furnished with each air handler.
2. Intensity: The minimal UV energy striking a targeted surface shall be sufficient to destroy a monolayer of common mold and fungi within six hours.
3. Lamps and fixtures are to be installed in sufficient quantity and in such a manner to ensure equal distribution of UV energy across the cooling face and drain pans.
4. Lamps: Each lamp shall contain no more than 8 milligrams of mercury consistent with current environmental practices and shall be capable of producing its specified output in temperatures of 55 - 135° and airflow velocities up to 1000 fpm. Useful lamp life shall be 9,000 hours with no more than 20% output loss at the end of one year, continuous use. Lamps shall be constructed of UV proof metal bases and shall not product ozone or other secondary contamination.
5. Fixtures: Each fixture shall be constructed of stainless steel. Galvanized steel or aluminum is not acceptable. All integral parts of the fixture shall be self-contained. Fixtures constructed to UL drip proof design and equipped with safety approved fixture-to-fixture plugs to facilitate UL approved multiple fixture and row coupling to A/C power. The UV assembly shall include mechanical interlocks to prevent energizing unless the system is properly installed.
6. Power Supplies: The power supply shall be electronic, high-efficiency type capable of producing the required coverage at no more than 80 watts of power consumption for each four square feet of cross sectional plenum area. Power supply shall be 120 VAC, 60 Hz. Power supply shall be matched to the lamp and designed to maximize photon production, radiance and reliability. Electronic power supply shall be UL listed for application in airstreams between 55 and 135°. There shall be a single source power connection wired with the VFD through a disconnect switch.
7. Portal: The UV lamp plenum area shall be equipped with a portal for viewing the lamp assembly. Portal shall be constructed to allow viewing without the possibility of exceeding the Minimal Erythermal Dose.
8. Testing and Safety Listing: UV fixtures shall have been tested and listed as UL/C-UL under Category Code ABQK (accessories, air duct mounted), UL Standards 153, 1598 and 1995 respectively. No exceptions. Manufacturer of UVC components shall be ISO 9001 certified.

2.07 VARIABLE FREQUENCY DRIVE

A. General: Refer to Section 23 0520. Variable Frequency Drives shall be furnished and installed by Air Handling Unit manufacturer and shall be factory wired and installed.

2.08 FACTORY TESTING

A. Standard Factory Tests:
1. The fans shall be factory run tested to ensure structural integrity and proper RPM. Provide copy of the test report as part of equipment submittal.
2. All electrical circuits shall be tested to ensure correct operation before shipment of unit.
3. Units shall pass quality control and be thoroughly cleaned prior to shipment.

B. Factory Sound Testing: The equipment manufacturer shall furnish calculations showing the estimated sound power levels at the supply and, return connections, as well as unit casing radiation for each air conditioning unit. Calculations shall be based on fan sound power levels which were determined in accordance with AMCA Standard 300 and 301. Provide copy of the test report as part of equipment submittal. Sound power levels shall be determined for each octave band and shall not exceed the following:

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2.09 RIGGING PROVISION

A. Rigging Provision – Multiple Piece Units: Units shipped in multiple sections shall be engineered for field assembly. The base frame shall have integral lifting lugs. The lifting lugs shall be fabricated from structural steel with an appropriate rigging hole. Lifting lugs shall be located at the corner of each section (and along the sides if required) and sized to allow rigging and handling of the unit. All gasket and necessary assembly hardware shall ship loose with unit. Junction boxes with a factory supplied numbered terminal strip shall be supplied at each shipping split for reconnection of control wiring.

PART 3 -EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which air handling units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF AIR HANDLING UNITS

A. General: Install air handling units where indicated, in accordance with equipment manufacturer’s published installation instructions, and with recognized industry practices, to ensure that units comply with requirements and serve intended purposes.
B. Coordination: Coordinate with other work, including ductwork, floor construction, roof-decking, and piping, as necessary to interface installation of air handling units with other work.

C. Access: Provide access space around air handling units for service as indicated, but in no case less than that recommended by manufacturer.

D. Piping Connections: Refer to Division 15 HVAC sections. Provide piping, valves, accessories, gages, supports, and flexible connectors as indicated.

E. Duct Connections: Refer to Division 15 Air Distribution sections. Provide ductwork, accessories, and flexible connections as indicated.

F. Grounding: Provide positive equipment ground for air handling unit components.

3.03 FIELD QUALITY CONTROL

A. Testing: Upon completion of installation of air handling units, start-up and operate equipment to demonstrate capability and compliance with requirements, field correct malfunctioning units, then retest to demonstrate compliance.

3.04 EXTRA STOCK

A. Furnish in original packaging from manufacturer and label each spare part to match the air handler unit tag the following spare parts for each air handler unit:
   1. One complete set of filters for each air handler.
   2. One set of fan belt for each fan of each air handler.
   3. Obtain receipt from Owner that belts and filters have been received by owner.

END OF SECTION 23 7513
SECTION 23 8126

SPLIT AIR CONDITIONING SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Split DX cooling only and heat pump system with indoor split DX fan coil and outdoor cooling/condensing unit.

1.02 RELATED SECTIONS

A. Related sections include but are not limited to the following:

1. Division 23
   a. Section Basic HVAC Requirements.
   b. Section Electrical Requirements for HVAC Equipment.
   c. Section Building Automation System required in conjunction with split cooling system
   d. Section Testing, Adjusting and Balancing
   e. Section Power and Gravity Ventilators

2. Division 26
   a. Section Electrical Connections for Equipment

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, dimensions, required clearances, weights, furnished specialties and accessories; and installation and start-up instructions.

B. Shop Drawings:

1. Submit shop drawings detailing the manufacturer's electrical requirements for power supply wiring for rooftop cooling/condensing and DX fan coil units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

2. Submit shop drawings detailing the mounting, securing, and flashing of the outdoor unit to redwood sleepers and sleepers to the roof structure. Indicate coordinating requirements with roof membrane system.

C. Operation and Maintenance Data: Submit maintenance data and parts list for each split cooling system, including "trouble-shooting" maintenance guide, servicing guide and preventative maintenance schedule and procedures. Include this data in maintenance manual in accordance with requirements of Division 1.

1.04 QUALITY ASSURANCE

A. Codes and Standards:

1. Refrigerating system construction of split cooling system shall be in accordance with ASHRAE 15 "Safety Code for Mechanical Refrigeration".
2. Seasonal Energy Efficiency Ratio (SEER) of split cooling system shall be equal to or greater than prescribed by Title 24 California Administrative Code "Building Energy Efficiency Standards".

3. Split cooling system shall be designed, manufactured, and tested in accordance with UL requirements.

1.05 DELIVERY, STORAGE AND HANDLING

A. Handle split cooling system and components carefully to prevent damage. Replace damaged rooftop units or components with new.

B. Store split cooling system and components in clean dry place, off the ground, and protect from weather, water, and physical damage.

C. Rig outdoor units to comply with manufacturer's rigging and installation instructions for unloading outdoor units, and moving them to final location.

1.06 SCHEDULING AND SEQUENCING

A. Coordinate installation of outdoor unit redwood sleepers with roof structure.

B. Coordinate roof-opening locations for mechanical and electrical connections.

1.07 SPECIAL WARRANTY

A. Warranty on Compressor: Provide written warranty, agreeing to replace/repair, including all parts and labor within warranty period, compressors with inadequate and defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform a required provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period.

B. Warranty period shall be for a period of one year from the agreed start of the District's beneficial use.

C. Extended warranty period. Provide written warranty signed by manufacturer, agreeing to replace components parts only, for an additional four (4) years for all hermetically sealed compressors.

1.08 MAINTENANCE

A. Extra Materials: Furnish to District, with receipt, the following spare parts for each split cooling system:

1. One set new filters for each unit set.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Provide product of one of the following manufacturers:

1. Carrier Corp.
2. Mitsubishi
3. Trane
2.02 SPLIT COOLING SYSTEM (GENERAL)

A. Split cooling only and heat pump system shall be factory assembled and tested, consist of an indoor, wall mounted direct expansion fan coil unit and an outdoor roof mounted, air cooled unit with a hermetic compressor, an air cooled coil, up-blast propeller type blow-through condenser fans, accumulator, holding refrigerant charge, and control box.

2.03 INDOOR UNIT

A. General: Indoor, direct-expansion, wall-mounted or ceiling-mounted fan coil. Unit shall be complete with coil, fan, fan motor, piping connectors, electrical controls, microprocessor control system, integral temperature sensing, and a holding charge of R-410A refrigerant. Unit shall be furnished with integral wall-mounting or ceiling-mounting bracket.

B. Unit Cabinet: Cabinet discharge and inlet grilles shall be attractively styled, high-impact polystyrene.

C. Fan: Shall be tangential blower type with air intake at the upper front face of the unit and discharge at the bottom front. Automatic motor-driven horizontal air sweep shall be provided standard.

D. Coil: Shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins will be bonded to the tubes by mechanical expansion. A drip pan under the coil shall have a drain connection for hose attachment to remove condensate.

E. Motors: Shall be permanently lubricated with inherent overload protection. Fan motors shall be multi-speed.

F. Controls: Shall consist of a microprocessor-based control system that shall control space temperature, determine optimum fan speed, and run self-diagnostics. The unit shall have:

1. An automatic restart after power failure at the same operating conditions as at failure.
2. A timer-function to provide a minimum 15-hour timer cycle for system on or off.
3. Temperature-sensing controls and a high discharge temperature shut down.
4. Wired control or wireless infrared control to enter set points and operating controls (required accessory).
5. Filter status indication after 250 hours of indoor fan operation.
6. Test mode button to run self-diagnostics and aid in troubleshooting.

G. Filters: Unit shall have filter track with factory-supplied cleanable filter.

2.04 OUTDOOR UNIT

A. General: Factory assembled, single piece, air-cooled outdoor unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, compressor, and holding charge of R-410A refrigerant.

B. Unit Cabinet:

1. Unit cabinet shall be constructed of galvanized steel, bonderized and coated with a baked enamel finish.
2. Unit access panels shall be removable with minimal screws and shall provide full access to the compressor, fan, and control components.
3. Compressor compartment shall be isolated and have an acoustic lining to assure quiet operation.

C. Fans:
1. Condenser fans shall be direct-drive propeller type, discharging air horizontally, and blowing air through the condenser coil.
2. Condenser fan motors shall be totally enclosed, single-phase motors with class B insulation and permanently lubricated ball bearings. Motor shall be protected by internal thermal overload protection.
3. Shaft shall have inherent corrosion resistance.
4. Fan blades shall be corrosion resistant and shall be statically and dynamically balanced.
5. Condenser fan openings shall be equipped with PVC grille cover and screen protection grille.

D. Compressor:
1. Compressor shall be fully hermetic reciprocating or scroll type.
2. Compressor shall be equipped with oil system, operating oil charge, and motor. Internal overloads shall protect the compressor from over temperature and current. Scroll compressors shall also have high discharge gas temperature protection.
3. Motor shall be NEMA rated class F, suitable for operation in a refrigerant atmosphere.
4. Reciprocating compressors shall be equipped with crankcase heaters to minimize liquid refrigeration accumulation in compressor during shut down and to prevent refrigerant dilution of oil.
5. Compressor assembly shall be installed on rubber vibration isolators and shall have internal spring isolation.

E. Condenser Coil: Shall be constructed of aluminum fins mechanically bonded to internally enhanced, seamless copper tubes that are cleaned, dehydrated, and sealed.

F. Refrigeration Components: Refrigerant circuit components shall include external liquid line service valve with service port, suction line service valve with service gage connection port, service port connections on compressor suction and discharge lines with Schrader-type fittings, 4-way valve on heat pumps, accumulator, filter drier, pressure relief, and a holding charge of refrigerant.

G. Controls and Safeties: Operating controls and safeties shall be factory selected, assembled, and tested. The minimum control function shall include:

1. Controls:
   a. Time delay restart to prevent compressor short cycling.
   b. Automatic restart on power failure.
   c. Three-pole contactors on 3-phase units.
   d. Safety lockout.
   e. High and low pressure switches.
   f. Automatic fan motor protection.
   g. Start capacitor and relay only on single-phase units.
   h. When heat pump units are matched with high wall and ceiling suspended units, defrost control shall be based on demand determined by the outdoor air temperature and the coil temperature.

2. Safeties:
a. High temperature protection.
b. System diagnostics.
c. Compressor motor current and temperature overload protection.
d. High-pressure relief.
e. Condenser fan failure protection.

H. Electrical Requirements:
   1. Unit electrical power shall be a single point connection.
   2. Unit control voltage to the indoor fan coil shall be 24V.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which split cooling system is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION

A. General: Install split cooling system in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

B. Support: Install and secure redwood sleepers to roof structure, in accordance with National Roofing Contractors Association (NRCA) installation recommendations and shop drawings.

C. Electrical Connections: Refer to Division 16 Electrical Connections for Equipment for final connections to equipment and installation of loose-shipped electrical components.

3.03 DEMONSTRATION

A. Provide the services of a qualified service representative to start-up split cooling system in accordance with manufacturer's written start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

END OF SECTION 23 8126
SECTION 26 0500
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to, the following:
   1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
   2. Electrical General Provisions and requirements for electrical work.
   3. Division-1; General Requirements; General Conditions.

B. Organization of the Specifications into Divisions, Sections and Articles, and arrangement of Drawings shall not control the CONTRACTOR in dividing the Contract Work among Sub-contractors or in establishing the extent of work to be performed by any trade.

1.02 GENERAL SUMMARY OF ELECTRICAL WORK

A. The Specifications and Drawings are intended to cover a complete installation of systems. The omission of expressed reference to any item of labor or material for the proper execution of the work in accordance with present practice of the trade shall not relieve the CONTRACTOR from providing such additional labor and materials.

B. Refer to the Drawings and Shop Drawings of other trades for additional details, which affect the proper installation of this work. Diagrams and symbols showing electrical connections are diagrammatic only. Wiring diagrams do not necessarily show the exact physical arrangement of the equipment.

C. Before submitting a bid, the CONTRACTOR shall become familiar with all features of the Building Drawings and Site Drawings, which may affect the execution of the work. No extra payment will be allowed for failure to obtain this information.

D. If there are omissions or conflicts between the Drawings and Specifications, clarify these points with the District’s Representative before submitting bid and before commencing work.

E. Provide work and material in conformance with the Manufacturer’s published recommendations for respective equipment and systems.

1.03 LOCATIONS OF EQUIPMENT

A. The Drawings indicate diagrammatically the desired locations or arrangements of conduit runs, outlets, equipment, etc., and are to be followed as closely as possible. Proper judgment must be exercised in executing the work so as to secure the best
possible installation in the available space and to overcome local difficulties due to space limitations or interference of structure conditions encountered.

B. Where outlets are placed on a wall, locate symmetrically with respect to each other, furniture, cabinets, and other features or finishes on the wall.

C. In the event changes in the indicated locations or arrangements are necessary, due to developed conditions in the building construction or rearrangement of furnishings or equipment, such changes shall be made without cost to the Contract, providing the change is ordered before the conduit runs, etc., and work directly connected to same is installed and no extra materials are required.

D. Lighting fixtures in mechanical spaces are shown in their approximate location only. Do not install light outlets or fixtures until mechanical piping and ductwork is installed; then install lights in a location to provide best lighting.

E. Coordinate and cooperate in every way with other trades in order to avoid interference and assure a satisfactory job.

F. The location of the existing utilities, building, equipment and conduit shown on the Drawings is approximate. Verify exact locations and routing of existing systems by potholing all trench routes prior to digging the trench. Pothole at least 100 feet ahead of the actual trenching to allow space to alter the new conduit routing to accommodate existing conditions.

G. Underground Detection Services Existing Utility Structures
1. Detection/location services shall be provided utilizing the latest detection equipment available. Services shall be performed by a company regularly engaged in the business of existing Underground Utility Structure Detection for the past 5-years.
2. Prior to excavation and prior to directional boring the following work shall be performed:
   a. Contractor to mark excavating and trenching/directional boring locations and indicate width and depth.
   b. Locate, by way of vertical and horizontal control dimensions, existing subgrade petroleum product pipes, process piping, conduits, sewer, water, gas, storm drain, electrical, telephone, and irrigation lines in the affected areas of Contract construction work.
   c. Arrange and meet with the District’s Representative to review existing underground conditions.
   d. The proposed route of each excavation shall be continuously surveyed along the entire excavation path using Ground-Penetrating Radar (GPR) operating from the surface grade. The GPR shall detect and map existing underground metal and non-metal, both private and public utility lines, pipes, conduits, conductors, etc. The GPR shall identify the horizontal and vertical location of existing underground conditions located at a depth of up to 3-meters below finish grade and located with a vertical and horizontal accuracy within ± 12-inches of actual condition. The Contractor shall add this information to the existing conditions site plan.
3. Exercise extreme caution in directional boring, excavating and trenching on this site to avoid existing underground utilities and structures, and to prevent hazard to personnel and/or damage to existing underground utilities or structures. The Contract Documents, Drawings and Specifications do not
include necessary components for construction safety, which is the responsibility of the CONTRACTOR.

4. Repair/replace, without additional cost to the Contract, and to the satisfaction of the District any existing work damaged that was identified in the Record Drawings provided; Identified by the District’s Representative; Identified by the Underground Detection Services performed; or any existing work damaged as a result of failure to comply with all the referenced requirements.

5. The CONTRACTOR shall contact Common Ground Alliance (CGA) telephone #811 “Know What’s Below-Call Before You Dig” and Underground Service Alert (USA), not less than 72-hours prior to excavation. Contractor shall not excavate until verification has been received from CGA and USA that existing underground utilities serving the site have been located, identified, and marked.

H. The locations of existing underground utilities, where shown on Drawings, are shown diagrammatically and have not been independently verified by the District, the District’s Representative, the Architect/Engineer. The District, the District’s Representative, and the District’s Architect/Engineer are not responsible for the location of underground utilities or structures, whether or not shown or detailed and installed under this or any other Contracts. The CONTRACTOR shall identify each existing utility line prior to excavation and mark the locations on the ground of each existing utility line.

1.04 AIR CONDITIONING, HEATING, PLUMBING EQUIPMENT WIRING

Provide electrical work, materials, and control components required for proper operation of the air conditioning, heating and plumbing systems as indicated on the Electrical, Mechanical, and Plumbing Contract Documents and specified herein.

1.05 PERMITS

Take out and pay for all Required Permits, Inspections and Examinations without additional cost to the DISTRICT.

1.06 QUALITY ASSURANCE

A. Work and Materials shall be in full accordance with the latest Rules and Regulations as follows. The following publications shall be included in the Contract Documents requirements. If a conflict occurs between the following publications and any other part of the Contract Documents, the requirements describing the more restrictive provisions shall become the applicable Contract definition:

2. California Part 3 "California Electrical Code" CEC, Title 24 and Title 8 "Division of Industrial Safety".
4. California Fire Code – CFC
9. Underwriter’s Laboratory – UL.
10. Other applicable State and Local Government Agencies Laws and Regulations.
11. Electrical Installation Standards National Electrical Contractors Association (NECA) and National Electrical Installation Standards (NEIS):
a. NECA/NEIS-1: Standard of Practices for Good Workmanship in Electrical Contracting  
b. NECA/NEIS-101: Standard for Installing Steel Conduit (Rigid, IMC, etc.)  
c. NECA/NEIS-104: Recommended Practice for Installing Aluminum Building Wire and Cable  
d. NECA/NEIS-105: Recommended Practice Installing Metal Cable Trays  
e. NECA/NEIS-111: Recommended Practice Installing Nonmetallic Raceways  
f. NECA/NEIS-230: Recommended Practice for Installing Motors  
g. NECA/FOA-301: Standards for Installing and Testing Fiber Optic Cables  
h. NECA/NEIS-305: Standard for Fire Alarm System Job Practice  
i. NECA/NEIS-331: Standards for Installing Building and Service Entrance Grounding  
j. NECA/NEIS-400: Recommended Practice for Installing and Maintaining Switchboards  
k. NECA/NEIS-402: Recommended Practice for Installing and Maintaining Motor Control Centers  
l. NEIS/NECA and EGSA-404: Recommended Practice for installing Generator Sets  
m. NECA/NEIS-405: Recommended Practices for installing and Commissioning Interconnected Generation Systems  
n. NECA/NEIS-407: Recommended Practice for Installing Panelboards  
o. NECA/NEIS-408: Recommended Practices for Installing Busway  
p. NECA/NEIS-409: Recommended Practice for Installing and Maintaining Dry-Type Transformers  
q. NEIS/NECA and IESNA-500: Recommended Practice for Installing indoor Commercial Lighting Systems  
r. NEIS/NECA and IESNA-501: Recommended Practice for Installing Exterior Lighting Systems  
s. NEIS and IESNA-502: Recommended Practice for Installing Industrial Lighting Systems  
t. NECA/BICSI-568: Standards for Installing Commercial Building Telecommunications System  
u. NECA/NEIS-600: Recommended Practice Installing Medium-Voltage Cable  

B. All Material and Equipment shall be new and shall be delivered to the site in unbroken packages. All material and equipment shall be listed and labeled by Underwriters Laboratories or other recognized Testing Laboratories, where such listings are available. Comply with all installation requirements and restrictions pertaining to such listings.

C. Work and Material shown on the Drawings and in the Specifications are new and included in the Contract unless specifically indicated as existing or N.I.C. (not in Contract).

D. Keep a copy of all applicable Codes and Standards available at the job site at all times for reference while performing work under this Contract. Nothing in plans or Specifications shall be construed to permit work not conforming to the most stringent of Building Codes.
E. Where a conflict or variation occurs between applicable Codes, Standards and/or the Contract Documents, the provisions of the most restrictive provision shall become the requirement of the Contract Documents.

1.07 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. General
   1. Review of CONTRACTOR'S submittals is for General Conformance with the design concept of the Project and General Compliance with the information given in the Contract Documents. Any action shown is subject to the requirements of the Plans and Specifications. CONTRACTOR is responsible for quantities; dimensions which shall be confirmed and correlated at the job site; fabrication processes and techniques of construction; coordination of work with that of all other trades and satisfactory performance of their work.
   2. The CONTRACTOR shall review each submittal in detail for compliance with the requirements of the Contract Documents prior to submittal. The CONTRACTOR shall "Ink Stamp" and sign each item of the submittal with a statement "CERTIFYING THE SUBMITTAL HAS BEEN REVIEWED BY THE CONTRACTOR AND COMPLIES WITH ALL THE REQUIREMENTS OF THE CONTRACT DOCUMENTS". The CONTRACTOR shall clearly and specifically identify each individual proposed substitution, substitution of equal or proposed deviation from the requirements of the Contract Documents with a statement "THIS ITEM IS A SUBSTITUTION".
      The burden of research, preparation of calculations and the furnishing of adequate and complete Shop Drawings information to demonstrate the suitability of CONTRACTOR'S proposed substitutions and suitability of proposed deviations from the Contract Documents is the responsibility of the CONTRACTOR.
   3. Departure from the submittal procedure will result in resubmittals and delays. Failure of the CONTRACTOR to comply with the submittal requirements shall render void any acceptance or any approval of the proposed variation. The CONTRACTOR shall then be required to provide the equipment or method without variation from the Contract Documents and without additional cost to the Contract.
   4. The CONTRACTOR at no additional cost or delays to the Contract shall remove any work, material and correct any deficiencies resulting from deviations from the requirements of the Contract Documents not approved in advance by the DISTRICT prior to commencement of work.
   5. Shop Drawings submitted by the CONTRACTOR, which are not specifically required for submittal by the Contract Documents, or CONTRACTOR shop Drawings previously reviewed and resubmitted without a written resubmittal request to the CONTRACTOR, will not be reviewed, considered, or commented on. The respective shop drawing submittal/resubmittal will not be returned to the CONTRACTOR and will be destroyed without comment or response to the CONTRACTOR. The respective submittal shall be considered null and void as being not in compliance with the requirements of the Contract Documents.
   6. Refer to Division-1 for additional requirements.

B. Material Lists and Shop Drawings
   1. Submit material list and Equipment Manufacturers for review within 35 days of award of Contract. Give name of Manufacturer and where applicable, brand name, type and/or catalog number of each item. Listing of more than one Manufacturer for any one item of equipment, or listing items "as specified",
without both make and model or type designation, is not acceptable. Shop Drawings shall not be submitted before review completion of Manufacturers list. The right is reserved to require submission of samples of any material whether or not particularly mentioned herein.

2. After completion of review of the material and Equipment Manufacturers list, submit Shop Drawings for review. Shop Drawings shall be submitted in completed bound groups of materials (i.e., all lighting fixtures or all switchgear, etc.). The CONTRACTOR shall verify dimensions of equipment and be satisfied as to fit and that they comply with all code requirements relating to clear working space about electrical equipment prior to submitting Shop Drawings for review. Submittals, which are intended to be reviewed as substitution or departure from the Contract Documents, must be specifically noted as such. The requirements of the Contract Documents shall prevail regardless of the acceptance of the submittal.

3. Shop Drawings shall include catalog data sheets, instruction manuals, dimensioned plans, elevations, details, wiring diagrams, and descriptive literature of component parts where applicable. Structural calculations and mounting details, signed by a Structural ENGINEER registered by the State of California, shall be submitted for all equipment weighing over 400-pounds, and shall be in compliance with Title 21 of the California Code of Regulations.

4. Each Shop Drawing item shall be identified with the Specification Section and paragraph numbers, lighting fixture types and Drawing sheet numbers; the specific Shop Drawing is intended to represent. Shop Drawings 11-inches by 17-inches or smaller in size shall be bound in three (3) ring binders. Divider tabs shall be provided in the three (3) ring binders identifying and separating each separate Shop Drawing submittal item. Shop Drawings larger than 11-inches by 17-inches, Shop Drawing pages/sheets submittals shall be sequentially numbered with unique alphanumeric numbering system to facilitate correspondence referencing identification of individual sheets.

5. The time required to review and comment on the CONTRACTOR’S submittals will not be less than 14 calendar days, after receipt of the submittals at the office of FBA Engineering. The review of CONTRACTOR submittals and return to CONTRACTOR of submittals with review comments will occur in a timely manner conditioned upon the CONTRACTOR complying with all of the following:
   a. The submittals contain complete and accurate information, complying with the requirements of the Contract Documents.
   b. CONTRACTOR’S submittals are each marked with CONTRACTOR’S approval “stamp”, and with CONTRACTOR signatures.
   c. The submittals are received in accordance with a written, shop drawing submittal schedule for each submittal. The CONTRACTOR distributes the schedule not less than 35-calendar days in advance of the Shop Drawing Submittals, and the schedule identifies the calendar dates, the CONTRACTOR will deliver the various submittals for review.

6. Shop Drawings shall include the Manufacturers projected days for shipment from the factory of completed equipment, after the CONTRACTOR releases the equipment for production. It shall be the responsibility of the CONTRACTOR to insure that all material and equipment is ordered in time to provide an orderly progression of the work. The CONTRACTOR shall notify the District’s Representative of any changes in delivery, which would affect the Project completion date.
7. **Submittal Identification**
   a. Each submittal shall be dated: with submittal transmission date; sequentially numbered and titled with submittal contents identification and applicable Specification/Drawing references (i.e., Submittal dated: 5/12/98 Submittal #4 Contents: Branch circuit panelboards Sheet #E5.1 and transformers Specification Section 26 0505 Paragraph 2.11, etc.).
   b. Each resubmittal shall be dated: with original submittal date and resubmittal transmission dates; sequentially numbered with original submittal number and sequential resubmittal revision number and titled with submittal contents identification and applicable Specifications/Drawing references (i.e., Original Submittal Date: 5/12/98 Resubmittal Date: 10/9/98 Original Submittal #4 resubmittal Revision R2 Contents: Transformer resubmittal Specification Section – 26 0505 Paragraph 2.11, etc.).
   c. Contractor shall provide a written response narrative with each resubmittal. Describe each response-action, resubmittal addition, change and deletion. Correspond each response to A/E specific review comment.

C. The CONTRACTOR shall be responsible for incidental, direct and indirect costs resulting from the CONTRACTOR’S substitution of; or changes to; the specified Contract Materials and Work.

D. The CONTRACTOR shall pay, upon request by the District’s Representative, a fee for the District’s Representative time involved in the review of substitution submittals and design changes resulting from the CONTRACTOR’S requested substitutions. The fee shall be not less than $125.00 per hour but, in no case, less than stated in Division-1, whichever is greater.

E. Maintenance and Operating Manuals
   1. The CONTRACTOR shall furnish three (3) copies of type-written Maintenance and Operating Manuals for all electrical equipment, fire alarm equipment, sound system equipment, etc., to the District.
   2. Instruct the District’s Personnel in correct operation of all equipment at completion of Project. Provide the quantity and duration of instruction class as specified; but in no case less than two (2) 4-hour durations separate instruction classes for each individual equipment group furnished as part of the Contract. Instruction classes shall be presented by Manufacturer’s Authorized Field Service ENGINEER at the Project Site. Instruction class size shall be at the District’s discretion, not less than one (1) or more than fifteen (15) students shall attend each instruction session. Submit fifteen (15) written outline copies of the proposed instruction class curriculum, 14-days prior to the class-scheduled dates.
   3. Maintenance and operating manuals shall be bound in three (3) ring, hard-cover, plastic binders with table of contents. Manuals shall be delivered to the District’s Representative, with an itemized receipt.

F. Portable or Detachable Parts: The CONTRACTOR shall retain in his possession, and shall be responsible for all portable and detachable parts or portions of the installation such as fuses, keys, locks, adapters, locking clips, and inserts until final completion of Contract Work. These parts shall then be delivered to the District’s Representative with an itemized receipt.
G. Record Drawings (ADDITIONAL REQUIREMENTS)
   1. Provide and maintain in good order a complete set of Electrical Contract "Record" prints. Changes to the Contract to be clearly recorded on this set of prints. At the end of the Project, transfer all changes to one set of transparencies to be delivered unfolded to the District’s Representative.
   2. The actual location and elevation of all buried lines, boxes, monuments, vaults, stub-outs and other provisions for future connections shall be referenced to the building lines or other clearly established base lines and to approved bench marks. If any necessary dimensions are omitted from the Record Drawings, the CONTRACTOR shall, at the Contractor’s own expense, do all excavation required to expose the buried work and to establish the correct locations.
   3. The CONTRACTOR shall keep the "Record" prints up to date and current with all work performed.
   4. Refer to Division-1 for additional requirements.

1.08 CLEANING EQUIPMENT, MATERIALS, PREMISES

   All parts of the equipment shall be thoroughly cleaned of dirt, rust, cement, plaster, etc., and all cracks and corners scraped out clean. Surfaces to be painted shall be carefully cleaned of grease and oil spots and left smooth, clean and in proper condition to receive paint finish.

1.09 JOB CONDITIONS - PROTECTION

   Protect all work, materials and equipment from damage from any cause whatever and provide adequate and proper storage facilities during the progress of the work. Provide for the safety and good condition of all the work until final acceptance of the work by the District and replace all damaged or defective work, materials, and equipment before requesting final acceptance.

1.10 EXCAVATION, CUTTING, BACKFILL AND PATCHING ADDITIONAL REQUIREMENTS

   A. General
      1. Perform excavation, cutting, backfill, core drilling, directional boring, and patching of the construction work required for the proper installation of the electrical work.
      2. Patching shall be of the same material, thickness, workmanship, and finish as existing and accurately match-surrounding work to the satisfaction of the District’s Representative.
      3. Prior to penetrating, coring, drilling or cutting existing building elements, concrete and/or masonry, provide imaging equipment examinations of each specific location. The imaging process shall identify existing internal embedded components and locations, including structural elements/anchors, conduit, and piping that are present. Do not penetrate or damage the existing internal embedded elements. Imaging shall employ one (1) of the following, with GPR methodology preferred:
         a. Non-invasive imaging employing high frequency, Ground Penetrating Radar (GPR), single side echo reflection technology.
         b. Non-invasive imaging employing x-ray radiography, through-and-through imaging technology.
B. Excavation Temporary Cover
   1. Excavations for Contract Work occurring in streets, vehicular drive areas, parking lots, sidewalks; any paved surface; or any area accessible to the public; provide temporary steel plating and shoring support for the plates, to completely cover the excavations under one or more of the following conditions:
      a. Excavation shall not remain "open" for more than 4-calendar days; provide temporary plating.
      b. Excavation shall not be "open" over weekends (Saturday, Sunday) or Holidays; provide temporary plating.
   2. The temporary plating shall be a minimum of 0.75-inch thickness steel, but in no case shall the thickness be less than required to support AASHO-H20 traffic loading.
   3. Provide a minimum of two (2) 100% open lane(s) (12-foot lane width) for vehicular traffic at all times during construction, for vehicle access to all areas.

1.11 IDENTIFICATION

A. Equipment Nameplates
   1. Panelboards, terminal cabinets, circuit breakers, disconnect switches, starters, relays, time switches, contactors, push-button control stations, and other apparatus used for the operation or control of feeders, circuits, appliances, or equipment shall be properly identified by means of descriptive nameplates or tags permanently attached to the apparatus and wiring.
   2. Provide nameplate label on electrical service entrance equipment describing available short circuit information calculated by the CONTRACTOR, including:
      a. Calculation date, month-day-year.
      b. Calculate maximum available short circuit fault current.
      c. Description of parameters and changes affecting the requirements for recalculation of the fault current information.
   3. Electrical equipment including switchgear, switchboards, electric panels and control panels, motor control centers, combination motor starters, transformers, disconnects, etc., shall each be labeled by the Manufacturer with "Electric-ARC-FLASH" warning signs. The signs shall explain a hazard to personnel may exist if the equipment is worked on while energized or operated by personnel while energized. The sign shall instruct personnel to wear the correct Protective Equipment/clothing (PPE) when working "Live", or operating "Live" electrical equipment and circuits.
   4. Nameplates shall be engraved laminated phenolic. Shop Drawings with dimensions and format shall be submitted before installation. Attachment to equipment shall be with escutcheon pins, rivets, self-tapping screws or machine screws. Self-adhering or adhesive backed nameplates shall not be used.
   5. Provide black-on-white laminated plastic nameplates engraved in minimum ¼-inch high letters to correspond with the designations on the Drawings. Provide other or additional information on nameplates where indicated.

B. Plates: All cover and device plates shall be furnished with engraved or etched designations under any one of the following conditions (minimum character size not less than 0.188 inch. Engraving shall indicate circuits and equipment controlled or connected):
   1. More than two (2) devices under a common coverplate.
   2. Lock switches.
3. Pilot switches.
4. Switches in locations from which the equipment or circuits controlled cannot be readily seen.
7. As required on all control circuit switches, such as heater controls, motor controls, etc.
8. Receptacles other than standard 15 ampere 120 volt duplex receptacles; shall indicate circuit voltage, ampere, phase and source circuit number.
9. Where outlets or switches are connected to emergency power circuit; provide panelboard and circuit number engraved on plate.
10. Low voltage and signal system outlets.

C. For equipment and access doors or gates to equipment containing or operating on circuits of more than 100 volts AC or DC nominal. Provide red-on-white laminated warning signs engraved in ½-inch high letters to read: "DANGER - 480 (or applicable voltage) VOLTS KEEP OUT AUTHORIZED PERSONNEL ONLY".

D. Wire and Cable Identification
1. Provide identification on individual wire and cable including signal systems, fire alarm, electrical power systems (each individual phase, neutral and ground), empty conduit pull ropes, and controls circuit.
2. Permanent identification shall be provided at each termination location, splice location, pullbox, junction box and equipment enclosure.
   a. Individual wire and cable larger than #6AWG or 0.25-inch diameter, shall be provided with polypropylene identification tag holders, with yellow polypropylene tags interchangeable black alphanumeric characters, character height 0.25 inch. Attach identification tags with plastic “tie” wraps, minimum of two (2) for each tag. As manufactured by Almetek Industries-“EZTAG” series; or TECH Products - “EVERLAST” series.
   b. Individual wire and cable #6AWG and smaller or smaller than 0.25 inch diameter, shall be provided with water and oil resistant, flexible, self-laminating pressure sensitive machine embossed plastic tags that wrap a minimum of 360 degrees around the wire/cable diameter. The entire tag shall then be covered with a clear flexible waterproof plastic cover wrapped a minimum of 540 degrees around the wire/cable diameter and completely covering the identification. As manufactured by Brady Identification; or 3M; or Panduit.
   c. Each identification tag location shall indicate the following information:
      circuit number, circuit phase, source termination and destination termination equipment name (or outlet number as applicable).
3. Install permanent identification after installation/pulling of wire/cable is complete, to prevent loss or damage to the identification.

E. Cardholders and cards shall be provided for circuit identification in panelboards. Cardholders shall consist of a metal frame retaining a clear plastic cover permanently attached to the inside of panel door. List of circuits shall be typewritten on card. Circuit description shall include name or number of circuit, area, and connected load.
F. Junction and pull boxes shall have covers stenciled with box number when shown on the Drawings, or circuit numbers according to panel schedule. Data shall be lettered in a conspicuous manner with a color contrasting to finish.

1.12 TESTING

A. The CONTRACTOR shall obtain an independent Testing Laboratory, provide all instrumentation and perform tests on the electrical system and equipment as hereinafter described and further directed by the District’s Representative. The test shall be performed after the completion of all electrical systems included in the Contract Scope of Work. All tests shall be recorded and documented and submitted to the District’s Representative for review.

1. All equipment and personnel required for set-up and testing shall be provided by the CONTRACTOR.

B. Test for Phase to Ground and Neutral Condition:

1. Open main service disconnects.
2. Isolate the system neutral from ground by removing the neutral disconnects link located in the service switchboard.
3. Close all submain disconnects.
4. Close all branch feeder circuit breakers.
5. Turn all switches to “on” position, unplug all portable equipment from outlet receptacles.
6. Measure the resistance of each phase to ground and phase to neutral. A properly calibrated "megger" type test instrument shall be used. The test voltage shall be a nominal 500 volts.
7. Record all readings after 1-minute duration and document into a complete report.
8. Isolating Grounds: In the event that low resistance ground neutral connections are found in the system, they shall be isolated and located by testing each circuit individually as outlined above. Make proper corrections to restore the resistance values to an acceptable value.

C. Method of obtaining ground resistance shall be in accordance with the latest edition of the James G. Biddle (Plymouth Meeting, Pennsylvania) manual published on this subject.

1. Perform "fall-of-potential" three (3) point tests on the main grounding electrode of system per IEEE Standard No. 81, Section 8.2.1.5. when suitable locations for test rods are not available, a low resistance dead earth or reference ground shall be utilized.
2. Perform the two (2) point method test per IEEE Standard No. 81, Section 8.2.1.1, to determine the ground resistance between the main grounding system and all major electrical equipment frames, system neutral, and/or derived neutral points.

D. The testing, calibrating and setting of all ground and ground fault equipment, circuit breakers, circuit device protection relays, and meters adjustable settings shall be by an independent Testing Laboratory. Set as recommended by the respective Manufacturer and Coordination Study so as to be coordinated with other protection devices within the electrical design. Bound and tabulated copies of the test and settings shall be sent to the District’s Representative.
E. Ampere and Voltage Measurements
   1. Measure and record ampere and line voltage measurements under full load on all panel feeders, switchboard, and switchgear feeders, motor control centers and motor circuits provided in the Contract. Record measurements at the equipment tested and submit to the District’s Representative for review.
   2. Ampere voltage readings shall be:
      a. Phase A-B, A-C and B-C.
      b. Phase A-Neutral, B-Neutral and C-Neutral.
   3. The ampere and voltage readings shall be not less than 20-minutes duration for each test. Record and submit the measured minimum, maximum and 20-minute average for each ampere and voltage value and test location. Voltage and ampere measurements shall occur at the connected load end of each respective feeder, not at the source of supply end of each feeder.
   4. Test equipment shall be accurate within plus or minus 1%.
   5. Branch circuit devices 40 ampere or less and motor loads ten (10) horsepower or smaller are excluded from ampere and voltage testing requirement.
   6. If, in the opinion of the District’s Representative, the voltages and regulations are not met within acceptable limits, make arrangements with the serving utility for proper electrical service. Retest feeder line voltages, and submit to District’s Representative for review, after the Utility Company has completed corrective actions. Reset “voltage taps” on transformers provided or modified as part of the Contract Work, to adjust line voltages to within acceptable values, as directed by the District’s Representative.

F. The Contractor shall complete the following work before any electrical equipment is energized.
   1. All equipment shall be permanently anchored.
   2. All bus connections and conductor/wire connections shall be tightened per Manufacturer’s instructions and witnessed by the District’s Representative.
   3. All ground connections shall be completed and identified. Perform and successfully complete all required megger and ground resistance tests.
   4. Feeders shall be connected and identified.
   5. The interiors of all electrical enclosures including busbars and wiring terminals shall be cleaned of all loose material and debris, paint, plaster, cleaners or other abrasive’s over spray removed and equipment vacuumed clean. The District’s Representative shall observe all interiors before covers are installed.
   6. All wall, ceiling, and floor work and painting shall be completed within areas containing electrical equipment prior to installation of equipment. The equipment indoor rooms and spaces shall be weather-tight and weather protected from environmental incursions.
   7. All doors to electrical equipment rooms shall be provided with locks in order to restrict access to energized equipment.
   8. Electrical spaces and rooms shall not be used as storage rooms after power is energized.
   9. Outdoor electrical equipment enclosures and housings shall be weather protected.
   10. The electrical system time current coordination and ARC-Fault study shall be complete for circuit breakers, ground relays sets, and circuit relay sets, fuses; set-up, tested and calibrated accordingly.
1.13 COMMISSIONING - CX

A. General
1. The Commissioning shall verify the electrical systems for the term of the Contract, by observation; and by calibration; and by testing. The Commissioning shall ensure the electrical systems perform interactively and correctly, according to the Contract and Operational Requirements.

2. Commissioning shall provide startup, testing and documented confirmation of the Contract Constructed Systems, materials and work, functions in compliance within the criteria set forth in the Contract Documents to the satisfaction of the District’s needs. The Commissioning Scope shall encompass each system identified as requiring "Commissioning" by the Contract Documents, including but not limited to:
   a. Electrical circuits’ protection, short circuit, overcurrent, and ground fault devices.
   b. Electrical circuits monitoring and metering.
   c. Light fixtures, lamps and ballasts.
   d. Lighting control devices, equipment and lighting control systems.
   e. Standby and emergency electric power supply equipment and systems.
   f. Fire alarm, equipment, devices and fire alarm systems.
   g. Additional systems described in the Contract Documents.

3. Commissioning process shall review all of the Shop Drawing submittals, including:
   a. Controls, Operation and Maintenance requirements.
   b. Facility performance testing compliance.
   c. Project Contract requirements compliance.
   d. Compliance with basis for design and operational descriptions provided in the Contract.

4. Commissioning shall be the process of ensuring all the systems described in the Contract Documents comply with the Contract Document design; all systems are installed properly; all systems are functional, tested and capable of being operated and maintained to perform within the Contract requirements and design intent.

5. Functional setup, recalibration, correcting deficiencies, retesting and the associated costs, for system(s) that fail commissioning, shall be the responsibility of the CONTRACTOR. The CONTRACTOR shall include all commissioning costs in the Contract Scope of Work.

6. Complete all commissioning functions prior to the occupancy of the facility by the District, unless directed otherwise by the District's Representative.

7. Submit six (6) copies of commissioning documentation to District’s Representative.

8. Commissioning, unless specifically indicated otherwise, shall be performed by Factory-Trained Technician(s) Authorized and Certified by the Manufacturers of the respective equipment/systems. Where specifically indicated, commissioning shall be performed by Independent Test Lab.

B. Commissioning Procedures
1. Prepare a commissioning matrix identifying components and systems included in the commissioning scope; the status; actions completed and actions to be completed.

2. Verify CONTRACTOR compliance with Contract Document requirements Manufacturer's recommendations and approved Shop Drawings.

3. Perform startup, functional tests, reports, and document results.
4. Evaluate and document the setup parameters, software, operating condition and performance of each system at the time of functional test completion. Document and record each performance parameter and condition, in the commissioning report.

5. Schedule testing and prepare descriptions of testing.

6. Describe measures performed to correct deficiencies.

7. Verify that instructions to District’s Representatives, Operations and maintenance manuals comply with Contract Documents.

8. Prepare warranty matrix identifying the start dates, expiration dates, routine preventative maintenance dates and the District’s responsibility for performing preventative maintenance and keeping logs for each maintenance function and warranty claims.

9. Confirm completion of all punch list items that have been acceptably accomplished and a list of what has not been acceptably completed.

10. Describe uncorrected deficiencies accepted by the DISTRICT.

C. Commissioning Phasing
The commissioning phases of work shall include the following activities:

1. SDQ - Shop Drawing Qualification shall verify complete and correct shop Drawings have been submitted.

2. IQ – The Installation Qualification of Contract Work shall verify systems are correctly and properly installed.

3. OQ - Verify systems interfaces and software are correctly and properly operational.

4. ITM - Verify the Contract Inspection, Testing and procedures for Maintenance are complete.

5. PQ - Performance Qualification complete the functional performance testing to validate each building system.

1.14 POWER OUTAGES

A. All electrical services in all occupied facilities of the Contract Work are to remain operational during the entire Contract period. Any interruption of the electrical services for the performance of this work shall be at the convenience of the District and performed only after consultation with the District’s Representative. Work involving circuit outages shall be only at such a time and of such a duration as approved in writing. Work involving circuit outages for the work required to connect new equipment and disconnect existing equipment shall be performed at the convenience of the DISTRICT.

B. Contract Work involving outages or disruption of normal function in electrical power systems, telephone/communication systems, fire alarms, shall be performed during the following time periods. The Contract Work shall be phased to limit outages in the respective systems to the stated periods:

1. 11:30 p.m. Friday to 11:30 p.m. Sunday of the same weekend. Work shall occur on multiple weekend periods if a single weekend is not sufficient time to complete the work.

2. The Contract Work involving outages shall be phased in multiple work time units, to comply with the permitted outage limitations.

C. Work involving system outages to the building fire alarm system shall be performed only after consultation with the DISTRICT and shall be only at such a time and of such duration as approved in writing. Contractor shall provide continuous “Fire-
Watch” during fire alarm system outages and comply with AHJ “Fire-Watch” requirements.

D. Provide overtime work; double shift work; night time work; Saturday, Sunday, and holiday work to meet outages schedule.

E. Provide temporary electrical power to meet the requirements of this Article.

F. Any added costs to CONTRACTOR due to necessity of complying with this Article shall be included in the Contract Scope of Work.

G. When electrical work involving power disruptions to existing areas is initiated, the work shall proceed on a continuous basis without stopping until electric power is restored to the affected areas.

H. The CONTRACTOR shall request in writing to the DISTRICT’S Representative a minimum of 3-weeks in advance, for any proposed electrical outage.

1.15 TEMPORARY ELECTRICAL POWER

A. Provide temporary electrical power if work requiring power outages cannot be completed in time permitted and approved by the DISTRICT’S Representative.

B. Temporary electrical power shall be a standby diesel engine generators. Voltage, frequency, regulation, etc. shall be equal to that of normal utility source. Exhaust system shall have a critical silencing muffler. Generator voltage shall match the existing secondary voltage required at the site. The CONTRACTOR shall furnish all necessary cables, switches, etc., to make all required connections to existing panels, feeders, etc. Generator shall be sized to adequately carry the demand load. If record of demand load is not available, size generator to match corresponding transformer, maximum capacity circuit as directed by the District’s Representative.

C. After completion of required usage of the temporary generators, prior to completion of the project, the CONTRACTOR shall remove the generators. All temporary cables, switches, etc. shall be removed and all permanent equipment left in satisfactory condition.

D. Each generator shall be housed in security type sound attenuated housing to prevent access by unauthorized personnel. Temporary power cables, connections, etc. shall be protected from unauthorized personnel.

E. The CONTRACTOR shall be responsible for complete operation of the generator including personnel, fuel supplies, proper safety precautions, etc. Generator shall not be left unattended while in operation.

F. The CONTRACTOR shall provide temporary construction lighting and power as required in areas where work is being performed. Temporary power arrangements, outages, installation, work schedules, etc., shall be submitted in writing 3-weeks prior to requested outage date, and approved by the DISTRICT’S Representative prior to start of work.

1.16 ASBESTOS, POLYCHLORINATED BIPHENYL (PCB) OR HAZARDOUS WASTE:

A. It is understood and agreed that this Contract does not contemplate the handling of asbestos, PCB or any hazardous waste material. If asbestos, PCB or any
hazardous waste material is encountered, notify the District’s Representative immediately. Do not disturb, handle or attempt to remove.

B. Lighting Fixture Demolition Hazardous Materials
1. The removal of existing lighting fixtures will generate hazardous material waste disposal Contract Documents.
   a. The existing lighting fixture ballast contains PCB material.
   b. The existing lighting fixture lamps contain mercury.
   c. The existing lighting fixture internal wire insulation may contain asbestos.
2. Remove, handle, store, contain, dispose of and document the hazardous materials resulting from existing lighting fixtures work, as part of the Contract requirements.

1.17 TIME/CURRENT COORDINATION, SHORT CIRCUIT, ARC-FLASH AND SERIES RATED EQUIPMENT

A. Series Rated Equipment.
1. Circuit protective Devices identified as "Series Rated" or "Current Limiting" (i.e., CLCB - Current Limiting Circuit Breaker; CLF - Current Limiting Fuse, etc.) shall be Series Rated and Tested (UL 489 and CSA5) by the Manufacturer with all equipment and circuit protective devices installed downstream of the identified series rated or current limiting device.
2. Provide nameplates on all equipment located downstream, including the CLCB and CLF devices, to comply with CEC/NEC paragraphs 110-22 and 240-83 "CAUTION SERIES RATED SYSTEM - NEW DEVICE INSTALLATIONS AND REPLACEMENTS SHALL BE THE SAME MANUFACTURER AND MODELS".

B. Short Circuit, Coordination and ARC-Flash
1. Perform Engineering Analysis and submit engineered settings for each equipment location, fuse and circuit breaker device, showing the correct time and current settings to provide the selective coordination within the limits of the specified equipment. Shall comply with the latest application standards of IEEE and ANSI. Provide electrical system short circuit worst case bolted-fault analysis, both 3-phase line-to-line and 1-phase line-to-ground calculations as part of the Coordination Analysis recommendations. Provide Electric ARC-FLASH calculations as part of the Coordination Analysis recommendations.
2. The information shall be submitted in both tabular form and on time current log-log graph paper, with an Engineering Narrative. Written narrative describing data, assumptions, analysis of results and prioritized recommendations, six (6) copies.
3. The goal is to minimize an unexpected but necessary electrical system outage and personnel exposure to the smallest extent possible within the fault occurrence location, using the specified Contract Equipment. Shall comply with, but not limited to:
   d. CEC/NEC
4. Provide permanent warning labels on each equipment location. The labels shall describe ARC-FLASH, Short-Circuit and Time/Current Coordination,
including safety precautions and protective clothing. Also described actions to be taken if any circuit changes or equipment modifications occur.
5. Shall be submitted with the Shop Drawing submittals for the respective equipment.

1.18 INDEPENDENT TESTING LABORATORY

A. Testing Laboratories Definition
2. Membership in the National Electrical Testing Association (NETA) shall also constitute acceptance of meeting said criteria, for testing of electrical systems.

1.19 SPARE FUSES

Provide three (3) spare fuses for each size and type at each location to match the installed fuses where the fuses are provided as part of the Contract. Provide spare fuse holders on inside door of each respective fuse compartment. Provide engraved nameplate on front of fuse access door indicating fuse type/catalog number ampere rating and Manufacturer of fuse.

1.20 EQUIPMENT SEISMIC AND WIND LOAD REQUIREMENTS (ADDITIONAL REQUIREMENTS)

A. Refer to Structural, Architectural, and Soils Report Contract Documents for additional requirements.

B. General
1. Equipment supports and anchorage’s provided as part of the Contract shall be designed, constructed and installed in accordance with the Earthquake Regulations of the California Building Code (CBC), International Building Code (IBC).
2. Provide equipment anchorage details, coordinated with the equipment mounting provision, prepared, signed and "stamped" with PE Registration in good standing, by a Civil or Structural Engineer Licensed as a Professional Engineer (PE) in the State of California.
3. Mounting recommendations shall be provided by the Manufacturer based upon approved shake-table tests used to verify the seismic design of that type of equipment.
4. The Equipment Manufacturer shall document the details necessary for proper wind-load and seismic mounting, anchorage, and bracing of the equipment for floor, ceiling, and wall/back installation location.
5. Seismic performance shall be based on actual install location of the respective equipment in the building and height above or below grade.
6. The seismic requirements are typical for each equipment item exceeding 19-pounds, including but not limited to the following:
   a. Switchgear, switchboards, and motor control equipment
   b. Transformers
   c. Equipment racks and terminal cabinets
   d. Panels
   e. Conduits with floor, ceiling or wall attachment support and conduits with suspension attachments.
   f. Busway, wire way and cable tray
g. Uninterruptable power supplies (UPS)  
h. Inverters  
i. Generators and related equipment  
j. Lighting equipment  
k. Fire alarm equipment  

C. Certification  
1. Electrical Equipment Manufacturers and Contractor shall provide Special Seismic Certification (SCC) for each specific equipment configuration with shake-table verification, all furnished as part of the Contract Documents requirements. The SCC shall include the specific installation location characteristics of the respective equipment including as follows:  
a. Ground or floor attachment  
b. Wall attachment  
c. Ceiling attachment  
d. Roof attachment  

2. Wind Loading  
Electrical equipment and anchorages shall withstand the wind-load imposed at the install location. Wind loading withstand requirements shall apply to all electrical equipment installed in outdoor locations and to all electrical equipment exposed to the weather. The equipment shall be Tested and Certified by the Manufacturer and Contractor. The wind-load withstand qualification of the equipment and anchorages shall be verified by the following methods:  
a. Areo-dynamic wind tunnel test method.  
b. Analytical calculation method, for oversized equipment too large for wind tunnel test method.  

3. The wind-load withstand rating and the SCC shall comply with the requirements of the Authority Having Jurisdiction (AHJ), and include the latest revisions, but not limited to the following:  
a. American Society of Civil Engineers; ASCE-7  
b. CBC/IBC; including but not limited to Sections 1702, 1708, 1709, 1708A and 1709A.  
c. California Office of Statewide Health Planning and Development OSHPD; OPA-Preapproval of Anchorage; Code Application Notice CAN 2-1708A.5 and OSP-Special Seismic Certification Approval  
d. US Department of Homeland Security; FEMA- (installing seismic restraints for electrical equipment)  

D. Wall Mounted Electrical Equipment  
1. Surface Mounted Equipment  
a. Provide multiple horizontal sections of metal “C” channels for support and attaching wall mounted equipment to walls. Channels shall provide “turned lips” at longitudinal edges to hold “lock-in” fasteners and shall comply with ANSI-1008 and ASTM-A569 latest revision. The channels shall be steel hot dip zinc galvanized. As manufactured by Unistrut or Kindorf.  
b. The “C” channels shall be positioned horizontally within 3-inches of the top and bottom of each, equipment section cabinet and located behind each equipment vertical section. Provide additional intermediate “C” channels at not less than 36-inches on center between the “top” and “bottom” “C” channel positions, located behind each equipment vertical Section.
c. The “C” channels shall be of sufficient length to provide connection to not less than two (2) vertical structural wall framing elements separated by not less than 16-inches; but in no case shall the “C” channel length be less than the width of the respective Equipment Section.
d. Attach the “C” channels to the wall structural elements after the wall, finish surface, installation (including painting) is complete.
e. Attach the “C” channels with fasteners to the building wall framing structural elements as follows: welded to steel framing; bolted to wood framing; cast in place concrete inserts for masonry and concrete construction; drilled “afterset” expansion anchors for existing masonry and concrete construction.
f. Attach the equipment to the “C” channels with threaded and bolted fasteners to “pre-locate” and lock into the channel “turned lips” and channel walls.

2. Flush mount equipment
   a. Provide anchor attachment of equipment into adjacent wall structural elements.

E. Housekeeping Pad
   1. Provide cast-in-place, steel re-enforced concrete raised “housekeeping” pads under all floor standing electrical equipment (except data network equipment racks).
   2. Pad sizes
      a. The raised housekeeping pad height shall extend 4-inches above the surrounding finished floor elevation for interior building locations.
      b. The pad shall extend 8-inches below finish grade plus 4-inches above finish grade for outdoor equipment location on grade.
      c. The pads shall extend 7-inches past the “footprint” edge of the respective floor standing equipment.
   3. Anchor equipment to pads. Anchor pads to the building structural floor. Equipment pad, equipment re-enforcing and equipment anchoring shall comply with Seismic Earthquake requirements and Wind Load requirements.
   4. Unless shown otherwise on Drawings. The equipment housekeeping pad steel re-enforcing shall consist of two (2) layers of number 4-size steel-rebar laid horizontally and uniformly spaced 6-inches on center. Position rebar in two (2) directions (90-degrees opposed) and centered inside the concrete housekeeping pad. Horizontal rebar shall extend to within 3-inches of the edge of the concrete pad in all directions. Metal wire “tie-wrap” shall be provided at each rebar crossing.
   5. Equipment anchor attachments shall extend through the housekeeping pad and into the structural concrete below the pad a minimum of not less than 2-inches.

1.21 ELECTRICAL WORK CLOSEOUT

A. Prepare the following items and submit to the District’s Representative before final acceptance.
   1. Two (2) copies of all test results as required under this Section.
   2. Two (2) copies of Local and/or State Code Enforcing Authority’s Final Inspection Certificates.
   3. Copies of record Drawings as required under the General Conditions, pertinent Division One Sections and Electrical General Provisions.
4. Two (2) copies of all receipts transferring portable or detachable parts to the DISTRICT’S Representative when requested.
5. Notify the District’s Representative in writing when installation is complete and that a Final Inspection of this work can be performed. In the event any defect or deficiencies are found during this Final Inspection they shall be corrected to the satisfaction of the District’s Representative before final acceptance can be issued.
6. List of spare fuses and locations identified by equipment name and building designation.
7. Prior to energizing, retighten to the proper torque, each circuit conductor lug landing, each bus bar (phases, neutral and ground) and circuit protection device threaded connections in all switchboards, switchgear, motor control centers, transformers, busways, disconnect switches, motor starters, motor terminals and panelboards, after the equipment is installed/connected and prior to energizing the equipment. The torque values shall comply with Manufacturer’s recommendations.

B. Electrical Power Single Line Diagrams – SLD
1. Provide single line diagrams showing the Contract Document Work complete electrical power system (normal and emergency). SLD shall show interconnection circuits, electrical equipment, panels, and circuit protection devices, nominal 50% (½-size) approximately 18-inches by 24-inches. Show installed voltages and electrical capacity sizes.
2. SLD shall be mounted in metal (picture frame) rigid enclosure frame with rigid-backing (backer-board) and clear/transparent front, for hanging on wall. Provide clear transparent cover over SLD inside the frame.
3. Provide a wall-hung (± 48-inches) SLD in each “main” and “sub” electrical equipment room. If wall space is limited, alternatively securely attach SLD frame to room door facing into the respective electrical room.

END OF SECTION

100515/223015
SECTION 26 0505

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
   2. General provisions and requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Submit product data sheets for all outlet boxes, floor boxes, wiring devices, device plates, relays, contactors, timeswitches, and disconnects fuses.

B. Submit Detailed Shop Drawings including dimensioned plans, elevations, details, schematic and point-to-point wiring diagrams and descriptive literature for all component parts for transformers, relays, time clocks, and photocells.

C. Submit Transformer Test Reports.

D. Submit Material List for Outlet Boxes.

PART 2 - PRODUCTS

2.01 OUTLET AND JUNCTION BOXES

A. General:
   1. Flush or concealed outlet boxes and junction boxes.
      a. Non-masonry and/or non-concrete locations provide pressed steel boxes. Steel thickness not less than 0.062-inch, hot-dip galvanized. Knockout (KO) type with conduit entrances and quantities size to match conduits shown connecting to respective junction box and outlet box.
      b. UL-514 listed and labeled.
      c. Minimum required box depth is exclusive of extension-ring depth.
      d. Provide all boxes with matching cover plates. Cover plates shall be gasketed water-tight in wet and outdoor locations.
      e. Boxes installed in masonry or concrete shall be UL "concrete-tight" approved for installation in concrete, and shall allow the placing of conduit without displacing reinforcing bars.
   2. Provide outlet boxes of proper code size for the number of wiring devices, connecting conduits, and conductors/cables or conduits passing through or terminating therein. In no case shall outlet box be less than 4.0-inches square by 2.125-inches deep. Unless specified elsewhere or noted otherwise on the Drawings, 2.5-inches minimum depth for box width's exceeding 2-gang.
   3. Increase the minimum outlet box size to 4.69-inches square by not less than 2.125-inches deep, where one or more of the following conditions occurs:
      a. More than two (2) conduits connect to the outlet box.
b. Circuit “Homerun” or Conduit “Homerun” connects to outlet box.

4. Signal, Communication and Low Voltage Outlet Boxes:
   a. Individual or duplex audio/visual, telephone, computer or data outlets: 4.69-inches square by 2.125-inches deep minimum with single gang wide extension ring.
   b. Combination AV/signal/telephone/data or computer outlets: 4.69-inches square by 2.125-inches deep minimum with 2-gang wide extension ring.

5. Junction boxes shall be sized to comply with the following:
   a. Code requirements size based on the conduit quantities, conduit sizes and wire-fill connected to the junction box.
   b. Junction box minimum size shall not be less than 4.69-inches square by 2.5-inches deep, but not less than size indicated on the Drawings or required by Code.

6. Provide extension rings on flush outlet boxes and flush junction boxes, to finish face of extension ring flush to (within ± 0.63-inches) of finished building surfaces. Extension ring shall match outlet box materials/construction and contain "attachment mounting-tabs" for wiring devices. Extension rings shall be "screw-attached" to respective box and maintain "ground" bonding continuity.

7. Outlet boxes installed in outdoor locations, or in wet locations, or in concrete/masonry, shall be cast-iron or cast-bronze, with threaded conduit hubs. UL rated for wet locations.
   a. Aluminum boxes shall NOT be in contact with concrete or masonry. Die-cast aluminum or cast aluminum water-tight electrical outlet boxes with threaded hubs may be provided as an alternate to cast-iron or cast-bronze outlet boxes, only where one (1) or more of the following conditions occur:
      1) Outdoor locations above finish grade.
      2) Indoor wet locations surface or flush in walls or ceilings.
      3) Not in contact with concrete or masonry.

8. Provide fixture-supporting device in outlet boxes for surface mounted fixtures as required.

9. Provide solid gang boxes for three (3) or more devices, typical for line and low voltage switches, receptacles, low voltage/signal outlets, etc. for mounting devices behind a common device plate.

10. Provide isolation barriers in outlet boxes:
    a. Between line voltage and low voltage devices.
    b. Where more than one (1) device is installed in an outlet box, between and separating each device.
    c. Between 277-volt and 120-volt devices.
    d. Between devices connected to emergency and non-emergency circuits of all voltages.

11. Outlet boxes installed penetrating into fire rated walls, fire rated floors, fire rated ceilings and all fire rated construction. The outlet boxes shall be UL listed, classified and labeled, for fire rated and temperature rated penetration of the respective fire rated surface and fire rated construction. The outlet box fire rating and temperature rating shall equal or exceed the fire/temperature rating of the surface/construction being penetrated. Provide UL listed and labeled supplemental fire and temperature protection to maintain ratings:
    a. Wall and ceiling penetrations, supplemental tumescent fire wrap (external or internal of outlet box).
    b. Floors provide subfloor supplemental fireproofing below floor box.

12. Outlet boxes installed in floors. The floor outlet boxes shall be UL listed and labeled for scrub water exclusion requirements, including but not limited to tiles, carpeting and exposed wood and concrete floor fishes.
13. Outdoor flush in wall device outlet boxes:
   a. Flush in wall outlet box with corrosion resistant gasketed water tight, hinged, key locking cast metal, self-closing cover. Tamper resistant and vandal resistant.
   b. UL-listed and labeled for installation in masonry, cast-in-place concrete, hollow-framed walls and wet locations.
   c. Flush cast-iron or cast-bronze or brass, device back-box, nominal 4.68-inch square by 2.25-inch deep.
   d. Internal metal adapter plate for wiring device types, in the box as indicated on the Drawings.
   e. As manufactured by Legrand/Pass and Seymour #4600 Series; or C.W. Cole #310 Series.

14. PVC Coating
   a. Metal outlet and junction boxes installed in outdoor or exposed non-weather protected locations shall be PVC coated.
   b. PVC coating shall be factory applied, to comply with NEMA-RN1 and 5-19.
   c. The adhesion of the PVC coating to the metal box shall exceed the strength of the coating itself, based on 0.5-inch "strip-pull" test.
   d. Uniform coating thickness shall be continuous without "breaks" or "pinholes" and shall not be less than the following:
      1) Box exterior surfaces, 40-millimeter coating thickness.
      2) Box interior surfaces, 10-millimeter coating thickness.

15. Refer to Architectural and Structural Contract Documents and Details for additional box and install requirements.

B. Surface Outlet Boxes
   1. Surface mounted outlet boxes, cast iron Type FS or FD, with threaded hubs as required. Box interior dimensions and interior volume capacity not less than required for “press steel boxes”, and “sheet steel boxes”. Provide plugs in all unused openings. Provide weatherproof gaskets for all exterior boxes.

C. Floor Boxes
   1. General:
      a. Outlet boxes installed in floors. The floor outlet boxes shall be UL listed and labeled for scrub water exclusion requirements, including but not limited to floor tiles, carpeting and exposed wood and concrete floor fishes.
      b. Electrical power receptacles in a floor box; shall be industrial grade wet location heavy-duty, high-abuse rated devices, tamper resistant. Grounding type, 125 volts, 60Hz AC, 20-amperes, NEMA 5-20R (duplex), or other NEMA configurations noted on the Drawings. Standard length receptacle mounting strap as required by the Manufacturer of floor box being furnished.
      c. Tested, listed and labeled to comply with UL-514A and/or UL514C.
   2. Concrete floor outlet box for chair/seat aisle light fixture connection:
      a. Flush-in -concrete floor box, brass or cast iron, nominal 18-cubic inches internal wire capacity, removable screw attached flush top cover.
      b. Minimum of three (3) 0.75-inch conduit threaded entrances; one (1) surface/top entrance location for aisle light fixture connection to box, plus two (2) side and bottom locations for “in-out” branch circuit connections.
      c. The top entrance conduit position shall not interfere with removal and reinstallation of the box top cover, with the top conduit connected between the box and aisle light fixture and the top of the box set flush with finish floor surface.
d. Box and conduit shall be protected and concealed, below each respective aisle seat containing an electric aisle light fixture. Orientation of top entrance conduit to match position of aisle light fixture.

e. As manufactured by Hubbell #F3185 Series; no known equal.

3. Poke-Thru floor boxes for “After-Set” Floor Outlets.

a. Through floor wiring for power and communication shall be UL listed with a fire and temperature rating of not less than 2-hours. The units shall include an internally divided floor fitting; a divided through-floor conduit/raceway, and a divided under floor junction “split-box” not less than 4.7-inches by 4.7-inches by 2.125-inches in size. Junction box shall be installed concealed in ceiling space of the floor below. The length of the floor “through-raceway” shall match the thickness of the finish floor and as recommended by the Manufacturer. Unit shall be self-supporting without the attachment of an above floor fitting. Internal isolation barriers between high potential and low potential circuits and sections. The integral fire barrier shall incorporate a cold smoke barrier to prevent the passage of smoke when heat is not present.

b. Poke-Thru Floor boxes shall contain dual services for high potential and low potential devices and circuits.

c. Poke-Thru Floor pedestal type; (internally divided high potential and low potential sections) service fittings die cast, brushed aluminum, single piece device housing, with stainless steel device cover plates front and rear of the housing as follows:

1) Front side (high potential) one (1) 20-ampere, 120 volt, 60Hz, AC, grounding duplex convenience outlet plugs.

2) Rear side (low potential) shall contain “knockouts” or “keystones” as follows at locations shown on the Drawings:

   a) Knockouts for signal cables one (1) 1-inch diameter and two (2) ¾-inch diameter with rubber bushing grommets for each knockout.

   b) Four (4) RJ-45 keystone, snap-in retainers for low potential plug-in signal connections.

   c) The CONTRACTOR shall provide the type of outlet(s) at each poke-thru location as required by the low voltage-signal Contract Documents.

3) Alternately where specifically indicated on the Drawings, the front and rear cover plates shall be supplied with knockouts for 1.0-inch flexible conduit “Furniture” connection, one per cover plate.

4) The pedestal shall provide 0.25-inch or greater protective over-hang (drip-lip) of the device coverplates. Provide stainless steel device coverplates.

d. Non-Pedestal Poke-Thru flush in floor type; (internal divided high potential and low potential sections) die cast, flush with finish floor, metal cover flip-open, locking, hinged access covers. Open-close die cast aluminum port-covers for plug-in portable cable connections. ADA compliant, wide trim matching flange.

1) Two (2) 20-ampere, 120 volt, 60Hz, AC, grounding duplex convenience receptacles for high potential power connections.

2) Four (4) RJ-45 keystone, snap-in retainers for low potential plug-in signal connections. The CONTRACTOR shall provide the type of outlet(s) at each poke-thru location as required by the Low Voltage-Signal Contract Documents.

3) Cover shall close and lock after portable plug-in cables have been inserted into respective connections, under the cover.
4) UL wet mop, scrub water rated for carpeted and non-carpeted floors.

e. Die cast aluminum cover, nominal 8-inch diameter metal housing flush in “core-hole”, outlet metal body size.

f. Flush with floor or pedestal type as indicated on Drawings. As manufactured by Wiremold/Legrand# Evolution Poke-Thru 8AT Series, Smoke and Fire Rated Poke-Through fittings; no known equal.

4. Floor Boxes for Flush Floor Outlets (non-pedestal), recessed concealed inside outlet box, plug-in receptacles.

a. Provide cast-in-floor with concrete pour pan, rated for on grade to prevent direct earth contact, cast-in-place concrete floors on-grade and above-grade; adjustable “leveling-feet” for box.

b. UL wet mop, scrub water rated for carpeted and non-carpeted floors. UL-File E171211 installation fire rating and/or UL-Fire Resistance Classified.

c. Floor boxes shall contain dual services:

1) High potential with not less than two (2) 120 volt 60Hz AC 20-ampere grounding duplex convenience receptacles.

2) Low potential for low voltage system outlets and signal circuits with up to and including eight (8) RJ-45 plug-in keystone snap-in retainer receptacles. The CONTRACTOR shall provide the type of outlet(s) at each poke-thru location as required by the low voltage-signal Contract Documents.

3) Internal isolating barrier between high and low potential circuits and sections of box.

4) Also refer to Drawings for additional outlet requirements.

d. Conduit knockouts in bottom of box and in each side walls of box. Not less than one (1) 1.25-inch and one(1) 0.75-inch knockouts for both low potential and high potential conduits connections on each opposing box sides. Include the same configuration of knockouts on the bottom of the box, for high potential section and low potential sections.

e. Floor box cover:

1) Flush tamper resistant "lock-down" removable main cover. Independent hinged "flip-out" port in the removable cover, to allow main box cover to be in a fully closed position with "plug-in" cords connected into box when the lock-down cover is closed. Main cover "lock-down" to prevent non-authorized access into box interior.

2) Brass, removable recessed main cover, rated for carpet, or tile for floor finish, brass overlapping trim cover finish. Cover recess depth 0.25-inch, 0.5-inch or 0.75-inch as required to match respective floor covering thickness and type. ADA compliant, wide trim matching flange.

f. Floor box with metal body, nominal box size 10-inches by 12-inches by depth to match floor, but not less than 3.0-inches deep box.

g. Floor box as manufactured by FSR #FL-500P Series; no known equal.

2.02 PULL BOXES

A. General

1. Sizes as indicated on the Drawings and in no case of less size or material thickness than required by the Governing Code and AHJ.

2. Exercise care in locating pull boxes to avoid installation in drain water flow areas and to clear existing condition interferences.

3. UL listed and labeled for electrical circuits.
B. General Purpose Sheet Metal Pullbox
   1. General purpose sheet steel pull boxes: Install only in dry protected locations with removable screw attached covers. Manufacturer’s standard rust proofing and baked enamel finishes.

C. Concrete Pull Boxes and Hand-Holes for Electrical
   1. AASHTO H-20 traffic loading rated box and cover, pre-cast concrete, steel reinforced pull boxes and hand-holes. Provide complete with pulling irons, hot-dip galvanized metal traffic cover with hot-dip galvanized metal cover frame, pull-box concrete base with sump. Four (4) cable full height wall racks with porcelain cable support blocks.
   2. Boxes shall be “Intercept” type with Multiple Box Sections. Extension cable-intercepts at both ends of box. Refer to Drawings for box size.
   3. Covers shall be flush bolt down. Covers weighing more than 40-pounds shall be split cover type “Torsion-Spring” assist, hinged open-close.
   4. Box covers shall comply with Federal ADA, UL, State and Local AHJ for slip resistance. Provide cast-or-bead weld on cover of pull box to indicate services within pull box (i.e., “480/277-VOLT, 3-PHASE, 4-WIRE ELECTRICAL” OR “SIGNAL/TEL/P.A./CLOCK/FIRE ALARM” etc.).
   5. Shall be set on a machine-compact ed pea gravel base 12-inches thick with gravel base extend 6-inches beyond box base on all sides. Provide a 0.75-inch by 10-feet copper clad ground rod through the box bottom with 9-inch projection into box, for grounding all metal parts and frames with continuous #10 AWG copper bond wire.
   6. Seal all box joints and seal box between cover and frame with a mastic compound similar to Parmagum or Dukseal. After cables have been pulled, connected, tested and inspected, seal box cover and bolt-close cover.
   7. As manufactured by Jensen Precast; or Oldcastle Precast.

2.03 SWITCHES, WIRING DEVICES

A. General
   1. Provide wiring device circuit switches totally enclosed, electrical insulating Bakelite or electrical insulating composition base, manual operator type with 277 volt 60Hz AC rating for full capacity contacts rated for incandescent lamp loads, fluorescent lamp loads and motor loads. Switch mounting-ears for screw attachment to outlet box. Switches shall be UL listed and labeled; conform to NEMA-WD1 and WD6.
   2. Switch controlling (on-off) rated for all lighting loads and all non-lighting loads; switch ratings shall be 20 ampere; unless indicated otherwise on Drawings.
   3. Color as selected by OWNER’S Representative. Switches and wiring devices controlling circuits connected to emergency power shall be red.
   4. All switches shall be of the same Manufacturer.
   5. Where switches are mounted in multiple gang assembly and are operating at 277 volts and/or 277 volts and 120 volts or emergency/non-emergency and mounted in same outlet box, there shall be an insulating barrier installed between each switch.
   6. Devices shall additionally be listed and labeled as UL-All Weather-Resistant wet-location for the following install locations:
      a. Devices indicated on Drawings as Weather-Proof (W.P.).
      b. Devices installed in outdoor locations
      c. Installed in classified wet or damp area locations both indoor and outdoor.
7. Wiring devices shall be listed and labeled for connection of both “solid” and “stranded” copper circuit conductors.
8. Switches with ampere and voltage ratings different than described herein. The different rated switches shall have the same characteristics and performance as the respective described switches, except for differing ampere and voltage characteristics.

B. Switches Heavy Duty (Toggle – Type)
1. Single Pole Switches – 20 Amp at 277V

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Toggle Type</th>
<th>Lock Type</th>
</tr>
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<tbody>
<tr>
<td>Hubbell</td>
<td>#HBL1221</td>
<td>#HBL1221-L</td>
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<tr>
<td>Legrand/P&amp;S</td>
<td>#20AC1</td>
<td>#20AC1-L</td>
</tr>
<tr>
<td>Leviton</td>
<td>#1221</td>
<td>#1221-L</td>
</tr>
<tr>
<td>Cooper-Arrow/Hart</td>
<td>#AH1221</td>
<td>#AH1221-L</td>
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</table>

2. Double Pole Switch – 20 Amp at 277V

<table>
<thead>
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<th>Toggle Type</th>
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<tr>
<td>Legrand/P&amp;S</td>
<td>#20AC2</td>
<td>#20AC2-L</td>
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<tr>
<td>Leviton</td>
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<tr>
<td>Cooper-Arrow/Hart</td>
<td>#AH1222</td>
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3. Three-Way Switches – 20 Amp at 277V

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<th>Manufacturer</th>
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<th>Lock Type</th>
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<tbody>
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<td>#HBL1223</td>
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<tr>
<td>Legrand/P&amp;S</td>
<td>#20AC3</td>
<td>#20AC3-L</td>
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<td>Leviton</td>
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4. Four-Way Switches – 20 Amp at 277V

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<tr>
<td>Legrand/P&amp;S</td>
<td>#20AC4</td>
<td>#20AC4-L</td>
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<td>Leviton</td>
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<tr>
<td>Cooper-Arrow/Hart</td>
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5. Momentary Contact Switches – 20 Amp at 277V

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<tr>
<th>Manufacturer</th>
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<th>3-Position Lock</th>
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<tr>
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<tr>
<td>Leviton</td>
<td>#1251</td>
<td>#1251-L</td>
</tr>
<tr>
<td>Cooper-Arrow/Hart</td>
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6. Maintained Contact Switches (Double Throw, Center Off) – 20 Amp at 277V

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>1-Pole</th>
<th>2-Pole</th>
<th>1-Pole</th>
<th>2-Pole</th>
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<tbody>
<tr>
<td>Legrand/P&amp;S</td>
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<td>#1226</td>
<td>#12250L</td>
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<td>#HBL1386-L</td>
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<td>Leviton</td>
<td>#1385</td>
<td>#1386</td>
<td></td>
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<tr>
<td>Cooper-Arrow/Hart</td>
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<td>#AH (extra)</td>
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7. Pilot lights used in conjunction with circuit switches shall be LED type with red jewel.
C. Switches – Shall be Decorator (“Rocker” type operations) Style, for residential locations only.

1. 120 volt 60Hz AC, rated 15 ampere for lighting loads and rated 20 ampere for non-lighting loads, unless indicated otherwise on Drawings.

2. Single Pole Switches

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Rocker Type</th>
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<tbody>
<tr>
<td>Legrand/P&amp;S</td>
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<tr>
<td>Hubbell</td>
<td>#RSD115</td>
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<tr>
<td>Leviton</td>
<td>#5621-2</td>
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<tr>
<td>Cooper-Arrow/Hart</td>
<td>#7501</td>
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3. Double Pole Switch

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Rocker Type</th>
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<tbody>
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<td>Legrand/P&amp;S</td>
<td>#TM870(extra)</td>
</tr>
<tr>
<td>Hubbell</td>
<td>#RSD215</td>
</tr>
<tr>
<td>Leviton</td>
<td>#5622-2</td>
</tr>
<tr>
<td>Cooper-Arrow/Hart</td>
<td>#7502(extra)</td>
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</table>

4. Three-Way Switches

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Rocker Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legrand/P&amp;S</td>
<td>#TM873</td>
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<tr>
<td>Hubbell</td>
<td>#RSD315</td>
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<td>Leviton</td>
<td>#5623-2</td>
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<tr>
<td>Cooper-Arrow/Hart</td>
<td>#7503</td>
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5. Four-Way Switches

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Rocker Type</th>
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<tbody>
<tr>
<td>Legrand/P&amp;S</td>
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<tr>
<td>Hubbell</td>
<td>#RSD415</td>
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<td>Cooper-Arrow/Hart</td>
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6. Momentary Contact Switches

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<tr>
<th>Manufacturer</th>
<th>3-Position Regular</th>
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<tbody>
<tr>
<td>Legrand/P&amp;S</td>
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<td>Hubbell</td>
<td>#RSD(extra)</td>
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<td>Leviton</td>
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<tr>
<td>Cooper-Arrow/Hart</td>
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7. Maintained Contact Switches (Double Throw, Center Off).

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Rocker Type</th>
</tr>
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<tbody>
<tr>
<td>Leviton</td>
<td>1-Pole #5685-2</td>
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<tr>
<td></td>
<td>2-Pole #5686-2</td>
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</table>

8. Pilot lights used in conjunction with circuit switches shall be LED type with red jewel.

D. Weather-Proof (W.P.) Switches

1. Outdoor switches provide heavy-duty, tamper resistant gasketed weather proof metal, hinged door cover for each switch.

2. Cover door shall be key locking-type or padlock-type.

E. Other Switches, Receptacles, Devices, and Outlets

1. Special devices outlets and outlet locations shall be as indicated on the Drawings. Modify device and outlet characteristics to accommodate the actual install location conditions for each outlet.
2.04 ELECTRIC RECEPTACLE WIRING DEVICES

A. General

1. All receptacle wiring devices in flush type outlet boxes shall be installed with a bonding jumper to connect the box to the receptacle ground terminal. Grounding through the receptacle mounting straps is not acceptable. The bonding jumper shall be sized in accordance with the branch circuit protective device as tabulated herein under "Grounding". Bonding jumper shall be attached at each outlet to the back of the box using drilled and tapped holes and washer head screws 6-32 or larger (except isolated ground receptacles). For receptacles in surface mounted outlet boxes direct metal-to-metal contact between receptacle mounting strap (if it is connected to the grounding contacts) and outlet box may be used. Receptacle mounting-ears for screw attachment to outlet box. Receptacle shall be UL listed and labeled; conform to NEMA-WD1 and WD6.

2. All receptacles shall be a product of the same Manufacturer.

3. Receptacle color as selected by OWNER’S Representative. Receptacles connected to emergency power circuits shall be red.

4. Tamper Resistant Receptacle
   a. Devices shall additionally be listed and labeled as tamper resistant, provide tamper resistant receptacles in buildings containing: dormitories, guestrooms, condominiums, housing/residences, apartments, dwellings, hotels/motels, classrooms, secondary schools K through 12th grade, childcare/day-care/kindergarten, hospital pediatric-care units and other locations required by AHJ.
   b. The electrical receptacles shall be rated "Tamper-Resistant-Receptacle" (TR), UL-TR (RTRT). Spring loaded shutters shall automatically open-close (unblock-block) the receptacle slots, when the plug-in (cap) insertion and removal occurs.
   c. Typical for 15-ampere and 20-ampere receptacles. Modify Manufacturer’s catalog number description to include tamper resistant receptacle function.

5. Wiring devices shall be listed and labeled for connection of both “solid” and “stranded” copper circuit conductors.

6. Duplex convenience receptacles and 120-volt single phase branch circuits.
   a. Duplex (convenience) receptacle, wiring device with two (2) single receptacles with the same electrical rating, integrated into a single assembly by the Manufacturer.
   b. 20-ampere branch circuits with a single duplex convenience receptacle connection on each circuit, receptacles shall be rated for 20-ampere.
   c. 15-ampere and 20-ampere branch circuits with two (2) or more duplex convenience receptacle connections each circuit, receptacle shall be rated 15-ampere or 20-ampere.

7. Devices shall additionally be listed and labeled as UL-All Weather-Resistant, provide weather resistant receptacles for the following install locations. Modify Manufacturer’s catalog number descriptions, shall include all-weather-resistant UL listing and labeling:
   a. Devices indicated on Drawings as Weather-Proof (W.P.).
   b. Devices installed in outdoor locations.
   c. Devices installed in classified as damp or wet locations both indoor and outdoor.
   d. All GFCI (ground-fault) receptacles all locations.

8. Receptacles with ampere and voltage ratings different than described for duplex convenience receptacles. The different rated receptacles shall have the same characteristics and performance as the respective duplex convenience
receptacles, except for differing ampere and voltage characteristics. Refer to “Floor Boxes” for additional receptacle requirements.

9. Receptacles shall be GFCI type for the following locations:
   a. Located within 84-inches of a sink or hosebib shall be GFCI receptacles.
   b. Devices installed in outdoor locations.
   c. Devices installed in classified as damp or wet locations both indoor and outdoor.
   d. Devices indicated on Drawings as GFCI or Weather-Proof (W.P.).

10. “Split-wire” duplex convenience receptacles. Each split-wire receptacle plug connects on independent common circuit. Provide nameplate or graphic on face of receptacle describing the receptacle function and control source. Comply with California Title-24 and ASHRAE-90.1, latest revisions.

B. Duplex convenience receptacles.

1. Shall be grounding type, 120 volt and shall have two (2) current carrying contacts and one (1) grounding contact which are internally connected to the frame. Outlet shall accommodate standard parallel blade cap and shall be side wired. Receptacles shall be tamper resistant–TR, UL-TR.

2. GFCI receptacles shall be all Weather-Resistant and wet location rated. Duplex, rated 120 volt 60Hz AC, 20 ampere, unless indicated otherwise on Drawings.

3. Heavy Duty Industrial Grade
   Manufacturer NEMA 5-15R NEMA 5-20R NEMA 5-20R-GFCI
   Legrand/P&S . . . . . #5262 . . . .......#5362 . . ........#2095HG
   Leviton . . . . . . . . . #5262 . . ........#5362 . . ........#W7899
   Hubbell . . . . . . . . . . #CR5252. . .......#5362 . . ........#GFR8300
   Cooper-Arrow/Hart . #AH5262. . .......#AH5362 . . .......#WRFVF20

C. Isolated Ground Receptacles-IGR

1. The receptacle insulation barrier shall isolate the receptacle ground contact system from ground. Connect the ground plug contact to a separate dedicated insulated ground-bonding conductor. The receptacle ground plug contact shall not be grounded to the raceway or outlet box. Isolated ground duplex convenience receptacle 20-ampere minimum, with two (2) current carrying contacts and one grounding contact, or as noted on the Drawings.

2. High-abuse, heavy-duty industrial grade, NEMA 5-20R, duplex convenience receptacles.

3. Identify receptacle with an orange triangle on the receptacle face and orange receptacle body. Red body for receptacles connected to emergency power.
   Manufacturer NEMA 5-20R
   Legrand/P&S . . . . . . . . . . #IG6300
   Leviton . . . . . . . . . . . . . #5362IG
   Hubbell . . . . . . . . . . . . . #CR5352IG
   Cooper-Arrow/Hart . . . . . . #IG5362

D. Hospital Grade Duplex Convenience Receptacles

1. Receptacles shall be Underwriters Laboratories listed hospital high abuse, heavy-duty rated grade.

2. Duplex convenience receptacles shall be grounding type 120 volt with two (2) current carrying contacts and one (1) grounding contact which is internally connected to the frame. Outlets shall accommodate standard parallel blade cap and is side wired.
3. Ground Fault Circuit Interrupter (GFCI or GFI) 20-ampere duplex convenience receptacles with test-reset buttons and visual pilot. Shall be all Weather-Resistant and wet location rated.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>NEMA5-15R</th>
<th>NEMA5-20R</th>
<th>NEMA5-20R-GFCI</th>
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<tr>
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<td>Hubbell</td>
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<td>Cooper-Arrow/Hart</td>
<td>#AH8200</td>
<td>#AH8300</td>
<td>TRVGFH20</td>
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</table>

E. Weather Proof (W.P.) Receptacle
1. Outdoor receptacles shall be duplex convenience GFCI type rated 20-ampere 120 Volt 60Hz AC weatherproof, GFCI, unless indicated otherwise on Drawings. Test-reset buttons and visual pilot.
2. GFCI receptacles shall be wet location and Weather-Resistant rated weatherproof, gasketed, key locking tamper resistant, wet location.
3. Outdoor, flush mount outlet with hinged, key-locking, weather-proof cover (CEC/NEC – 406.8 compliant). As manufactured by Pass and Seymour/Legrand #4600 Series; or C.W. Cole #310 Series.
4. On exposed conduit runs, provide weatherproof ground fault circuit interrupter type GFCI receptacles installed in "FS" conduit water tight cast metal body, with weather-proof spring door type covers, gasket water tight. Door shall be key locking-type or padlock-type.

F. Duplex convenience receptacles, for residential locations only.
1. Receptacles shall be “Decorator” type, grounding type, 120 volt, 60Hz AC, and shall have two (2) current carrying contacts and one (1) grounding contact which are internally connected to the frame.
2. Outlet shall accommodate standard parallel blade cap and shall be side wired.
3. GFCI receptacles shall provide test-reset buttons and visual pilot. Rated 120 volt 60Hz AC, unless indicated otherwise on Drawings. GFCI receptacles shall be wet location and all Weather-Resistant rated.
4. Tamper Resistant Receptacles
   a. All the electrical receptacles shall be rated “Tamper Resistant Receptacles” for 120 volt, 15-ampere and 20-ampere (TR), UL-TR (RTRT). Spring-loaded shutters shall automatically open-close (unblock-block) the receptacles slots, when the plug-in (cap) insertion and removal occurs.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>NEMA 5-15R</th>
<th>NEMA 5-20R</th>
<th>NEMA5-20R-GFCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legrand/P&amp;S</td>
<td>#885TR</td>
<td>#TR26362</td>
<td>#2095TRWRW</td>
</tr>
<tr>
<td>Leviton</td>
<td>#T5325</td>
<td>#T5825</td>
<td>#W7899TR</td>
</tr>
<tr>
<td>Hubbell</td>
<td>#RRD15STR</td>
<td>#RRD20STR</td>
<td>#GFTR20</td>
</tr>
<tr>
<td>Cooper-Arrow/Hart</td>
<td>#TR1107</td>
<td>#TR6350</td>
<td>TWRVG20</td>
</tr>
</tbody>
</table>

G. Other Switches, Receptacles, Devices, and Outlets.
1. Special devices, outlets and outlet locations shall be as indicated on the Drawings. Modify device and outlet characteristics to accommodate the actual install location conditions for each outlet.

2.05 PLATES

A. Metal Cover Plates for Devices
1. Provide cover plates for every line voltage and low voltage switch, receptacle, telephone, computer, television, signal and other device outlets.
   a. All line voltage circuit plates shall be metal, 0.040-inch stainless steel Type 302 alloy, composed of 18% chromium and 8% nickel.
b. Plates for low voltage signal systems may be metal or non-metal. Non-metal plates shall be high-abuse, hard-service and high-impact resistant.

2. Plates shall be as manufactured by P&S; or Hubbell; or Leviton; or General Electric.

B. Residential Location Project non-metal cover plates for line voltage and low voltage devices.
   1. Provide plates for every line voltage and low voltage switch, receptacle, telephone, computer, television, signal and other device outlets. Non-metal, heavy-duty, high-abuse and high-impact resistant plates.
   2. Plates shall be same Manufacturer as the respective wiring device.

2.06 VANDAL-PROOF FASTENINGS

Provide approved vandal-proof type screws, bolts, nuts where exposed to sight throughout the Project. Screws for such items as switch plates, receptacle plates, fixtures, communications equipment, fire alarm, blank covers, wall and ceiling plates to be spanner head stainless steel, tamperproof type. Provide OWNER with six (6) screwdrivers for this type.

2.07 STRUCTURAL AND MISCELLANEOUS STEEL

Structural and miscellaneous steel used in connection with electrical work and located out-of-doors or in damp locations, shall be hot-dip galvanized unless otherwise specified. Included are underground pull box covers and similar electrical items. Galvanizing averages 2.0 ounce per square foot and conforms to ASTM A123.

2.08 FLASHING ASSEMBLIES

A. General
   1. Flashing shall be compatible with the material being penetrated and with the pipe passing through the flashing. Coordinate with and comply with Manufacturer's recommendations, for both the flashing and the material being penetrated.
   2. Provide lead metal flashing assemblies at all roof penetrations, unless recommended otherwise by Manufacturer.
   3. Seal the joint between the flashing and pipe passing through the flashing with waterproofing compound.
   4. Lead flashing for roof penetrations, as manufactured by: Santa Rosa Lead Products; or Semco; or Flashco.

B. Storm Collars
   1. In addition to penetration flashing, provide a storm-collar counter-flashing for each roof penetration flashing. Shall attach to the structure of the penetration and form a water-tight “umbrella” counter flashing over the roof penetration flashing.
   2. As manufactured by: STD-Storm collars; or ASI-Storm collars.

2.09 RELAYS, CONTACTORS, AND TIMESWITCHES

A. Individual Control Relays (HVAC Plumbing of the Control Functions)
   1. Individual control relays shall have convertible contacts rated a minimum of 10 amperes, 600 volts regardless of usage voltage. Coil voltage, number and type of contacts shall be verified and supplied to suit the specific usage as shown in the wiring diagrams and/or schedules on the Electrical and Mechanical Drawings. Coil control circuit shall be independently fused, sized to protect
coil. Relays shall be installed on prefabricated mounting strips. Each relay shall have a surge suppressor to limit coil transient voltages. Furnished in the NEMA Type I enclosure unless indicated otherwise.

2. The following relays are approved:

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooper-Arrow/Hart</td>
<td>IMP</td>
</tr>
<tr>
<td>General Electric</td>
<td>Class CR 2811</td>
</tr>
<tr>
<td>Square D Co.</td>
<td>Class 8501, Type A</td>
</tr>
<tr>
<td>Westinghouse</td>
<td>Bul. 16-321, Type NH</td>
</tr>
<tr>
<td>Allen Bradley</td>
<td>Approved Equal</td>
</tr>
</tbody>
</table>

B. Contactors and/or Relays
1. Contactors and/or relays for control of lighting shall be 600 volt AC, electrically operated, and mechanically held units, open type for panel mounting with number of poles and of size as indicated on the Drawings. Provide auxiliary control relay for operation of each contactor and/or relay with a 2-wire control circuit.

2. Contactors and/or relays shall be mounted in panelboards in barriered section under separate hinged lockable doors or in contactor and/or relay cabinets as called for on the Drawings. Contactors and/or relays shall be installed on Lord sound absorbing rubber mounts.

3. Contactors and/or relays shall be Automatic Switch Co. Bulletin #920 Series for 2-pole and 3-pole, Automatic Switch Co. Bulletin 917 Series with poles as indicated on Drawings. Coil control circuit shall be independently fused, sized to protect coil.

4. Contactors and/or relays shall be equipped with a switch, in the proper configuration, to disconnect the control circuit controlling the coil of the respective device. Control circuit disconnect switch shall be labeled showing function of device.

C. Time-Switches
1. All timeswitches shall have synchronous motor drive for operation on 120 or 277 volts, 60Hz, AC and shall be furnished with a 10-hour, spring-driven, reserve-power motor. Contacts shall be rated 40A per pole.
   a. Exterior lighting timeswitches for control of individual circuits or electrically operated relays shall have astronomic dial and shall be Tork 7000ZL Series or approved equal by Paragon or Intermatic.
   b. Interior lighting timeswitches for control of individual circuits or electrically operated relays shall be Tork 7000 Series or approved equal by Paragon or Intermatic.
   c. Timeswitches for control of air conditioning or plumbing equipment shall have seven day dial and shall be Tork WL Series or approved equal by Paragon or Intermatic.

2. All timeswitches shall be mounted in separate section in top of panelboards under separate lockable door unless otherwise indicated on Drawings. Clear opening for timeswitch shall be a minimum of 12-inches by 12-inches.

D. Contactors and/or Relays/Timeswitch Cabinet
1. Contactors, relays, and/or timeswitches not indicated to be mounted in electrical panels shall be mounted in a cabinet, size as required, with hinged lockable door keyed same as panelboards. Construction of cabinet shall be similar to terminal cabinets.

2. Each contactor, relay or timeswitch mounted in the contactor cabinet shall be barriered in its own compartment, and shall be installed on Lord sound absorbing mounts.
3. Contactor cabinets shall be of the same Manufacturer as the panelboards.
4. Where relays and/or contactors occupy the same enclosure as timeswitches they shall have a clear acrylic shield installed over each relay or contactor to guard line exposed parts from accidental contact by nonauthorized personnel.

2.10 DISCONNECTS (SAFETY SWITCHES)

A. General
1. Disconnect switches shall all be rated:
   a. 600 volt 60Hz AC for all disconnect safety switches.
   b. NEMA Type HD, quick-make, quick-break, H.P.-rated.
   c. Fused Class "R", in NEMA Type I indoor location enclosure. Where enclosure is indicated outdoor or W.P. (Weather-Proof) switches shall be rain tight NEMA 3R enclosure. Lockable access door.
   d. Number of poles horse power rating and amperage as indicated on the Drawings.
2. Provide internal neutral bus, ground-lug and conductor landing lugs, size to match conductors shown on Drawings. Switch access door shall be interlocked with switch to prevent access inside switch when switch is “on” closed position.
3. Maximum voltage, current and horsepower rating clearly marked on the switch enclosure and switches having dual element fuses shall have rating indicated on the nameplate.
4. Disconnect switch and fuses ampere rating shall also comply with Manufacturer’s recommendation for the connected load.

2.11 SPARE FUSE CABINETS

Provide a cabinet in each room where a switchboard or motor control center is installed and contains fuses. Cabinets shall be as specified for "Terminal Cabinets" and shall be of sufficient size to contain all spare fuses hereinbefore specified. Provide clips (two (2) per fuse) for each spare fuse. Mount clips in plywood backboard in cabinet. Label cabinet "SPARE FUSES".

2.12 CONCRETE WORK (ADDITIONAL REQUIREMENTS)

A. Portland Cement
1. ASTM C33-(latest revision), Type II, Low Alkali Cement. Composed of Portland cement, coarse aggregate, fine aggregate, and water.
   a. Concrete for use as electrical equipment footings, lighting pole bases and equipment slabs on grade, concrete shall attain minimum 28-day compressive strength of 4000psi, using not less than 5.75 sacks of cement per cubic yard of wet concrete.
   b. Concrete for underground duct/conduit encasement, the minimum 28-day compressive strength shall be 2000 psi. Provide a minimum of 10-pounds of red oxide concrete coloring per yard of concrete.
   c. Mix shall obtain a 6-inches slump, measured with standard slump cone per ASTM C143/C143M (latest revision).
2. Coarse Aggregate: Uniformly graded between maximum size not over 1½-inch and not less than 0.75-inch and minimum size #4, crushed rock or washed gravel. For concrete encased conduit only, maximum aggregate size shall be ½-inch.
3. Fine Aggregate: Clean, natural washed sand of hard and durable particles varying from fine to particles passing ⅜-inch screen, of which at least 12% shall pass fifty (50) mesh screens.
B. Water: Clean and free from deleterious quantities of acids, alkalis, salts, or organic materials.

C. Reinforcement
   1. Bars: Intermediate Grade Steel conforming to ASTM A615/A615M grade 60, with pattern deformations.
   2. Welded Wire Fabric: ASTM A185/A185M.
   3. Bending: Conform to requirements of ACI 318.

D. Form Material: For exposed work, use PS 1-66 "B-B Concrete Form" plywood forms, or equal. Elsewhere, forms may be plywood, metal, or 1-inch by 6-inch boards. Forms for round lighting pole bases shall be sono-tube.

2.13 TRANSIENT VOLTAGE SURGE PROTECTOR (TVSS) – DIRECT CONNECT

A. General
   1. The unit shall be modular in construction and operate in parallel with 60Hz AC line voltage, 4-wire or 5-wire, grounded or ungrounded systems, as applicable; voltage, kVA and ampere capacity as indicated on the Drawings. Suitable for direct connection through an external circuit breaker or combination switch/fuse protective device rated 30-ampere, continuous duty, rated for Service Entrance equipment connection. Transient electrical surge protection sequences shall include circuit configurations as follows:
      a. Line-to-Line (Phase-to-Phase).
      b. Line-to-Ground (Phase-to-Ground).
      c. Line-to-Neutral, where neutral is present.
      d. Ground-to-Neutral, where neutral is present.
   2. The unit shall operate correctly with any combination of resistive, inductive, or capacitive loads. The unit shall automatically shunt to ground the electrical transients and EMI/RFI noise occurring above the specified values. The unit shall automatically reset after transient condition has passed. Operating temperature minus 40°C centigrade to plus 85°C centigrade.
   3. Provide one or more individual self-contained protection module(s) for each line voltage phase, ground and neutral, suitable for direct connect with line-side C/B protection and disconnect. Provide one (1) spare individual plug-in protection module. Provide incoming line, neutral and ground conductor termination lugs rated CU/AL #14 through #4 AWG. Lugs shall be barriered from and prewired to the respective protection modules.
   4. Provide a NEMA twelve (12) housing to contain all unit modules, devices and conductor terminations. The housing shall include a hinged pad-lockable access door.
      a. Flush housing for mounting internally inside related equipment.
      b. Surface mounted, with conduit entrance knockouts for external mounting. Maximum housing size shall not exceed 36-inches wide by 72-inches high by 8-inches deep.
   5. As manufactured by Total Protection Solutions Model #ST-TVSS; or MCG Electronics; or Advantage Protection Technologies, Inc.

B. Operational Characteristics
   1. Transient voltage protection, testing, listing and certification.
      a. UL 1449 (latest edition) and CSA listed and labeling, for Transient Voltage Surge Suppressor, UL 1283 for transient voltage electrical noise attenuation, ANSI/IEEE C62.45, C62.1 for C62.41, (latest edition) bi-directional transient clamping voltages for both Normal Mode and
Common Modes against Category A and B ring wave and Category B impulse wave.

b. The unit connected to the service entrance shall also withstand a minimum of two thousand (2000) sequential ANSI/IEEE C62.41 Category C surges without failure following IEEE Test procedures in C62.1, C62.41 and C62.45.

2. Transient voltage protection, EMI noise rejection, and RFI noise rejection shall be provided for Common Mode (line-to-neutral and line-to-ground), Normal Mode (line-to-line) and neutral to ground.

3. EMI and RFI noise rejection.
Conducted line noises interference both Electromagnetic (EMI) and Radio Frequency (RFI) shall be reduced by the unit over a continuous spectrum of 0.5MHz to 1.0MHz. The basis for reduction shall be a standardized 50-OHM insertion loss MIL-STD-220A test. Provide Spectrum Analysis Test dB attenuation reports showing RFI filtering over specified frequencies. Test data based on calculated or computer simulation is not acceptable.

4. Three phase and grounded "WYE" performance requirements.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>208/120 Volt</th>
<th>480/277 Volt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal line-to-line</td>
<td>208 Volt</td>
<td>480 Volt</td>
</tr>
<tr>
<td>Nominal line-to-neutral</td>
<td>120 Volt</td>
<td>277 Volt</td>
</tr>
<tr>
<td>Internal capacitance (Microfarads)</td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td>Maximum response time</td>
<td>1-nanosecond</td>
<td>1-nanosecond</td>
</tr>
<tr>
<td>EMI/RFI noise rejection</td>
<td>25-35dB</td>
<td>25-35-dB</td>
</tr>
<tr>
<td>Nominal peak clamp voltage</td>
<td>500 Volts</td>
<td>900 Volts</td>
</tr>
<tr>
<td>Line-to-neutral and line-to-ground</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum transient energy dissipation per phase (at 8x20 microseconds waveform)</td>
<td>1000 Joules</td>
<td>1500 Joules</td>
</tr>
<tr>
<td>Peak transient withstand (at 8x20 microseconds waveform) without failure of the unit</td>
<td>50,000 Amp</td>
<td>60,000 Amp</td>
</tr>
<tr>
<td>a. Category-C3</td>
<td>300,000 Amp</td>
<td>500,000 Amp</td>
</tr>
<tr>
<td>b. Category-B3</td>
<td>100,000 Amp</td>
<td>150,000 Amp</td>
</tr>
<tr>
<td>c. Category-A3</td>
<td>60,000 Amp</td>
<td>80,000 Amp</td>
</tr>
</tbody>
</table>

C. Diagnostic Indicators
1. Shall display the "Normal" and "Fault" status of each line suppression circuit, along with protection circuit "on" indication.
2. Shall provide a sonic audible fault alarm with silence push-button.

D. Surge Suppressor Protection Categories
1. Surge protectors shall comply with ANSI C62.41 (Latest Revision) Standard Protection Categories for "impulse" and "ringwave" transients, based on the installation locations shown in the Contract Documents.
   a. Service entrance, main switchboard or substation locations - Category "C3", high exposure, Type-1.
   b. Mid building, distribution panels, distribution panels over 400-ampere main bus rating locations - Category "B3", high exposure, Type-1.
   c. Branch circuit panelboards 400-ampere or less main bus rating - Category "A3", high exposure, Type-1.

2. The TVSS short circuit current withstand rating shall exceed the actual short circuit current available at the TVSS installation location.
2.14 PLUG STRIP TRANSIENT VOLTAGE SURGE SUPPRESSOR

A. General:
1. Point-of-Use Type-3 self-contained unit rated 15-ampere, nominal 120 volt plus-or-minus 10%, 60Hz, AC, 1875 watts full continuous load. Internal 15 ampere resettable overload protection circuit breaker. Red illuminated on-off switch. 6-foot, 14 AWG 3-conductor, grounded, heavy duty jacketed AC line cord with NEMA 5-15 cap. Multi-outlet receptacles, suitable for use with the following types of plug in loads, data processing equipment, audio/video equipment, test instruments, medical equipment, photo graphic equipment and "switching type" power supplies.
2. Protected outlets shall be NEMA 5-15R 15-ampere, AC 60Hz receptacles. Provide [4] [6] [8] protected outlet plugs on each plug strip, as indicated on the Drawings. Each group of two (2) receptacles (duplex) shall be connected to separate protected load isolated filter banks. Each duplex shall be isolated from the other output receptacles, minimum isolation of 25dB at 1MHz line to line, line to neutral, line to ground and neutral to ground.
4. As manufactured by TRIPP LITE-Isobar Series; or Advanced Protection Technologies; or equal.

B. Operation:
Self-contained RFI and EMF shielded housing with mounting slots for temporary mounting of the unit. Protected outlet receptacles shall supply filtered, electrical line voltage power to the connected equipment. Line noise RFI and EMI interference filtering suppression, transient voltage surge and spike protection shall occur in all three modes of operation line to ground, line to neutral and neutral to ground as follows:
1. 13,000-ampere, 210 joules (watt-seconds) peak withstands capacity.
2. Transient response time less than five (5) nano seconds.
3. 140-volt AC RMS initiate spikes suppression 330 volt maximum let through.
4. RFI and EMI Suppression-Provide Spectrum Analysis Test dB attenuation reports showing RFI filtering over specified frequencies.
   50KHz greater than 20dB
   150KHz greater than 40dB
   1MHz greater than 80dB
5. Diagnostic indicator lights located on the TVSS housing shall provide alarm alert for each of the following conditions:
   a. Loss of AC power.
   b. Damage, malfunction in the TVSS suppression circuits.
   c. Improper AC electrical outlet wiring.
6. Standards Testing, Listing, Labeling and Certification Compliance, latest revisions:
   a. IEEE 587 A and B compliance.
   b. UL 1449 transient voltage surge suppressers.
   c. UL 1363 temporary power taps.
   d. UL 1283 electromagnetic interference filters.

C. Rack Mounted TVSS
1. TVSS units installed in equipment racks shall comply with all of the same performance requirements, except as follows.
   a. EIA/TIA – Equipment rack mount style (19-inches or 24-inches as applicable).
b. Minimum of two (2) front mounted receptacle outlets and not less than six (6) rear mounted receptacle outlets.

c. 20 ampere 120 volt 60Hz AC electric circuit rating, instead of 15 ampere.

2.15 WIREWAY

A. General:
   1. Unobstructed lay in type, metal wireway, fittings and connectors UL listed for use as wireway and auxiliary gutter. Length, elbows and "T-S" as shown on Drawings. Minimum cross-section size 4-inches by 4-inches, but not less than shown on the Drawings. Suitable for mounting in any position orientation.

B. Construction:
   1. Minimum metal gauge shall not be less than 14 gage.
   2. Cover shall be hinged entire length of cover. Cover shall be held in the closed position with bolts and nuts.
   3. Provide spring nuts on all hardware fastener penetrations into the interior of the wireway to protect against wire insulation damage.
   4. The inside of 90-degree corners in the wireway shall be a 45-degree bevel.
   5. Grounding continuity between wireway sections and fittings shall be continuous the entire length of the wireway.

C. Finish:
   1. Indoor non-raintight, rust inhibitor phosphatizing base coating and baked enamel finish, Manufacturer's standard color.
   2. Raintight outdoor-galvanized metal, with corrosion resistant phosphate primer and baked enamel finish, Manufacturer's standard color, NEMA 3R construction.
   3. All hardware shall be plated to prevent corrosion.

PART 3 - EXECUTION

3.01 GROUNDING (ADDITIONAL REQUIREMENTS)

A. Grounding shall be executed in accordance with all applicable Codes and Regulations, both of the State of California and Local Authorities Having Jurisdiction.

B. Each pull box or any other enclosure in which several ground wires are terminated shall be equipped with a ground bus secured to the interior of the enclosure. The bus shall have a separate lug for each ground conductor. No more than one conductor shall be installed per lug.

C. The Maximum Resistance to Ground shall not exceed 5 ohms.

3.02 OUTLET AND JUNCTION BOXES

A. General:
   1. Accurately place boxes and securely fastens to structural members. Where outlets are shown at same location but at different mounting heights, install outlets in one vertical line. Where outlets are shown at same location and mounting height, mount outlets as close together in a horizontal row as possible. Where the outlet boxes for switches and receptacles are shown at the same location and mounting height, mount in common outlet box with barriers between devices. Provide single piece multi-gang cover plate for close mounted outlet boxes. Where switches are shown on wall adjacent to hinge side of doors, box shall be installed to clear door when door is fully opened.
2. Flush mounted boxes shall be attached to not less than two (2) parallel studs or structure members by means of metal supports. The supports shall span between and attach to the structure members.

3. Boxes above accessible ceilings shall be attached to structural members. Where boxes are suspended, they shall be supported independently of conduit system by means of hanger rods and/or preformed steel channels. Boxes shall be supported independently of all piping, ductwork, equipment, ceiling hanger wires and suspended ceiling grid system.

4. Surface mounted outlets shall be attached to concrete or masonry walls by means of expansion shields.

5. Floor boxes shall be installed level with finish floor and within adjustable limits of floor ring. Where outlets are shown at same or adjacent location, use multi-gang boxes.
   a. Provide cut-outs in the sub-floor assembly, to accept the recess depth of each electrical floor box. Provide added “fire-proof” applications on the bottom of each floor box location extending through the sub-floor. The “fire-proof” application shall be equal to the floor fire-assembly withstand rating.
   b. Poke-thru floor outlets, core drill floor for installation of poke-thru. Install “split-box” in the ceiling space of the floor below. If the ceiling space of the floor below is not accessible ceiling type (lift-out), then provide 12-inches round removable fire-rated stainless steel access panel and trim-ring in the finish ceiling for hand-access to poke-thru “split-box” above the ceiling.

6. Outlet Box Horizontal and Vertical Separation: Outlet boxes and device outlet rings installed flush in walls shall be horizontally and vertically separated by not less than 24-inches (edge of box to edge of box) from device outlet boxes and rings in common wall surfaces located on the opposite (back) side of the same wall.
   a. Where the separation cannot be maintained, provide a solid backing behind and completely enclosing each outlet box.
   b. The backing shall extend the width of the wall cavity (i.e., between "studs" or masonry cells) behind the box and 12-inches above and below the outlet box centerline, completely enclosing the outlet box.
   c. The backing shall consist of the following:
      1) ⅜-inch thick gypsum board anchored in place for "stud" wall construction.
      2) Solid "mortar" to completely fill the outlet box "cell" behind the box in masonry construction.

7. Provide metal outlet box for each device. Install devices in metal outlet boxes. Typical for all wiring devices including, switches, receptacles, line voltage devices, and low voltage/signal system devices.

B. Fire Wrap:
   1. In fire rated walls and ceilings provide fire rated "box-wrap" around the outside of each outlet box placed in fire rated wall or ceiling. Install the fire wrap on exterior of box inside the wall or ceiling, to maintain the fire rating of wall or ceiling with the installed outlet boxes.

3.03 SWITCHES AND RECEPTACLES-DEVICES

A. General
   1. Provide outlet boxes for all devices, switches, receptacles, both line-voltage and low-voltage.
   2. Devices installed in wireways shall be installed flush in wireway assembly.
   3. Install and screw attach devices into outlet boxes and wireways.
4. Provide ground circuit connections to all devices.
5. Provide branch circuit connections to all devices.
6. Provide testing and commissioning for proper operation and phase/ground connectors.
   a. Test each GFCI devices and ARC-Fault devices after installation and circuit connection is complete.
   b. Test all devices for correct polarity and proper electrical energization.
   c. Test On-Off operation of automatically controlled outlets and receptacles.
7. Install and adjust all coverplates to be flush and level, with correct device and circuit identification.
8. Were one or more device occurs at the proximity with other similar devices, all of the devices shall be “granged” under one common coverplate as follows:
   a. Duplex convenience receptacles with other proximity (within 18-inches) duplex convenience receptacles.
   b. Lighting control switches not exceeding 20-ampere switch rating with other proximity (within 18-inches) similar switches.

B. Line-voltage Plug-In Type Receptacle Installation Orientation:
   1. The “ground-pin” shall face “up” at the receptacle top location (double duplex) 4-plex, individual and vertically mounted individual duplex receptacles.
   2. The “neutral-blade” shall face “up” at the receptacle top location on horizontally mounted duplex receptacles.

3.04 CONCRETE WORK

A. Form:
   1. Space forms properly with spreaders and securely tie together. Do not use twisted wire form ties. Keep forms wet to prevent joints from opening up before concrete is placed. Replace improper construction as directed. Do not use wood inside forms.
   2. Build in and set all anchors, dowels, bolts, sleeves, iron frames, expansion joints and other materials required for the Electrical Work. Place all items carefully, true, straight, plumb, and even.
   3. Carefully remove all exposed forms. Cut nails and tie wires below face of concrete and fill all holes. Rubbish will not be allowed to remain in, under, or around concrete.

B. Mixing: Use batch machine mixer of approved type. After ingredients are in mixer, mix for at least 1½-minutes.

C. Transit Mixing: In lieu of mixing at site, transit mixing may be used if rate of delivery, haul time, mixing time, and hopper capacity is such that concrete delivered will be placed in forms within 90-minutes from time of introduction of cement and water to mixer.

D. Placing of Concrete
   1. Before placing concrete, remove wood, rubbish, vegetable matter and loose material from inside forms. Thoroughly wet down wood forms to close joints.
   2. Clean reinforcement; remove paint, loose rust, scale and foreign material. Bars with bends not called for will be rejected. Hold securely in place to prevent displacement. Lap bar splices 24-diameters, min; lap fabric one mesh min. Tie intersections, corners, splices with 16-gallon annealed wire, or as otherwise called for.
   3. Place concrete immediately after mixing. Do not use concrete that has begun to set; no tempering will be allowed. If chuting is used, avoid segregation. In
placing new concrete against existing concrete, use bonding agent per Manufacturer's directions.

4. Give careful and thorough attention to curing of concrete. Keep concrete and forms wet for a minimum of 10-days, after placing concrete.

E. Concrete Finish
1. Finish of Exposed Concrete: Horizontal surfaces, steel troweled monolithic finish; vertical surfaces, smooth and free of fins, holes, projection, etc.
2. Exposed lighting pole bases shall be filled and sack finished to a smooth finish.
3. Remove concrete pour-forms.

3.05 TRANSIENT SURGE PROTECTOR INSTALLATION (TVSS)

A. Direct connect TVSS Installation
1. Install unit cabinet to insure a maximum connected circuit length of less than 5-feet from the equipment the transient surge unit is connected to, approximately plus 48-inches on wall.
2. Alternately, factory install TVSS unit directly into respective equipment, instead of remote from equipment. Install TVSS inside respective switchgear, switchboards, distribution panels, panelboards, etc.
3. Connect between transient surge unit and supply equipment with not less than 1.25-inch conduit containing 5#4 AWG, copper conductor, 600 volt THHN/THWN insulation, connection circuit.
4. Provide a subfeed overcurrent protective device in the respective panel or switchboard to supply the TVSS connection circuit, whether or not shown on the Drawings. The protective subfeed device shall be a thermal magnetic circuit breaker rated not less than 30-ampere 3-pole or a safety switch and fuse unit rated not less than 60-ampere 3-pole, voltage and short circuit fault interrupting class to match the respective circuit voltage.
5. Connect transient surge unit to main building ground bus or electric distribution equipment ground bus (whichever is closer distance), with 1.25-inch conduit - 1#4 AWG copper conductor 600 volt, THHN/THWN insulation.

B. Plug-in type TVSS
1. Install in respective equipment racks.
2. Install at respective workstation locations, cabinets and furniture.
3. Connect to respective equipment and wall electrical outlets.

C. Install, Connect, and Test each TVSS Unit in Accordance with Manufacturer's recommendations.

3.06 WIREWAY INSTALLATION

Wireway hangers shall provide clamp type, hanger rod type, direct bolted bracket type from ceiling or walls as indicated on the Drawings and required for field installation locations. Supports shall be installed a minimum of 5-feet on center.

END OF SECTION
100515/223015
SECTION 26 0530

CONDUIT AND WIRE

PART 1 – GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
   2. General provisions and requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Submit product data sheets for all wire, supports, conduit, fittings and splicing materials.

B. Submit material list for all conduit and conduit fittings.

C. Submit details and structural engineering calculations for conduit support systems.

PART 2 - PRODUCTS

2.01 CONDUIT

A. General

1. The interior surfaces of conduits and fittings shall be continuous and smooth, with a constant interior diameter. Conduits and conduit fittings shall provide conductor raceways of fully enclosed circular cross section. The interior surfaces of conduits and fittings shall be without ridges, burrs irregularities or obstructions. Conduits and fittings of the same type shall be of the same uniform weight and thickness.

2. Type of conduit, type of conduit fittings and conduit supports shall be suitable for the conditions of use and the conditions of location of installation, based on the Manufacturer’s recommendations and based on Applicable Codes.

3. All fittings for metal conduit shall be suitable for use as a grounding means, pursuant to the applicable code requirements. All metal conduit and metal conduit fittings shall provide 3 second duration ground fault current carrying ratings, when installed and connected to the respective conduit, as follows:
   a. RMC and EMT conduit fittings.
      1) 0.5 inch through 1.5 inch conduit/fitting size - 10,000 ampere RMS.
      2) 2.0 inch and larger conduit/fitting size - 20,000 ampere RMS.
   b. FMC and LTFMC Conduit Fittings
      1) 0.5 inch through 1.25-inch conduit/fitting size-1,000 ampere RMS (without external bonding jumper).
      2) 1.5 inch through 4.0-inch fitting size-10,000 ampere RMS with bonding jumper.
4. Protective corrosion resistant finish for metal conduit fabricated from steel and metal conduit fittings fabricated from steel, shall be as follows:
   a. Clean all metal surfaces (including metal threads) with acid bath “pickle” prior to coating, to remove dirt, oil and prepare surfaces for galvanizing.
   b. Hot-dip galvanized zinc coating on all interior and exterior steel surfaces. Minimum finish zinc coating thickness shall not be less than 0.002 inches.
   c. Threads shall be hot-dip zinc coated after machine fabrication.
   d. Exterior metal surfaces shall be finished with clear organic polymer topcoat layer, after galvanizing.
   e. The inner metal surfaces of conduit fittings shall be finished with a lubricating topcoat after galvanizing, to facilitate conductor pulling through the conduit/fitting.
5. Threads for metal conduit and metal conduit fittings shall be taper-pipe-thread, National Pipe Standards (NPS) and shall comply with ANSI-B1.20.1.
6. Metal conduit termination connector fittings shall be provided with a Manufacturer installed, insulating throat bushing inside the fitting. The bushing shall protect the wire conductor insulation from cutting, nicks and abrasion during conductor installation and electrical load “cycling” after installation is complete. The bushing shall comply with UL 94V-0 flammability.
7. Provide conduit bonding/grounding jumper from metal enclosures with “concentric ring” knockouts, to positively ground/bond each respective conduit(s) to the metal enclosure.
8. Metal conduit fittings connecting to PVC coated metal conduit shall be PVC coated to match the conduit.
9. The conduit and fittings shall be watertight and airtight without cracks and pinholes.

B. Rigid Metal Conduit (RMC)
1. Rigid metal, round tubing, machine threaded at both ends.
   a. The conduit and conduit fittings shall comply with the requirements for an equipment grounding conductor, pursuant to applicable codes.
2. RMC raceway types shall be as follows:
   a. Rigid Galvanized Steel conduit (RGS), minimum yield strength shall be 35,000 PSI. Shall comply with NEMA Standard 5-19 (latest revision); ANSI C80.1 and ANSI-C80.4 (latest revision); UL 514-B and UL 6 (latest revisions); National Pipe Standard Specification (latest revision).
   b. Intermediate steel Conduit (IMC). Shall comply with NEMA Standard 5-19 (latest revision) ANSI-C80.6 (latest revision); UL 2142 (latest revision).
3. RMC fittings:
   a. Fittings shall be compatible with RGS and IMC.
   b. Fittings shall be rated “liquid tight”.
   c. Fittings imbedded in concrete shall be rated “liquid tight” and “concrete tight”.
   d. Connectors and couplings for terminating, connecting and coupling to RMC conduit shall be threaded metal.
   e. Fittings shall comply with ANSI C80.4 and ANSI C33-84 (latest revision); NEMA FB1 (latest revision); UL 514 (latest revision).
   f. Conduit seal fittings:
      1) Conduit seals shall prevent the passage of gasses, liquids and vapors past the location of the seal installation in the conduit.
      2) Conduit seals shall be suitable for installation in both vertical and horizontal conduit locations.
      3) Conduit seals shall be visible and accessible for inspection after installation is complete.
4) Conduit seals shall be rated for the following locations:
   a) Wet locations
   b) Classified hazardous location materials NEC Class 1 Division 1.
   c) Temperature ranges from 0 [minus 20] degrees centigrade through 90 degrees centigrade.

5) Conduit seals, sealing compound and sealing compound dam shall be the products of the same Manufacturer.

4. RMC fittings as manufactured by:
   a. For threaded enclosure, termination connection.
      1) Thomas & Betts - 106 Series bonding locknut, 5302 series sealing ring with stainless steel retainer.
   b. For non-threaded enclosure, termination connector.
      1) Thomas & Betts - 370 Series watertight threaded sealing hub, 106 series threaded bonding lock nut, Sta-Con Series enclosure bonding jumper and 3870 Series threaded ground bushing.
      2) Emerson-OZ/Gedney-CHMT/CHT watertight threaded hub with bonding locknut and GH50G Series enclosure bonding jumper.
   c. For RMC to RMC conduit-to-conduit coupling
      1) Thomas & Betts/Erickson - 674 (threaded) Series
      2) Emerson-OZ/Gedney Type TPC (threaded) Series
      3) Threaded RMC conduit couplings, product of the same Manufacturer as the RMC conduit.
   d. For RMC Conduit Seals
      1) Emerson-OZ/Gedney-EYA and EYAM (threaded) Series
      2) Appleton-EYF and EYM (threaded) Series

C. Electrical Metallic Tubing (EMT)
   1. Rigid metal round tubing, “thin wall” steel construction, with non-threaded ends.
      a. The conduit and conduit fittings shall comply with the requirements for an equipment grounding conductor pursuant to applicable codes.
      b. The conduit shall be watertight and airtight without cracks and pinholes.
   2. EMT shall be allowed for conduit size ranges from 0.5-inch through 4.0-inches.
   3. Comply with ANSI C80.3, C80.4, and ANSI C33.98 (latest revisions); UL 594 and UL 797 (latest revisions); CEC Section 12500 (latest revision).
   4. EMT fittings:
      a. Connectors and couplings for terminating, connecting and coupling to EMT conduit shall be non-threaded steel fabrication.
      b. EMT termination connector fittings shall be as follows:
         1) Set screw type “concrete tight” when installed in dry interior locations.
         2) Compression types “raintight” and “concrete tight” when installed in wet or damp locations, outdoors and in concrete or masonry construction.
      c. Fittings shall comply with ANSI C33.84 (latest revision); UL 514 (latest revision); NEMA FB-1.
   5. EMT fittings as manufactured by:
      a. For threaded and non-threaded enclosure, termination connector
         1) Thomas & Betts-TC721A (set screw type) Series (with locknuts).
         2) Emerson-OZ/Gedney-TC500I (set screw type) Series (with locknuts).
         3) Thomas & Betts-5123 (compression type) Series (with 2 locknuts).
         5) Thomas & Betts-4240 (compression type) Series (90 degree angle with locknut).
6) Emerson-OZ/Gedney-TWL (compression type) Series (90 degree angle with locknut).

b. For EMT to EMT conduit-to-conduit coupling:
   1) Thomas & Betts-TK121A (set screw type) Series (with locknut).
   2) Emerson-OZ/Gedney-5000 (set screw type) Series (with locknut).
   3) Thomas & Betts-5120 (compression type) Series.
   4) Emerson-OZ/Gedney-TC600 (compression type) Series.

c. For EMT to RMC conduit to conduit combination coupling:
   1) Thomas & Betts-HT221 (set screw type) Series.
   2) Emerson-OZ/Gedney-ESR (set screw type) Series.
   3) Thomas & Betts-530 (compression type) Series.

D. Flexible Metal Conduit (FMC)
   1. Round flexible conduit, fabricated from a single continuous steel strip. The steel shall be factory formed into continuous interlocking convolutions to form a complete lock between steel strips and provide raceway flexibility.
   2. Metal to metal grounding contact shall be maintained throughout the length of the FMC conduit.
   3. FMC shall be allowed for conduit size ranges from 0.5 inch through 4.0-inches.
   4. FMC shall comply with ANSI-C.33.84 and ANSI C33.92; NEMA FB-1; CEC 12-1100.
   5. FMC Fittings
      a. FMC fittings shall be malleable iron construction or steel construction.
      b. Fitting shall automatically cause the FMC raceway throat opening to be centered with respect to the fitting throat opening.
      c. Straight and angled connector termination fittings shall be threaded on one end and shall include a threaded locknut, suitable for connection to threaded and unthreaded enclosures.
      d. The attachment of the fittings to FMC shall be angled saddle type, to engage and interlock with the FMC spiral groove, and shall be unaffected by vibration. Direct bearing screw type fittings shall not be used.
      e. Direct FMC conduit-to-FMC conduit coupling of FMC shall not be permitted.
      f. Shall comply with ANSI C33.9, and ANSI C33.92 (latest revision); NEMA FB1 (latest revision); U.L. 514.
   6. FMC fittings as manufactured by:
      a. Straight Termination Connectors 45 and 90 Degree Angle Connectors
         Thomas & Betts-3110 Series  Thomas & Betts-3130 Series
         (with locknut) (with locknut)
      b. FMC to EMT conduit combination coupling:
         Thomas & Betts 503TB Series.

E. Liquid Tight Flexible Metal Conduit (LTFMC)
   1. The metal conduit core of LTFMC shall comply with the same requirements as FMC conduit, with the addition of a thermoplastic exterior flexible jacket over the metal core.
   2. The exterior jacket shall be positively locked to the metal core to prevent jacket "sleeving".
   3. The LTFMC shall be rated for installation and operating service temperatures of between minus 20 degrees centigrade through plus 90 degrees centigrade.
   4. The LTFMC jacket shall be suitable for continuous exposure to sunlight, rainwater, water vapor, mineral oils and liquid solvents, without penetrating into the conduit and without deteriorating the jacket.
5. LTFMC sizes from 0.5-inch through 1.25-inch shall include an additional internal ground conductor, fabricated by the Manufacturer, as an integral part of the conduit core.

6. Direct LTFMC conduit-to-LTFMC conduit coupling of LTFMC shall not be permitted.

7. LTFMC shall be allowed for conduit size ranges from 0.5-inch through 4.0-inches.

8. In addition to the requirements for FMC conduit, LTFMC shall also comply with ANSI C-33.84 (latest revision); NEMA-FB1 (latest revision); CEC 12-1400 (latest revision).

9. LTFMC fittings
   a. Fittings shall include an external mechanical ground/bond wire connector.
   b. The attachment of the fitting to LTFMC shall be threaded compression type onto the conduit core with locknut and liquid tight jacket compression seal. The fitting shall automatically prevent “sleeving” of the jacket.
   c. Straight and angled termination connector fittings shall be threaded on one end and shall include locknut suitable for connection to threaded and unthreaded enclosures.

10. LTFMC fittings as manufactured by:
    a. Termination connector fittings:
       1) Thomas & Betts-5331 GR Series. Thomas & Betts-5341GR & 5351GR Series.
       2) Appleton-STB & STN-L Series Appleton-STB-L Series; STN-L Series for use with preformed “knockouts”.
       3) Emerson-OZ/Gedney-4Q Series. Emerson-OZ/Gedney-4Q Series for use with preformed “knockouts”.
    b. LTFMC to RMC conduit to conduit combination coupling fittings:
       1) Thomas & Betts-5271 GR Series.
       2) Emerson-OZ/Gedney-4Q Series

F. Rigid Non Metallic Conduit (RNMC)
1. General
   a. Conduit and fittings shall be 90 degree centigrade conductor rated. Fabricated from homogeneous material, free from visible cracks, holes or foreign inclusions, with integral “end-bell”. The conduit and conduit fittings shall be watertight and airtight.
   b. Conduit, conduit fittings and conduit fitting assembly “solvent cement” shall all be the product of the same Manufacturer. Conduit fittings shall be solvent cement welded watertight.
   c. Conduit and fittings shall be identified with legible markings showing ratings, size and Manufacturers name.
   d. RNMC and fitting shall be corrosion resistant, watertight.
   e. Conduit shall be suitable for conductor operating temperatures from minus 20 degrees centigrade to 90 degrees centigrade.
   f. RNMC shall comply with NEMA TC-2 (PVC 40 conduit, latest revision) NEMA TC-6 (EB conduit latest revision) and NEMA TC-3 (fittings, latest revision); UL 514 and UL 651 (latest revision).

2. Polyvinyl Chloride (PVC)-RNMC
   a. PVC-schedule 40 heavy wall construction.
   b. PVC-schedule 80 extra heavy wall construction.
   c. PVC-type EB.

3. RNMC fittings connecting to metallic raceways shall be provided with a ground/bond jumper connection.
G. Combi-Duct
   1. Rigid nonmetallic conduit combining a continuous linear outer raceway (duct) with factory installed (inside the outer duct) multiple, segregated inner raceway (ducts). Rigid, schedule 40 PVC construction. Shall be modular lengths of 20-feet for each duct segment.
   2. The conduit shall be suitable for use with signal/telecommunications, fiber optic, telephone and computer/data circuits, operating at 100 volts or less, UL listed and labeled.
   3. Outer Duct, outer enclosing Schedule-40 PVC duct size. The outer enclosing duct shall be 4.2-inches inside nominal duct diameter and 4.5-inches outer duct nominal diameter.
   4. Inner-ducts (contained inside the enclosing outer duct), non-metallic SDR-19 or Type-C/CAO-8546:
      Triple Combi-Duct
      a. Quantity of three (3) continuous round rigid inner linear ducts, nominal size inside diameter 1.5-inch for each inner duct.
      Quad Combi-Duct
      b. Quantity of four (4) continuous round rigid inner linear ducts, nominal size inside diameter 1.19-inch for each inner duct.
   5. Manufacturer’s standard bends and offsets, minimum 72-inches radius.
   6. Combi-duct and combi-duct fittings shall be airtight and watertight. Approved for direct burial in earth and approved for encasement in concrete.
   7. As manufactured by Carlon # Multi-Guard/Multi-Cell Series; American Pipe and Plastic (AMTEL) #Multi-Bore Series; or equal.

H. Expansion Joint, Deflection Joint and Seismic Joint Conduit Fittings
   1. Expansion Conduit Fitting - Fitting shall provide for a minimum of 2-inches straight line movement between two (2) connecting conduits in each direction (total 4-inches conduit expansion and Contraction) parallel to the respective conduit lengths. Fitting shall be watertight.
   2. Deflection Conduit Fitting - Fitting shall provide for a minimum of 30 degrees angular deflection movement (“Shear” deflection) between two (2) connecting conduits, in any direction perpendicular to the length of the respective conduits. Fitting shall be watertight.
   3. Combination Expansion/Deflection Conduit Fitting - Fitting shall provide the combined “expansion” and “deflection” movement capacity between two (2) connecting conduits as described for separate “expansion” and “Deflection” conduit fittings. Fitting shall be approved for installation concealed in both masonry/concrete construction and exposed non-masonry/concrete construction. Fitting shall be watertight.
   4. Fittings shall comply with UL.
   5. Fittings as manufactured by:
      a. Conduit expansion fittings exposed or concealed locations as manufactured by:
         1) Emerson-OZ/Gedney – AXB-8 Series for RMC conduit.
         2) Emerson-OZ/Gedney - TX Series for EMT conduit.
         3) Appleton – AXB or XJ8 Series for RMC conduit and EMT conduits. Provide RMC to EMT combination conduit coupling fittings for each end of the expansion fitting.
      b. Combination expansion/deflection conduit fittings exposed or concealed conduit locations as manufactured by:
         1) Emerson-OZ/Gedney - AXDX Series for RMC conduit.
         2) Emerson-OZ/Gedney - AXDX Series for EMT conduit.
         3) Appleton-DX Series for RMC conduit.
4) Provide RMC to EMT combination conduit coupling fittings for each end of the expansion/deflection fitting.

c. Conduit expansion/deflection fittings for FMC and LTFMC conduit.
   1) Provide a minimum of 12-inches of “slack” LTFMC in each FMC or LTFMC conduit at building and structure seismic or expansion joint conduit crossings.
   2) Note: Each FMC “slack” expansion/deflection location, shall be considered as not less than a 90 degree conduit bend location, for compliance with the maximum quantity of conduit bends allowed in a raceway.

6. Conduit fitting bonding jumper:
   a. The grounding/bonding path of metal conduit shall be maintained by the fitting.
   b. Provide a bonding jumper at each expansion, deflection and combination expansion deflection conduit fitting.
   c. The jumper shall be a bare flexible copper “braid”. The copper braid electrical current carrying capacity shall be equal to the metal conduit.
   d. Provide a factory terminated ground clamp on each end of the braid with adjusting steel conduit grounding clamps and connect to each respective conduit end.
   e. The jumper braid length shall be 8-inches longer than the respective conduit fitting.
   f. Bonding jumper for FMC and EMT fittings as manufactured by:
      1) Emerson-OZ/Gedney – BJ and BJE Series
      2) Appleton – BJ/XJ Series

I. Conduit Bodies Conduit Fitting
   1. Conduit bodies shall provide conductor access with a removable conduit body cover and wiring area enclosed in metal housing. The conduit body shall facilitate pulling conductors.
   2. In-line form “C” conduit bodies shall be prohibited.
   3. The interior space “length” of 90 degree “elbow” conduit bodies shall not be less than six (6) times the diameter size of the largest conduit connecting to the conduit body.
   4. Conduit body covers shall be removable, gasketed; watertight “domed” metal covers “Mogul-Type” with threaded screw attachment to the conduit body.
   5. Lubricated, reusable, wire roller guards inside the conduit body shall protect wire from insulation damage during wire “pulling”.
   6. Conduit body fittings shall comply with UL 514.
   7. Conduit bodies as manufactured by:
      a. For RMC Conduit
         2) Emerson-OZ/Gedney - LB 6X/Mogul (90 degree elbow) Series - threaded body.
         3) Appleton – NEC6X-LB/Mogul (90 degree elbow) Series - threaded body.
      b. For EMT Conduit
         1) Same as for RMC conduit. Provide EMT to RMC conduit combination coupling fitting for each outlet body connection.
2.02 PVC COATING

A. PVC coatings shall be provided as described for specified metal products.

B. PVC coating shall be factory applied, to comply with NEMA-RN1 and 5-19.

C. The adhesion of the PVC coating to the coated metal shall exceed the strength of the coating itself, based on 0.5-inch “strip-pull” test.

D. Uniform coating thickness shall be continuous without “breaks” or “pinholes” and shall not be less than the following:
   1. Exterior metal surfaces, 40-millimeter coating thickness.
   2. Interior metal surfaces, 10-millimeter PVC or urethane coating thickness (i.e. interior of conduits, interior of conduit fittings etc.).

2.03 CONDUIT SUPPORTS

A. General
   1. Conduit Supports, hangers and fasteners for metal conduit shall be steel, hot dip zinc galvanized.
   2. Conduit supports, hangers and fasteners for PVC coated conduit shall be PVC coated to match the conduit PVC coating.
   3. Threaded hardware shall be continuous, free running threads.
   4. Conduit support systems, including support channels, pipe clamps, braces, anchors, hardware, fasteners, shall be sized to support the full capacity circuit conductors weight, plus the installed conduit weight, plus the conduit fitting weight and support hardware weight, plus a 300% additional weight capacity safety factor.
   5. Provide lock washer at each “bolted”/threaded connection.
   6. Conduit supports, fasteners, channels, braces, hardware, anchors, pipe clamps, and hangers as manufactured by Unistrut or Kindorf.
   7. Supports shall be free of “BURRS” and sharp edges.
   8. Metal supports cut in the field shall be zinc galvanized after cutting to prevent rust.

B. Conduit Hangers
   1. Threaded steel hanger rods.
      a. Hanger rods smaller than 0.375-inches in diameter shall not be used for support of individual conduits.
      b. Hanger rods smaller than 0.5-inches in diameter shall not be used for support of multiple conduits.
   2. Conduit hanger wires shall be not less than 12-gauge steel.
   3. Conduit hangers shall attach to structure fasteners with steel “Clevis” or “Swing” hangers and shall provide a minimum of 45 degrees of angular movement in any direction at the point of the conduit hanger attachment to the structure fasteners.
   4. Conduits individually suspended by conduit hangers shall fasten to the respective hangers with “Clevis” type pipe hangers. The pipe hangers shall be steel, adjustable to fit conduit size and shall completely enclose the conduit circumference.

C. Conduit Support Channels
   1. “C” channels shall be factory preformed with a minimum 12 gauge thickness metal. The channel shall be factory “punched” with regularly spaced slotted holes for fastener attachments along the length of the channel.
2. The “C” channel shall not deflect more than 0.1 inch between channel supports at maximum installed design load, including required safety factor.

3. Channels shall comply with ANSI-1008 (latest revision) and ASTM-A569 latest revision.

4. Channels shall provide “turned lips” at longitudinal edges to hold (lock-in) fasteners.

5. Conduit support channels suspended from conduit hangers shall attach to conduit hangers with threaded connections. Provide a minimum of two hangers (trapeze style) connected to each channel.

6. Non-suspended conduit support channels shall connect to structure fasteners with threaded connectors.

D. Fasteners, Seismic Earthquake Rated

1. Channel fasteners:
   a. Channel fasteners shall “prelocate” and lock into the channel “turned lips” and channel “walls”.
   b. A separate metal strap shall “tie” each conduit to each channel with conduit channel fasteners.

2. Structure fasteners:
   a. Structure fasteners for wall and floor mounted conduit attachments shall attach to existing masonry and concrete structures with structure fasteners using drilled, mechanical, expansion shield anchors.
   b. Structure fasteners for wall and floor mounted conduit attachments shall attach to new masonry and concrete structures with structure fasteners using steel threaded inserts precast into the structures.
   c. Structure fasteners shall center the support load above or below the beam flanges and reduce torsion-rotation forces exerted on the structural beam. Attach to steel structural members with “swing-beam clamps”, with set-locking screw structure fasteners.
      1) Beam clamps shall include integral safety rod, strap or “J”-hook to secure the attachment clamp to the beam flanges on both sides of the beam, with integral hanger rod attachment.
      2) Or double-ended beam clamp to secure the attachment clamp to the beam flanges on both sides of the beam, with integral hanger rod attachment.
   d. Structure fasteners for wall and floor mounted conduit attachments shall attach to wood structural members with flush “through-bolted” wood beam/wood framing stud structure fasteners.
   e. Structure fasteners for wall mounted conduit attachments shall attach to steel framing studs and steel structural elements with spot welded steel structure fasteners or drilled and bolted structure fasteners.

E. Brace Connectors

1. Provide lateral brace connectors to resist horizontal, lateral and vertical movement of suspended conduits during seismic earthquakes.

2. The braces shall connect from each conduit support, attach as close to the conduit as possible, and attach to fixed rigid, nonsuspended building “main” structural elements with fixed anchoring.

3. Brace attachment connectors and fasteners shall be rigid preformed steel channels or flexible #10 gauge steel hanger wire.

4. Connect and attach the brace connectors to fixed structural elements in the same manner as conduit support hangers. The connection of braces to structural elements shall be independent of the conduit support hanger structure fasteners.
2.04 ELECTRICAL POWER WIRE AND CABLE

A. General
1. All wire and cable shall be single-conductor, annealed copper, insulated 600 volt, #12AWG minimum unless specifically noted otherwise on the Drawings.
2. Conductors #10AWG and smaller shall be solid. Conductors #8AWG and larger shall be stranded.
3. Insulation of conductor connected to circuit protection devices required to be "100%" rated, shall be 90 degree centigrade rated insulation.
4. Insulation of conductors installed outdoors, on grade or underground, insulation shall be rated for wet locations.
5. Insulation of conductors installed outdoors, installed exposed to the sun, installed in exposed conduits, insulation shall be rated for high-temperature 90 degrees centigrade.
6. Insulation of branch circuit conducts installed in light fixtures, insulation shall be rated for 90 degrees centigrade.
7. Conductor exposed to oil, insulation and jacket shall be oil resistant, complying with “Oil Resistant-1” and “Oil Resistant-2” UL 83.

B. Conductor Insulation
1. 600 Volt AC and/or DC insulated conductors installed entirely inside conduits, or enclosed inside wireways, or enclosed inside raceways, insulation shall be rated as follows.
   a. Dual rated THHN and THWN
   b. Individually rated THHN-2
   c. Individually rated THWN-2
   d. XHHW-2
2. Indoor above Grade locations either concealed or exposed.
   a. Dual rated THHN and THWN
   b. Individually rated THHN-2
   c. Individually rated THWN-2
   d. XHHW-2
3. Outdoor above Grade either concealed or exposed.
   a. XHHW-2
   b. THWN-2
   c. THW-2
4. Outdoor below Grade or outdoor on Grade.
   a. XHHW-2
   b. THWN-2
   c. THW-2
5. All other enclosed raceway locations not described above.
   a. XHHW-2
   b. THWN-2
   c. THW-2
6. Health Care facilities all circuits insulation shall be XHHW-2, rated Hospital-Grade.
7. 600 Volt AC and/or DC insulated conductors installed in open cable tray or open wireway or exposed insulation also shall be rated for exposed install locations.

C. Insulation Color Coding and Identification
1. The following color code for branch circuits:
   a. Neutral . . . White (Tape feeder neutrals with white tape near connections)
   b. Normal Power:
      
      | 120/208 Volt | Ground | Green     |
      | Phase A     | Black  | Red       |
      | Phase C     | Blue   |           |
c. Isolated ground insulation shall be green with a longitudinal yellow stripe.
d. Emergency power same insulation color as normal power except as follows:
   120/208 Volt
   Provide a continuous stripe on each conductor insulation, orange or yellow, except ground

2. When individual neutral conductors are shown for each branch circuit, the color code for the neutral conductors shall be as follows:
a. 120/208 volt; Phase A - White with Black stripe; Phase B - White with Red stripe; Phase C - White with Blue stripe.

3. Feeders identified as to phase or leg in each, switchboard, switchgear, panelboard and junction location with printed identifying tape.

4. Fire alarm conductors: Use 600-volt, type THHN-2/THWN-2 conductors and color-coded per Equipment Manufacturer's recommendations and approved and listed for use on fire alarm systems by the State Fire Marshal.

5. Color coding for mechanical and plumbing control wiring shall be an agreed upon color code between the Mechanical/Plumbing CONTRACTOR and the Electrical CONTRACTOR, and color code shall be submitted to the DISTRICT'S Representative in writing for approval prior to installation.

D. Panel Feeders, Copper or Aluminum:
1. Wire size shown on the Drawings is for copper conductors, unless specifically indicated otherwise.
2. If aluminum wire is proposed, increase wire size to ampere capacity of copper wire and voltage drop not to exceed that of copper feeders indicated on Drawings. Increase conduit size and quantity as required by code. Provide feeder calculation sheet, eight (8) copies, if aluminum wire is proposed, showing feeder number, length, size and voltage drop in percentage for original copper feeders and for equal aluminum feeders.
3. Aluminum Conductors (600 Volt or Less Only): CONTRACTOR has the option of using aluminum conductors in lieu of copper conductors for feeders only to panels, distribution boards/panels, switchboards, switchgear, transformers, motor control centers, and dimmer switchboard.
4. Aluminum Conductors shall be Aluminum Association AA-8000 Series Alloy, compact-stranded, with the same insulation as called for under copper conductors.
a. Aluminum conductor larger than 750 MCM shall not be used.
b. Aluminum conductors smaller than #2AWG shall not be used.
5. If the conductor termination is to be made on a bus bar or similar flat surface, a Burndy Type YA-A HYPLUG compression terminal intended for the specific conductor size, factory filled with oxide inhibitor compound shall be used. Terminal must be installed using a hydraulic compression tool equipment with a die head for the particular terminal used. Only Burndy Hypress tools shall be used for compression.
6. If the conductor termination is to be made into a circuit breaker or similar insert compartment it shall be terminated by use of a Burndy AYP HYPLUG compression connector intended for the specific conductor size, factory filled with oxide inhibitor compound. Connector must be installed using only Burndy Hydraulic compression tool specifically approved for each respective connector.
7. Connector aid shall be used for all terminations and connections. Connector aid shall be Burndy Pentrox A, NO-OX-1D Grade “A”.
8. When an aluminum lug is terminated to a copper bus with a steel or copper stud or bolt, place aluminum lug on stud or bolt followed by a flat steel washer, a Belleville washer, and steel or copper nut, in that order.
2.05 CHEMICAL GROUND ROD

A. General
1. Self-contained ground rod(s) using chemically enhanced grounding shall be provided where specifically indicated on the Drawings. As manufactured by Lyncole XIT Grounding Systems, 22412 South Normandie Avenue, Torrance, CA. Telephone #(800) 962-2610; or Superior Grounding Systems, Irwindale, CA. Telephone #(800) 747-7925; or ERICO – Eritech Chemical Ground Electrode.
2. The ground rod shall operate from changes in atmospheric pressure pumping air through the ground rod, hygroscopically extracting moisture from the air to activate the ground electrolytic chemicals and improve the ground rod performance.
3. Ground rod system shall be UL-467 listed.
4. Ground rod system shall be 100% self-activating, sealed and maintenance free. The addition of chemical or water solutions shall not be required.

B. Ground Rod
1. Ground rod shall consist of a 2-inches nominal diameter hollow, copper tube. The tube shall be permanently capped on the top and bottom. Air breather holes shall be provided in the top of tube. Drainage holes shall be provided in the bottom and sides of the tube for electrolyte drainage into the surrounding soil.
2. The ground rod shall be chemically filled at the factory with environmentally non-hazardous water-soluble metallic salts to enhance electrical grounding performance.
3. Ground rod shall be a minimum of 10-feet long for straight (vertical) installation; or “L” shape minimum 20-feet long for horizontal installation.
4. Ground wire clamping “U-Bolt” with pressure plate on the top end of the tube sized for 1#2 through 500 MCM AWG ground electrode conductor connection, and stranded 4/0AWG copper pigtail exothermically welded to the side of rod for ground electrode conductor connection.

C. Ground Box
1. Precast concrete box with slots for conduit entrances. Approximately 10-inch diameter by 12-inches high. Cast iron grate flush cover with “Breather” slots XIT Box #XB-12.

D. Backfill Material
1. Natural volcanic, non-corrosive Bentonite Clay backfill material.
2. Shall absorb water at a minimum of thirteen times its dry volume or approximately 14 gallons for 50 pounds of clay.
3. PH value 8-10 with maximum resistivity of 2.5 OHMS-M at 300% moisture content by weight.

2.06 FLEXIBLE CORDS AND PORTABLE CABLES

A. General
1. Multi-conductor insulated flexible cable with jacket rated extra heavy duty, extra hard-use and high abuse duty; ozone, sunlight, grease, oil resistant-UL 83 and water resistant; rated for indoor/outdoor use.
2. Quantity of conductors and conductor sizes as indicated on the Drawings but in no case less than five 16AWG.
3. Characteristics:
   a. Conductors - stranded copper, soft annealed conforming to ASTM-B-174 and ASTM-B-172. 600 volt individually insulated and color-coded. Separate green insulated ground conductor. Aluminum conductors shall not be permitted for cords and cables.
   b. Insulation - rubber conforming to UL 62; temperature range plus 105° Centigrade to minus 50° Centigrade.
   c. Flame resistance shall conform with MSHA-P123-103.
   d. Jacket - black for equipment connections and yellow for outlet connections. Rated for temperature range plus 105° Centigrade to minus 50° Centigrade, water, sunlight and ozone resistant. Permanently mark jacket a minimum of 40-inches on center with rated voltage, Manufacturer's name, wire/insulation type, AWG conductor size and quantity (minimum 24-inches on center).

2.07 CABLE RACKS

   A. Cable racks, installed on the vertical walls of the structure, including hooks and porcelain insulator cable cradles, shall be sufficient to accommodate the cables and splices.

   B. Vertical racks shall be installed on all walls of the structure a minimum of 24-inches on center within 6-inches of floor and top of wall. A rack shall be installed within 18-inches of each corner of each wall. Additional racks spaced equally on each wall shall be installed; spacing between vertical wall racks shall not exceed 24-inches.
   1. Wall racks shall be slotted to accept removable hooks and lock hooks into place.
   2. Non-metallic, 50% (minimum) glass reinforced nylon or non-metallic material of the same characteristics.
   3. The installed cable racks, cable support hooks with arms and wall anchor bolts shall support the following minimum loads for each hook/arm, with a 200% minimum safety factor. Based on multiple hook/arms located not less than 9-inches on center along the entire vertical length of the support rack:

      | Hook/Arm Length | Min. Weight Each Hook/Arm Supported | Max. Allowable Hook/Arm Deflection |
      |-----------------|-------------------------------------|----------------------------------|
      | 8-inches        | 450 pounds                          | 0.25-inch                        |
      | 14-inches       | 350 pounds                          | 0.37-inch                        |
      | 20-inches       | 250 pounds                          | 0.37-inch                        |
      (Based on load concentrated 1-inch from the end of each hook/arm.)
   4. Racks shall be bolted to the precast and cast-in place structure walls, within 3-inches of each rack end and not less than 9-inches on center. Provide cast-in place or after-set drilled expansion concrete anchors.

PART 3 - EXECUTION

3.01 TRENCHING, FOOTINGS, SLEEVES

   A. Provide trenching, concrete encasement of conduits, backfilling, and compaction for the underground electrical work, in accordance with applicable Sections of this Specification.

   B. Provide footings for all post and/or pole-mounted lighting fixtures: concrete shall conform to the applicable Sections of this Specification.
C. Sleeves
1. Provide sleeves for raceways, conduit and wire/cables passing through the following construction elements:
   a. Concrete and masonry foundations, floors, walls and slabs.
   b. Gypsum, Lath, and plaster walls and ceilings.
   c. Building structures (i.e., foundations, walls, floors, ceilings, beams, and roofs) with a fire rating exceeding 20-minutes.
2. Sleeves shall extend 1.5-inch above and below floors, except under floor standing electrical equipment. Sleeves shall be flush with wall ceiling foundations and partitions exposed to public view and extend approximately 0.5-inch past penetration in fire rated construction. Sleeves shall be installed at exact penetration locations and angles to accommodate wire/cable, raceway and conduit routings.
3. Joists, girders, beams, columns or reinforcing steel shall not be cut or weakened. Where construction necessitates the routing of conduit or raceways through structural members, framing or footings, written permission to make such installation shall first be obtained from the DISTRICT’S Representative. Such permission will not be granted, however, if any other method of installation is possible.
4. The layout and design of raceways and conduits located in or routed through masonry or reinforced beams or the DISTRICT’S Representative shall review walls before any work is performed. All sleeving shall be accomplished according to the instructions of the DISTRICT’S Representative and shall be accepted before any concrete is poured.
5. Sleeves, raceways and conduit shall be located to clear steel reinforcing bars in beams. Reinforcing bars in walls shall be offset to clear piping and sleeves.
6. Provide a continuous clearance between the inside of a sleeve and exterior of wire/cables, conduits and raceways passing through the sleeve not less than the following:
   a. 0.5-inch clearance except as required otherwise.
   b. 1.0-inch clearance through outside walls below grade.
   c. 3.0-inch clearance through seismic joints.
7. Sleeves set in fire rated construction shall be caulked between sleeve and building structure, additionally sleeves shall be caulked between the sleeve and the wire/cables, conduits/raceways passing through the sleeve. The caulking shall be a fireproof sealant, equal to the fire rating and temperature being penetrated. Clearance between components inside of sleeve and exterior of components passing through sleeve and between components inside the sleeve shall comply with Fireproof Sealant Manufacturer’s recommendations.
8. Sleeve material:
   a. In floor construction: Schedule 40 black steel pipe, with upper surface to be sealed watertight.
   b. In concrete or masonry walls roofs or ceilings: Schedule 40 black steel pipe. When installed in roofs or outside walls, seal outer surface watertight.
   c. In fire rated construction; 24 gauge galvanized iron or steel.
   d. Sleeves through waterproof membranes: Cast iron or Schedule 40 steel with flashing clamp device and corrosion resistant clamping bolts. Caulk space between pipe and sleeve and surfaces between sleeve and conduits sealed watertight.

3.02 GROUNDING

A. Grounding shall be executed in accordance with all Applicable Codes and regulations, both of the State and Local Authorities Having Jurisdiction.
B. Where nonmetallic conduit is used in the distribution system, the CONTRACTOR shall install the proper sized copper ground wire in the conduit with the feeder for use as an equipment ground. The electrical metallic raceway system shall be grounded to this ground wire.

C. The maximum ground/bond resistance to the grounding electrode shall not exceed 1 ohms from any location in the electrical system. The maximum ground resistance of the grounding electrode to earth shall not exceed 5 ohms.

D. Ground/Bond Conductors
1. Provide an additional, dedicated, green insulation equipment ground/bond wire inside each conduit type and raceway as follows. Size the ground/bond conductors to comply with CEC/NEC requirements. The metal conduit or raceway shall not be permitted to serve (function) as the only (exclusive) electrical ground return path:
   a. All types of nonmetallic conduit and all types of non-metallic raceways including but not limited to: RNMC - Rigid Nonmetallic Conduit.
   b. FMC - Flexible Metal Conduit.
   c. LTFMC - Liquid Tight Flexible Metal Conduit.
   d. Metal and non-metal raceways.
   e. RMC - Rigid Metal Conduit.
   f. EMT - Electrical Metal Tubing.
2. The equipment ground/bond wire shall be continuous from the electrical circuit source point of origin to the electrical circuit end termination utilization point as follows:
   a. Every conduit and raceway path containing any length of the above identified conduits or raceway.
   b. Every conduit path and raceway path connected to any length of the above-identified conduits and raceways.
3. The equipment ground/bond wire shall be sized as follows, but in no case smaller than indicated on the Drawings. Install equipment ground/bond wire in each conduit/raceway, with the respective phase conductors:
   a. **Feeder, Subfeeders & Branch Circuit Protection**
      | Min. Equip. Grnd Wire Size |
      |----------------------------|
      | 15 Amp                     | #12 |
      | 20 Amp                     | #12 |
      | 30 to 60Amp                | #10 |
      | 70 to 100Amp               | #8  |
      | 101 to 200Amp              | #6  |
      | 201 to 400Amp              | #2  |
      | 401 to 600Amp              | #1  |
      | 801 to 1000Amp             | 2/0 |
      | 1001 to 1200Amp            | 3/0 |
      | 1201 to 1600Amp            | 4/0 |
      | 1601 to 2000Amp            | 250 MCM |
      | 2001 to 2500Amp            | 350 MCM |
      | 2501 to 4000Amp            | 500 MCM |
4. Isolated grounds - Raceways containing branch circuit or feeder phase conductors connected to panelboards equipment, or receptacles with isolated grounds or isolated ground bus shall contain a dedicated insulated ground conductor connected to the isolated ground system only. The isolated ground conductor shall be continuous the length of the raceways and connected only to the isolated ground terminals in addition to and independent of the equipment bonding/ground conductor. The isolated ground conductor shall be sized as indicated above, for equipment ground/bond wire.
5. Splices in ground/bond wires shall be permitted only at the following locations:
   a. Ground buses with listed and approved ground lugs.
   b. Where exothermic welded ground/bond wire splices are provided.

6. Provide ground/bond wire jumpers for conduit fittings with ground lugs, expansion and deflection conduit fittings at conduit fittings connecting between metallic and non-metallic raceways and to bond metal enclosures to conduit fittings with ground lugs.

E. Where conductors are run in parallel in multiple raceways, the grounding conductor shall be run in parallel. Each parallel equipment-grounding conductor shall be sized on the basis of the ampere rating of the overcurrent device protecting the circuit conductors in the raceway. When conductors are adjusted in size to compensate for voltage drop, grounding conductors, where required, shall be adjusted proportionately in size.

F. Ground conductors for branch circuit wiring shall be attached at each outlet to the back of the box using drilled and tapped holes and washer head screws, 6-32 or larger.

G. Each panelboard, switchboard, pull box or any other enclosure in which several ground wires are terminated shall be equipped with a ground bus secured to the interior of the enclosure. The bus shall have a separate lug for each ground conductor. No more than one conductor shall be installed per lug.

H. UFER Ground
   1. In addition to all cold water and structural steel grounds provided to meet this specification, there shall be a main ground system of the UFER ground style.
   2. The UFER ground electrodes shall be a minimum of two (2) 20-feet lengths of #4/0 AWG bare stranded copper cable embedded horizontally in the cast in place concrete footing, extending in opposite directions in the footings. All portions of the ground electrodes shall be placed inside the concrete, between 2-inches and 4-inches from the earth surrounding the concrete.
   3. The lengths of cable shall extend in opposite directions in the footings, with the center end of each cable terminated onto the main electrical service ground bus for the main electrical service equipment.
   4. All wire cable connection terminations onto the ground bus shall be exothermic weld type.
   5. The “UFER” grounding electrode, embedded in concrete, shall be exothermically welded to each steel reinforcing bar (rebar) and each steel anchor bolt located within 18-inches of the grounding electrode inside the concrete. Note: Reinforcing steel (rebar), in concrete foundations, attached with metal “tie-wraps” and in direct physical contact to other adjacent rebar that is in turn exothermic welded to the UFER grounding electrode, may be classified as attached to the UFER grounding electrode, and does not require additional exothermic weld connections to the UFER grounding electrode.

I. Provide a separate ground/bond insulated grounding electrode conductor, copper wire from the main electrical service ground bus to each of the following locations. The ground/bond conductor shall be sized to comply with Applicable Codes and as indicated on the Drawings, but in no case smaller than the following:
   1. Main service entrance equipment ground bus:
      a. Services smaller than 1200 ampere 1.5-inch conduit with 1#4/0.
      b. Services 1200 ampere and larger 2.5-inches conduit with 1#500MCM.
      c. Where a separate ground bus is not required, connect ground to electrical equipment metal housing
2. Each telephone backboard and signal system backboard location, 1.25-inch conduit with 1#1.
3. Metal cold water pipe located inside the building, 1.5-inch conduit with 1#4/0.
4. Outdoor underground metal cold water pipe, make connection five feet from the building, 1.5-inch conduit with 1#4/0.
5. Each service entrance ground bus and each separately derived ground rod system:
   a. Services smaller than 1200 ampere 1.5-inch conduit with 1#4/0.
   b. Services 1200 ampere and larger 2.5-inches conduit with 1#500MCM.
6. Separate 1.25 inch conduit with 1#2 (AWG) bonding conductor to each interior metal pipe system located in the same building, including but not limited to, the following:
   a. Fire sprinkler system each stand pipe location (water based and non-water based).
   b. HVAC chilled water supply and return, at each pump location.
   c. Roof drains.
   d. Waste liquid disposal systems.
   e. Metal gas pipe service entrance and service meters.
   f. Hydraulic elevator hydraulic pipes.

3.03 CONDUIT
A. General
1. The sizes of the conduits for the various circuits shall be as indicated on the Drawings, but not less than the conduit size required by code for the size and quantity of conductors to be installed in the conduit.
2. Conduits shall be installed concealed from view. Install conduits concealed in walls, concealed below floors and concealed above ceilings, except as specifically noted otherwise.
   a. Conduits shall not be installed in concrete floors.
3. The following systems shall be considered as circuits 100 volts and less, all other circuits shall be considered to be over 100-volts (power circuits) unless specifically noted otherwise: Fire alarm, energy management control, telephone, public address, data, computer, television, intercom, intrusion alarm and nurse call.
4. Conduits shall be provided complete with conduit bends, conduit fittings, outlet boxes, pullboxes, junction boxes, conduit anchors/supports, grounding/bonding for a complete and operating conductor/wire raceway system.
5. Metal and nonmetal conduits shall be provided mechanically continuous between termination connection points. Metal conduit shall be provided electrically continuous between termination connection points.
6. Individual conduit paths and home runs shown on the Drawings shall be maintained as separate individual conduits for each homerun and path.
7. Conduits, conduit fittings and installation work occurring in classified hazardous materials locations shall comply with applicable code Class 1 Division 1 requirements, unless specifically noted otherwise.
8. Transitions between conduits constructed of different materials and occurring in above grade locations shall be allowed only at outlet boxes, junction boxes, pull boxes, and equipment enclosures unless specifically indicated otherwise. Provide outlet boxes and junction boxes.
9. Metal conduit terminating to nonmetal enclosures; terminating into metal enclosures with “concentric ring” knockouts; terminating into metal enclosures with knockout reducing washers, including but not limited to equipment housings, outlet boxes, junction boxes, pull boxes, cable trenches, manholes, shall be provided with a ground/bonding lug integrated with the conduit.
termination conductor fitting construction, by the Fitting Manufacturer. The lug shall provide for connection of a grounding/bonding conductor (insulated or uninsulated). The grounding lug shall be located on the fitting, inside the termination enclosure.

10. The type of conduit, type of conduit fittings, and type of conduit supports and method of conduit installation shall be suitable for the conditions of use and conditions of location of installation based on the Manufacturer’s recommendations; based on the Applicable Codes and based on the requirements of the Contract Documents.

B. RMC Installation Locations
RGS, IMC conduits and RGS, IMC fittings shall be installed in the following locations:
1. Embedded in floors, walls, ceilings, roofs, foundations, and footings constructed with concrete.
2. Embedded in walls and foundations constructed with brick and masonry.
3. Interior of buildings, within 9-feet of finish floor lines for exposed conduit locations.
4. Exterior of building for exposed conduit locations.
5. Damp or wet locations, exposed or concealed locations.
7. In hazardous materials areas and locations; below hazardous materials areas and locations; above hazardous materials areas and locations.
8. Exposed on utility service poles, for pole risers less than 9-feet above finish grade.
9. RMC conduit and RMC fittings may be installed in any location where EMT and FMC conduit is permitted to be installed.

C. PVC Coated RMC Installation Locations
PVC coated RMC conduit and PVC coated RMC fittings shall be installed in the following locations:
1. Underground conduit locations for elbows and bends with a radius of less than 36-times the conduit diameter.
2. Underground vertical risers extending above grade.
3. Entire length of underground conduits for the following circuits:
   a. Audio microphones
   b. Lighting dimming controls
4. Installed in contact with earth or corrosive materials.
5. Exposed in "cold" rooms and "refrigerated" rooms, rooms with a maintained temperature below 65 degrees Fahrenheit.

D. EMT Installation Locations
EMT conduit and EMT fittings may be installed in the following locations, for circuit conductors operating below 600 volts to ground; locations containing only “non-hazardous materials”; only dry locations:
1. Concealed in hollow non masonry/non-concrete, metal stud frame and wood stud frame walls and floors.
2. Concealed above ceilings.
3. Exposed inside interior enclosed crawl spaces.
4. Exposed interior locations placed 9-feet or higher above finished floors (except as described in paragraph below at lower heights).
5. Exposed on walls and ceilings (any height) in the following dedicated function areas, interior enclosed room locations:
   a. Indoor enclosed electrical equipment rooms and closets.
   b. Indoor enclosed data and telecommunication terminal rooms and closets.
c. Indoor enclosed HVAC equipment rooms and closets.
6. Any location where FMC is described to be installed, except as the final connection to rotating or vibrating equipment.

E. FMC Installation Locations
FMC conduit and FMC fittings may be installed in the following locations for circuit conductors operating below 600 volts to ground; locations containing only “non-hazardous materials”; only dry, interior locations:
1. Concealed in hollow non-masonry metal stud frame and wood stud frame fully enclosed walls.
2. Concealed above fully enclosed ceiling spaces.
3. FMC conduit shall be installed in continuous lengths between termination points. FMC shall not be “spliced” or coupled directly to FMC or any other conduit type under any circumstance.
4. The maximum continuous length of FMC that shall be installed between termination end points is 15-feet. Circuits requiring continuous conduit lengths exceeding 15 feet between termination end points shall be installed using either RMC or EMT conduits. FMC lengths shorter than 16-inches are prohibited.
5. The minimum size FMC conduit shall be as shown on the Drawings but not be less than the following:
   a. FMC lengths of six feet or less, minimum FMC conduit size shall be 0.50-inch.
   b. FMC lengths exceeding 6-feet, minimum FMC conduit size shall be 1.0-inch.

F. LTFMC Installation Locations
LTFMC conduit and LTFMC fittings shall be installed in the following locations for circuit conductors operating below 600 volts to ground; locations containing only “non-hazardous materials”:
1. Final electrical connection to vibrating or rotating equipment; control and monitoring devices mounted on vibrating and rotating equipment including the following. Minimum conduit length shall not be less than 24-inches:
   a. Motor, engines, boilers, solenoids, and valves.
   b. Fixed mounted “shop” (manufacturing) production equipment.
   c. Fixed mounted food preparation equipment and “kitchen” equipment.
2. All locations where exposed flexible conduit connections are required, both indoor and outdoor.
3. Final connection to indoors electrical transformers. Minimum conduit length shall not be less than 24-inches; maximum conduit length shall not exceed 72-inches.
4. Do not install LTFMC located in environmental air plenums.

G. RNMC Installation Locations
RNMC conduit and RNMC fittings shall be installed in the following locations containing only “non-hazardous material”:
1. Underground, concealed below earth grade, unless specifically noted or specified otherwise.
2. Exposed on utility service poles, for pole risers at 9-feet or higher above finish grade, schedule 80 PVC only.
3. RNMC type “EB” conduit(s) shall be concrete encased along the entire length of the conduits for all installation locations.
4. Non-metal type raceways and RNMC type conduit shall not be installed inside buildings.
H. Combi-Duct Installation Locations
Combi-duct conduits shall be installed where shown on the Drawings. Combi-duct shall be installed underground (below grade) as follows:
1. Do not install exposed or inside buildings above grade.
2. Provide a 0.25-inch pull rope in each inner duct.
3. Radius and elbows shall be rigid non-metallic, PVC, Manufacturer factory fabricated, in lieu of PVC coated RMC conduit.
4. Inner ducts shall be supported by internal spacers inside the enclosing outer duct.
5. Provide end bell and three (3) hole "snug-plugs" at each entrance end of Combi-duct into pullboxes, manholes, equipment cabinets stubups and Combi-duct terminations. Compression type "snug-plugs" shall provide watertight and airtight seal between inner and outer ducts and around future cables installed in inner duct.

I. Conduit Installation
1. Conduit Supports
   a. Securely and rigidly support all raceways/conduits from the building structure. Raceways/Conduits shall be supported independent of all piping, air ducts, equipment ceiling hanger wires, and suspended ceiling grid systems. Secure conduit to structural element by means of UL listed and approved hangers, fasteners, "C" channels and pipe clamps.
   b. Provide conduit supports spaced along the length of the conduit as follows:
      1) RMC and EMT conduit, maximum not to exceed 96-inches on center; within 24-inches of each conduit bend and conduit termination location.
      2) FMC and LTFMC conduit, maximum not to exceed 24-inches on center; within 6-inches of each conduit bend and conduit termination location.
   c. Suspended conduit methods:
      1) Individual, suspended raceways/conduits separated by more than 12-inches from any other conduit and suspended from ceilings and roofs shall be supported as follows:
         a) Conduits smaller than 1.5-inches by means of hanger rods or hanger wires.
         b) Conduits 1.5-inches and larger by means of hanger rods.
         c) The conduit shall attach to the hangers with pipe clamps.
      2) Suspended raceways/conduits positioned within 24 inches of any other conduit shall be grouped and supported by hanger rods using trapeze type conduit support channels ("C" channels). Conduits shall individually attach to common channels side-by-side, with pipe clamps.
   d. Non-suspended conduit methods:
      1) Individual raceway/conduits placed against wall/ceiling/floors, placed inside hollow wall/ceiling construction or structure framing (i.e., “dry- wall” or plaster hollow wall construction), shall be secured by means of individual pipe clamps and fasteners attached to the framing studs or other structural members and the conduit/raceway.
      2) Provide common "C" channel supports for all multiple raceway/conduits placed against vertical or horizontal surfaces and positioned within 24-inches of other raceways/conduits. Attach channels to the framing studs or other structural members. Attach the conduits/raceway individually to common channels, side-by-side, with pipe clamps.
3) The use of toggle bolts is prohibited.

e. Conduit rising from floor for motor connection shall be independently supported if extending over 18-inch above floor. Support shall not be to a motor or ductwork, which may transmit vibrations.

f. Provide conduit anchoring, conduit support and conduit bracing systems conforming to Earthquake Seismic Zone 4 requirements. The conduit support/anchoring system capacity shall include the weight of the conduits, conduit fittings, conduit supports and conductors/wires/cables installed in the conduits plus a 300% safety factor. Submit shop-drawing details showing each typical conduit anchor, conduit support and conduit brace location. Submit structural calculations performed by and signed by a Professional Structural Engineer (P.E.) with a P.E. License, Registered in the State of California, U.S.A.

2. Conduit separation:

a. Conduit installed underground or below building slab without full concrete encasement: Shall be separated from adjacent conduits of identical systems (i.e. signal to signal, data to data, power to power, control to control etc.) by a minimum of 3-inches. Conduits of non-identical systems (i.e. signal to power; data to power; power to control; signal to control, etc.) shall be separated by a minimum of 12-inches.

b. Conduit installed underground with full concrete encasement; shall be separated from adjacent conduits of similar systems (100 volt and less) by a minimum of 2-inches; conduits for non power systems (100 volts and less to ground) shall be separated by a minimum of 6-inches from power circuits (over 100 volts to ground); conduits for power circuits shall be separated from adjacent conduits of similar power systems (over 100 volts to ground) by a minimum of 3-inches.

c. Separation of conduits entering termination points or crossing other conduits may be reduced as required within 60-inches of the termination or crossing points.

d. Conduits containing Utility Company service circuits (i.e. electrical power, telephone, or cable television) shall be separated a minimum of 12-inches from all other utilities and conduits, with or without concrete encasement; metallic or non-metallic conduit, above grade or underground conduit locations.

e. Conduits shall be separated from hot water piping, exhaust flues/chimneys, steam piping, boilers, furnaces, ovens by a minimum of 12-inches.

3. Conduit stubs:

a. Branch circuit and telephone conduits turned up from floor at the following locations shall terminate each conduit in a flush conduit coupling at the floor and then extend into partition or to equipment. Refer to DISTRICT’S Representative’s Drawings for location of walls and partitions.

   1) Interior demountable partitions.

   2) Below, into or adjacent to equipment not installed directly adjoining to a wall.

   3) Up from below the floor into hollow stud frame walls.

b. From each panel, and signal cabinet which is wall mounted, stub up from top of the panel/cabinet a minimum of (3) three 1-inch conduits to the nearest accessible ceiling spaces or other accessible location. Where the floor below the panel is accessible or is a ceiling space, stub an additional (3) three 1-inch conduits from the bottom of the panel into the accessible space below the panel. Cap conduits for future use.

c. Conduits stubbed underground outside of building line for future use shall be terminated a minimum of five feet clear (whichever distance is greater)
of building or adjacent concrete walks and AC paving. The stubout conduit shall be capped. Provide concrete monuments, 6-inches by 6-inches by 15-inches deep, buried flush with grade over the capped ends. The face of monument shall be furnished with 3-inch square brass plates securely mounted and engraved with the number and size of conduits and type of service (i.e., "POWER", "TEL.", etc.).

d. Conduits stubbed into ceiling or floor spaces from outlets for telephone, video, computer/data or television shall be provided with an insulated throat bushing, on the end of each conduit stubout.

e. Conduit stubouts from outlet boxes and equipment located in hollow stud walls, into ceiling and floor spaces, shall be EMT or RMC conduit. The stubouts shall terminate into the ceiling and floor spaces with a conduit termination connector fitting.

f. Empty conduit stubs into building spaces and equipment shall be individually identified with an "ID-tag" located at each end of the conduit. The ID-tag shall state the origination point and termination point of the respective conduit (i.e., "from PNL-A/to Room #121"; "from outlet #24/to outlet #17 in Room #120"; etc.).

g. Provide a conduit termination fitting with insulated throat bushing and mechanical ground lugs at each conduit “stub-up” location.

4. Conduit concrete encasement:

a. Conduits which are run underground exterior to building slab shall be continuously concrete encased except, 15 and 20-ampere power branch circuit conduits underground do not require concrete encasement.

b. PVC rigid-non-metallic-type EB conduit, of any size and any location shall be continuously concrete encased the full length of the conduit installation, including under building slab.

c. Concrete for encasement of underground conduits shall be 2000-PSI 28-days cure strength with a mix of cement, sand, water and maximum of ¾-inch gravel. Concrete encasement of conduits shall be continuous without voids. The encasement shall extend 3-inches past the edges of all conduits on all sides of the circuit. Provide 10-pounds of red oxide cement coloring uniformly mixed with each cubic yard of concrete for conduit encasement.

d. Conduits located below or adjacent to structural foundations shall be separated from the foundation by a minimum of 12-inches. Conduits located below structural foundations shall be fully and continuously concrete backfilled and encased between the bottom of the foundation to the bottom of the conduits. The concrete shall be 4000 PSI 28 day cure strength instead of 2000-PSI concrete.

e. Conduits of any size and type (including 15 ampere and 20 ampere power branch circuits) located under roads, paved areas and “transit-system” right of way shall be concrete encased.

5. Underground conduits:

a. Three or more underground conduits larger than 1-inch in size and occupying the same trench shall be separated and supported on factory fabricated, non-metallic, duct/conduit support spacers. The spacers shall be modular, keyed interlocking type, "built-up" to accommodate quantity, size orientation and spacing of installed conduits. The spacers shall maintain a constant distance between adjacent conduit supports and hold conduits in place during trench backfill operations. Minimum support spacer installation interval along with length of the conduits shall be as follows:

1) Concrete encased conduits, not less than 8-feet on center.

2) Non-concrete encased conduits, not less than 5-feet on center.
b. Provide trenching, excavation, shoring and Backfilling required for the proper installation of underground conduits. Tops of backfill shall match finish grade.

c. Bottoms of trenches shall be cut parallel to “finish grade” elevation. Make trenches 12-inches wider than the greatest diameter of the conduit.

d. Back-filling Trenches for Conduits without Concrete Encasement Requirements

1) Conduits which are not required by the Contract Documents to be concrete encased and are located exterior to building slab, shall be set on a 3-inch bed of damp clean sand. Conduit trenches shall be backfilled to within 12-inches of finished grade with damp sand after installation of conduit is completed. Remainder of backfill shall be native soil.

2) Conduits located under a building which are not required by the Contract Documents to be concrete encased, shall be completely backfilled and compacted with clean damp sand to the same level as the building foundation pad.

3) Provide a continuous yellow 12-inches wide flat plastic tracer tape, located 12-inches above the conduits in the trench. The tracer tape shall be imprinted with “Warning-Electric Circuits” a minimum of 24-inches on center.

e. Backfilling trenches for conduits under paved areas:

1) In addition to the requirements of conduit concrete encasement, conduits under walkways, roads, parking lots, driveways, and buildings shall be cast in place concrete “slurry mix” backfill. The slurry mix shall cover each side and top of conduits and conduit concrete encasement. The slurry mix shall be continuous to the underside of the finish subgrade surface.

g. Backfill material:

1) Sand and native soil backfill of trenches shall be machine vibrated in 6-inch lifts to provide not less than 90% compaction of backfill.

2) Soil backfill shall have no stones, organic matter of aggregate greater than 3-inches.

3) Concrete and slurry mix (2000-PSI) shall be machine vibrated during installation to remove “air-voids”.

4) The slurry mix shall consist of concrete, clean rock, clean sand and clean water mixture. Maximum shrinking of slurry mix shall not exceed 5% wet to dry.

h. Do not backfill until District’s Representative has approved Installation and As-built Drawings are up to date. Promptly install conduits after excavation has been done, so as to keep the excavations open as short a time as possible. Excess soil from trenching shall be removed from the site.

i. Install underground conduit, except under buildings, not less than 24-inches below finished grade in non-traffic areas and 30-inches below finished grade in traffic areas, including roads and parking areas. Not less than 48-inches below finished grade under public/private transit system right of way and railroad right of way. Dimensions shall be measured to the top of the conduit.
j. Conduit crossing existing underground utilities shall cross below the bottom depth of the existing utilities. If the top portion of the existing utility depth below finish grade exceeds 72-inches and the specified separation and depths are maintained when crossing over the top of the existing underground utility, the conduit may cross above the existing underground utility.

k. Provide long radius horizontal bends (minimum radius of 36-times the conduit diameter) in underground conduits where the conduit is in excess of 100-feet long.

l. Conduits installed below grade and on grade below buildings, shall not be smaller than 0.75-inches. Conduits for circuits exceeding 600-volts shall not be smaller than 5.0-inches.

m. Underground conduits entering a building shall be sloped. The conduit direction of slope shall be away from the building, and shall prevent water in the conduit from “gravity draining” towards the building. The conduit slope “high point” shall originate from the building, out to the first exterior pullbox, manhole etc. exterior conduit termination “low point”. The minimum slope angle shall be a constant 8-inches (or greater) of fall for each 100-feet of conduit length.

n. Dewatering:
   1) Provide pumping to remove, maintain and dispose of all water entering the excavation during the time the excavation is being prepared, for the conduit laying, during the laying of the conduit, and until the backfill at the conduit zone has been completed. These provisions shall apply on a continuous basis. Water shall be disposed of in a manner to prevent damage to adjacent property. Trench water shall not be drained through the construction. Groundwater shall not be allowed to rise around the pipe until joining compound has firmly set.
   2) The DISTRICT’S Representative shall be notified 48 hours prior to commencement of dewatering.

6. Raceway/Conduits, which are installed at this time and left empty for future use, shall have 0.25-inch diameter polyvinyl rope left in place for future use. The pull rope shall be 500-pound minimum tensile strength. Provide a minimum of 5-feet of slack at each end of pull ropes.

7. Unless otherwise restricted by Structural Drawings and Specifications, the maximum size conduit permitted in concrete slab on-grade, walls, ceilings and roofs constructed of masonry or concrete shall not be greater than 20% of the concrete/masonry thickness. Conduits installed in these locations shall not cross.
   a. Conduits shall not be installed in cast-in-place concrete floors.

8. Provide openings in building structures for conduit penetrations:
   a. New construction shall be provided with conduit sleeves, to provide conduit penetrations.
   b. Existing construction shall be drilled (core drill masonry and concrete) and provide conduit sleeves installed after drilling, to provide conduit penetrations.
   c. Where the structure penetrations for underground conduits penetrating through foundations will not comply with the (restriction/penetration) shown in the Contract Documents, install the conduits below and clear of the foundation lowest point.

9. Conduit bends risers and offsets:
   a. The minimum bend radius of “factory or field” fabricated conduit bends shall not be less than the following. The bend radius shall be measured at the surface, inside radius of the conduit wall:
1) FMC and LTFMC conduit - conduit minimum bend radius 12-times the conduit diameter.

2) RMC and EMT conduit minimum bend radius - conduit for power circuits over 100 volts and less than 600 volts, 8-times conduit diameter. Conduit for power circuits over 600 volt, 12-times conduit diameter. Conduit for low voltage, signal and fiber optic circuits, 10-times conduit diameter.

3) RNMC conduit - conduit minimum bend radius 36-times the conduit diameter. Under building reduce minimum bend radius to 10-times the conduit diameter. Conduit bends and offsets in RNMC with less than 36-times conduit diameter bend/offset radius, shall be RNMC PVC schedule 80 or PVC coated RGS.

4) Conduits for Utility Company conductors. Conduit minimum bend radius shall comply with the respective Utility Company requirements.

b. Bends and offsets in conduits shall be kept to an absolute minimum. The total summation of all bends and offsets permitted in a conduit segment, occurring between two conduit termination/connection end points, shall not exceed the following, including conduit fittings:
   1) RMC and EMT conduit - 360 angular degrees
   2) FMC and LTFMC conduit - 180 angular degrees
   3) RNMC conduit - 270 angular degrees

c. Each field fabricated conduit offset, bend and elbow which are not the standard product of the Raceway/Conduit Manufacturer shall be mandrel tested. The test shall be conducted after the conduit installation is complete and prior to pulling-in any wire, in the same manner as for underground conduits.

d. Factory manufactured angle connector conduit fittings shall be installed in exposed conduit locations only. Installation in locations normally concealed from view shall not be permitted. Not more than one (1) factory manufactured angle connector shall be permitted in any length of conduit between conduit termination end points.

e. RNMC conduit risers from below grade shall be PVC coated RGS. Conduit risers, bends or offsets entering into a building shall be PVC coated RGS.

f. If three (3) or more conduit-bends of the same conduit size and same conduit material type, installed, as part of the Contract Work, fail to comply with the required minimum conduit bend radius or conduit angular degree limits. The following corrective actions shall occur:
   1) The CONTRACTOR shall remove all the non-complying conduit bends and the respective wire in the conduit from the project site. Provide new conduit and wire, complying with the Contract Documents.
   2) Where the conduit bends similar to the non-complying conduit bends are installed concealed in walls, floors, above ceilings or below grade, the Contractor shall expose the conduit bends to allow visual observation.
   3) The CONTRACTOR shall remove the non-complying conduit bends and dispose of the Project Site. The CONTRACTOR shall provide new conduit bends and conductors complying with the Contract Documents.
   4) All the costs to correct the deficient material and work along with costs to repair the direct, indirect, incidental damages and Contract delays shall be the sole responsibility of the CONTRACTOR and shall be included in the bid price.
10. Expansion joint, deflection joint and seismic joint fittings.
   a. Provide a conduit expansion fitting for each conduit length and conduit type as follows (Note - The installation of specified combination expansion/deflection fittings at seismic joints shall satisfy this spacing requirement also):

<table>
<thead>
<tr>
<th>Conduit Type</th>
<th>Conduit Fitting Length</th>
<th>Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>RMC and EMT</td>
<td>Exposed exterior locations</td>
<td>200-feet</td>
</tr>
<tr>
<td>RMC and EMT</td>
<td>Interior weather protected locations</td>
<td>00 feet</td>
</tr>
</tbody>
</table>

   b. Provide a conduit combination expansion/deflection fitting for each conduit, crossing the following elements:
      1) At each building or non-building structure seismic joint.
      2) At each building on non-building structure expansion joint.
      3) At each conduit penetration of a "sound-rated" wall, floor or ceiling.

11. Provide two (2) locknuts and an insulated throat bushing at each metal conduit terminating at enclosures, including but not limited to outlet boxes, junction boxes, terminal cabinets, switchgear, transformers, switchboards, distribution panels and panelboards.

12. Provide metallic or plastic closure caps on all conduit ends during construction, until installation of conductors in the respective conduit.

13. Conduit run exposed, shall be run at right angles or parallel to the walls or structures. All changes in directions, either horizontally or vertically, shall be made with conduit outlet bodies as manufactured by Crouse Hinds, OZ or equal. Conduits run on exposed beams or trelliswork shall be painted to match surrounding surfaces.

14. Conduit exposed on roof:
   a. Conduits installed exposed on roofs shall be installed on conduit sleepers. Place the conduit sleepers a maximum 5-foot on center along the entire length of the conduit; under conduit expansion/deflection fittings; under each junction box and within 24-inches of each conduit bend.

   b. Provide a conduit support "C" channel continuous along the top length of the sleeper and rigidly bolted to the sleeper. Conduits shall be loosely fastened to each sleeper "C" channel with pipe clamps to allow for relative movement between the sleeper and conduit.

   c. Conduits shall not block or interfere with roof hatches, doors, ventilation openings, dampers, equipment access panels/doors, roof water drainage.

   e. Conduit sleepers shall be fabricated from "clear" solid redwood 4-inches by 4-inches (nominal) size. Sleeper length shall extend a minimum of 9-inches past the conduits attached to the sleeper, but in no case shall the length of the sleeper be less than 24-inches.

   f. Provide a pad under each sleeper; sleepers shall not be installed in direct contact with the roofing. Sleeper pads shall extend a minimum of 6 inches past each side of the sleeper. The sleeper pad shall be semirigid mineral surfaced composition board, not less than 0.375-inch thickness, bituminous impregnated, manufactured for application on the specific roofing material. Remove roofing “ballast” (gravel) under pad, prior to installation of sleeper pad. Do not puncture roof membrane.

   g. Position the “length” of the conduit sleepers’ perpendicular to the roof slope, to prevent obstruction of roof drainage water flow. Where the conduit routing prevents placing the conduit sleeper parallel to the roof slope, provide two separate sleeper pads for the conduit sleeper, with a continuous 3-inches wide water drainage gap between the sleepers. Align the water drainage gap to allow unimpeded water travel along the roof slope drainage flow line between the pads.

   h. Sleepers and sleeper pads shall be set in nonhardening mastic, a minimum of 0.25-inch thickness. Mastic shall be inorganic, nonhardening,
and complying with ASTM-D1227. Mastic shall be applied with continuous uniform coverage, minimum 0.25-inch thickness, on all the surfaces of each conduit sleeper and on the sleeper pad contact surface with the roof.

15. Rigid steel conduit or electrical metallic tubing shall not be strapped or fastened to equipment subject to vibration or mounted on shock absorbing bases.

16. RMC conduit threads:
   b. The length of bare metal exposed during thread fabrication shall be completely covered by conduit couplings and fittings. Additionally, the thread length shall insure that conduit joints will reach “torque” tightness and become secure before conduit ends “but” together and before conduit ends “but” into the “shoulders” of other conduit fittings.
   c. Running threads or right/left handed threads shall not be used to connect RMC.

17. RNMC conduit:
   a. Joints and fittings shall be solvent welded to RNMC conduit. Joints and fittings shall be watertight and airtight after fabrication.

18. Tighten each conduit fittings and fitting appurtenance, to the “torque” (allowable tolerance ±5%) value recommended by the Fitting Manufacturer and applicable code. If three (3) or more conduit fittings are found to not be in compliance with the Manufacturer’s “torque” (tightness) recommendations, the following corrective actions shall occur:
   a. The CONTRACTOR shall tighten “re-torque” the defective fittings and all similar conduit fittings installed as part of the Contract Documents in the presence of the District’s Representative.
   b. If the respective conduit fittings similar to the deficient “torque tightness” fittings are installed concealed in walls, floors, above ceilings or below grade, the CONTRACTOR shall expose the fitting, to allow retightening each similar conduit fitting to the Manufacturers recommended “torque” values.
   c. All the cost to repair the direct, indirect, incidental damages and Contract delays resulting from complying with these requirements shall be the sole responsibility of the CONTRACTOR and shall be included in the bid price.

19. Horizontal directional boring for underground conduit:
   a. Provide a directional guided horizontal “bore-hole” underground conduit installation where one or more of the following conduits occur:
      1) Continuous trenching excavation and backfill for conduit installation is not permitted by the Contract.
      2) Where continuous trenching excavation due to the existing surface and below grade conditions and restrictions, is not possible or practical to excavate a trench.
   b. Provide “path-tracing” of the underground bore head, from the surface, along the entire horizontal bore length. Path tracing shall use electronic transmitters and receivers, continuously communicating the underground bore head locations and depth to the bore equipment operator. The directional boring system shall employ active tracking and directional position/steering control of the bore equipment drill head location. The active tracking system shall provide a portable receiver/transmitter unit for tracking the position of the moving drill head; a sensor “Sonde” unit on the drill head for tracking signals to the receiver/transmitter; and a drill head tracking data view display located at the boring equipment operator position to view the drill head position information sent from the portable
receiver/transmitter. As manufactured by SPX-Radiodetection Company or similar products.

c. Provide vertical pilot excavations not more than 50-feet on center along the path of the bore-hole to intercept the horizontal bore-hole routing, provide excavations at the beginning and end terminals staging points of the horizontal bore-hole.

d. Provide full-depth “shoring” of the vertical pilot excavations. Remove the shoring, backfill, compact and repair the excavations when conduit installation is complete.

e. “Drilling-fluid” shall be used during “back-reaming” and “pullback”, pumped through the drill pipe to the bore drill head.

f. Directional guided horizontal drilling shall employ equipment specifically designed and manufactured for the process. The Equipment Manufacturer shall train bore equipment operating personal in the proper operation of said equipment.

g. Locate the position, size, depth and identify all underground “cross-bore” existing underground utilities, pipes, structures and conflicts along the entire bore path of each underground bore, prior to initiating directional boring work. Notify respective agency for each “cross bore” potential crossing. Comply with the recommendations of the Cross Bore Safety Association (CBSA).

h. Horizontal, directionally guided boring equipment, as manufactured by Ditch Witch; Vermeer Manufacturing; or Case Corporation.

J. Conduit Seals

1. Provide conduit seal fittings at each location where a conduit transitions or passes through the following areas and where indicated on the Drawings:
   a. Refrigerated areas.
   b. Temperature control rooms including warming rooms, steam rooms, saunas etc.
   c. Classified hazardous material areas.
   d. Water intrusion areas.

2. Provide conduit seals on each conduit entering a building from a below grade area located outside the building (i.e., basement, vault etc.) and connecting to the following types of equipment
   a. Transformers
   b. Panelboards
   c. Motor control centers
   d. Switchboards
   e. Switchgear
   f. Motors
   g. Terminal cabinets
   h. Terminal backboards
   i. Cable trenches

3. Conduit seals shall be installed in locations where the fitting is visible and accessible.

K. Nailing Shields

1. Provide “nail” shields where FMC conduit and conductors not installed in a conduit are installed through wood stud and wood frame construction. The nail shield shall provide a barrier resistant to “nailing” fasteners through the stud, and penetrating into the FMC and conductors.

2. The nail shields shall be flat nominal 1.5-inch by 3-inches, 14-gauge steel, and hot dip zinc galvanized with “nailing spurs”.

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3. Provide nailing shields on the front face and rear face of each FMC penetration. The shield shall be centered on each penetration through the respective framing, stud framing blocking, and stud framing plates.

L. Conduit Bodies
1. Conduit bodies shall be installed in exposed conduit locations only or above accessible ceilings.
2. Conduit bodies shall be accessible for removing body cover and pulling wire through the conduit body.
3. Conduit bodies shall not be installed inside enclosed walls.

M. Preparation of Reuse of Existing Conduits
1. Prepare existing conduits shown to be reused as part of Contract Work as follows: Complete the required work prior to installing any conductors or cables in respective existing conduits.
   a. “Rod” out existing raceways to be used under this contact, with approved test and flexible mandrels to remove all obstructions to clear debris from inside conduits.
   b. Use test mandrels at least 12-inches long, 0.25-inch less than diameter of duct at center, tapering to 0.5-inch less than duct size at ends.
2. If test mandrels cannot be pulled through raceways, CONTRACTOR shall perform the following to clear the existing raceways:
   a. Force rigid or semi-rigid rods through the raceways to clear the obstructions from one to both ends of the raceway.
   b. Force a power driven rotating router device through the conduit from one or both ends of raceways. Device shall incorporate small diameter cutting blades. Repeat the “router” process in incremental stages to a cutting blade diameter approximately ⅛-inch smaller than the raceway inside diameter.
3. After clearing the raceway of obstructions, pull a test mandrel or brush through the raceway to clear the remaining debris from the raceway.

3.04 WIRE AND CABLE

A. Branch circuit and fixture joints for #10AWG and smaller wire shall be made with UL-approved connectors listed for 600 volts, approved for use with copper and/or aluminum wire. Connector to consist of a cone-shaped, expandable coil spring insert, insulated with a nylon shell and two (2) wings placed opposite each other to serve as a built-in wrench or shall be molded one-piece as manufactured by 3M-"Scotchlok".

B. Branch circuit joints of #8AWG and larger shall be made with screw pressure connectors made of high strength structural aluminum alloy and UL-approved for use with both copper and/or aluminum wire as manufactured by Thomas & Betts. Joints shall be insulated with plastic splicing tape, tapered half-lapped and at least the thickness equivalent to 1.5-times the conductor insulation. Tapes shall be fresh and of quality equal to Scotch.

C. Use UL listed pulling compound for installation of conductors in conduits.

D. Correspond each circuit to the branch number indicated on the panel schedule shown on the Drawings except where departures are approved by the DISTRICT’S Representative.

E. All wiring, including low voltage, shall be installed in conduit.
F. Control wiring to conform to the wiring diagrams shown on the Mechanical Drawings and the Manufacturer's Wiring Diagrams.

G. All splices in exterior pull boxes and light poles shall be cast resins encapsulated.
   1. Power conductor splices - 3M Scotchcast Series 82/85/90; Plymouth or equal.
   2. Control and signal circuits 3M Scotchcast series 8981 through 8986, Plymouth or equal.

H. Neatly group and lace all wiring in panelboards, motor control centers and terminal cabinets with plastic ties at 3-inch on centers. Tag all spare conductors.

3.05 CHEMICAL GROUND ROD

A. General
   1. Install ground rod system in compliance with Manufacturer's instructions.
   2. Install rods vertically. Where subterranean hard rock conditions prevent vertical installation horizontal "L" shape ground rod shall be installed.
   3. Where ground rod is installed in an indoors dry location set ground box flush with finish floor. Where ground rod is installed outdoors set the top of the ground box four inches above finish grade.
   4. Do not remove sealing tape from ground rod holes until time of installation in ground.
   5. Separate ground rods from all other grounding electrodes and from each other by not less than 12-feet horizontal distance.

B. Excavation
   1. Vertical installation bore a 12-inches diameter vertical hole in the ground six inches deeper than ground rod length.
   2. Horizontal installations excavate a 12-inches wide trench, slope rod and trench to insure end cap of rod is 2-inches lower than the elbow.

C. Backfill
   1. Surround the entire rod with a minimum of 10 inches of bentonite clay mixed with water at six times volume to form a paste. Approximately 14-gallons for each 50-pounds of clay. Remove any excavation liners from the rod excavation area.
   2. Install ground box and complete backfill.

D. Connect grounding electrode conductor(s) to ground rod.

3.06 CABLE RACKS

A. General
   1. Provide cable racks in precast and cast-in place concrete pullboxes, manholes and cable trenches.

3.07 TESTING

A. Testing Conduit and Conduit Bends
   The CONTRACTOR shall demonstrate the usability of all underground raceways, and field fabricated conduit bends installed as part of this Contract.
   1. A round tapered segmented semi-rigid mandrel with a diameter approximately ¼-inch smaller than the diameter of the raceway, shall be pulled through each new raceway.
2. The mandrel shall be pulled through after the raceway installation is completed. Conduits which stubout only, may have the mandrel pulled after the concrete encasement is completed, but prior to completing the backfill.

3. DISTRICT’S Representative shall witness the raceway testing for usability. A Representative of the respective Utility Company shall witness the raceway testing where applicable.

4. CONTRACTOR shall repair/replace any conduit and conduit bend provided under this Contract which will not readily pass the mandrel during this test.

B. Refer to Section 26 0500 Common Work Results for Electrical item 1.13 for Testing requirements.

END OF SECTION
100515/223015
SECTION 26 0533
MANHOLES AND PULLBOXES

PART 1 - GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
2. General provisions and requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Submit product data sheets for all racks, hooks, supports, ladders, covers, grounding, manholes, vaults, pullboxes, joint sealing compound etc.

B. Submit detailed Shop Drawings including dimensioned plans, elevations, details, structural calculations signed by a California State Registered Structural ENGINEER and descriptive literature for all component parts.

PART 2 - PRODUCTS

2.01 MANHOLES

A. Each concrete precast section shall be identified by having the Manufacturer's name and address, along with respective section weight cast into an interior face or permanently attached thereto.
1. As manufactured by Jensen Precast Products; or Shaw Concrete Products, Utility Vault Products; or equal.

B. Material and Fabrication
1. Precast, rectangular, with round opening, designed for H-20 bridge loading. Complete with extension and cover.
2. Cast iron cover and frame, 30 in. diameter by Alhambra Foundry, as detailed on Drawings.
3. Provide cable racks spaced evenly at approximately 2 feet-6 inch intervals around interior of communication and power manholes and grounding as indicated on Drawing Details.
4. Not used.
5. Manholes shall be constructed of reinforced concrete, 5500 psi at 28 days minimum. Vertical clearance from finished floor to ceiling shall be as indicated on Drawings. A minimum of four straight walls shall be provided for cable splicing area or as shown on Drawings.
6. Duct entrances into manholes shall be so located that sharp bends of cable at duct mouth will be unnecessary. Duct termination in manhole shall be made with end bells as indicated on Drawings.
Frames and covers shall be made of cast iron. A recessed seat shall be provided to ensure a perfect joint between frame and cover. Frames shall be given two coats of asphalt paint. Covers shall be cast with the lettering "H.V. Electric" to denote electrical or "Communication" to denote communication, and manhole ID number stamped into frame ring as indicated on Drawings. In paved areas, top of manhole covers shall be installed flush with finished surface of paving. In unpaved areas, top of manhole covers shall be installed approximately ½-inch above finished grade. Where existing grades that are higher than finished grades are encountered, a sufficient number of courses of brick shall be used between top of manholes and manhole frame to elevate temporarily the cover at existing grade.

8. A sump shall be provided, minimum size 12 inches x 12 inches x 5 inches or a 5 inch deep, 13 inches round encased in floor of manhole with recessed grated cover plate as indicated on Drawings.

9. Pulling eyes made of heavy galvanized steel spider inserts welded to rebar shall be cast in the concrete walls below and opposite each ductbank entrance and in the ceiling above each ductbank entrance and as indicated on Drawings.

10. In each manhole as indicated on Drawings, a ¾-inch x 10 foot copper-clad ground rod shall be driven into the earth. Approximately 6 inch of rod will extend above manhole floor for ground grid. A manhole ground grid shall be installed using a 4/0 AWG stranded bare copper ground cable installed on cable racks as indicated on Drawings. Each ductline ground wire shall be connected to this manhole grid using an exothermic weld connection. The manhole ground grid shall be connected to the manhole ground rod using an exothermic weld.

11. In each manhole, include one access ladder, size to match depth of manhole as indicated on Drawings.

12. Provide a 6 inch base of ¾-inch crushed rock under manhole and slab box to ensure uniform distribution of soil pressure on floor.

13. Place and align precast manholes and slab boxes to provide maximum horizontal tolerance of 2 inches in any direction and vertical alignment with not greater than ½-inch maximum tolerance for 6 foot of depth. Completed manhole shall be rigid, true to dimensions and alignment, and shall be watertight.

14. Excavate, backfill, and compact in accord with Section 02320.

15. Seal manhole and slab box section joints with sealing compound furnished by the Manhole Manufacturer.

16. Provide conduit duct plugs for all unused terminator openings or spare conduits in manhole and slab box.

17. Give frames two coats of asphalt paint.

18. Interior walls and ceiling shall be primed and painted with two coats flat white paint as follows:

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>First coat (primer): Waterborne, epoxy concrete sealer</td>
<td>Dunn-Edwards Corp.</td>
</tr>
<tr>
<td>Second and third coats (finish): Exterior, 100% acrylic flat latex</td>
<td>Frazee Industries, Inc.</td>
</tr>
<tr>
<td></td>
<td>ICI Delux Paints</td>
</tr>
<tr>
<td></td>
<td>Sherwin-Williams Co.</td>
</tr>
<tr>
<td></td>
<td>Vista Paint Corp.</td>
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<td></td>
<td>W709</td>
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<td>203</td>
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<td>36</td>
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<td>4600</td>
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<tr>
<td></td>
<td>W701</td>
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<td>203</td>
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<tr>
<td></td>
<td>1300</td>
</tr>
<tr>
<td></td>
<td>A6 Series</td>
</tr>
<tr>
<td></td>
<td>2000</td>
</tr>
</tbody>
</table>

19. Duct and conduit penetrations or plastic terminators into manholes and/or boxes shall be sealed against water intrusion by concrete grouting or mortaring.
of any gaps that may have occurred during ducts installation. All duct windows shall be sealed around all ducts and end bells to form a watertight window.

20. Sumps shall be knocked out at time of installation.

C. Intercept Manholes/Pullbox Structures
   1. Intercept type manhole/pullbox structures shall comply with the requirements of non-intercept manholes and pullboxes, respectively. Plus the additional requirements listed below.
   2. Manholes/pullboxes shown to be installed at the same location as replacement for existing manhole/pullbox shall be custom fabricated "intercept" multi-section type.
   3. The structure shall be provided with multiple, vertical and horizontal custom fabricated sections for fitting around existing manholes/conduits/duct banks/conductors entrances into the structure during manhole installation without disturbing existing manholes/pullboxes. The structures shall allow placement of the structures without disconnecting or disrupting existing circuits during the installation. The structure walls shall be slotted to fit around existing concrete encased conduit entrances.
   4. Provide cast-in-place concrete steel reinforced foundation/footings and floor for the intercept structure. The foundation shall be installed prior to removal of existing manhole/pullbox. The floor shall be installed after removal of the existing manhole/pullbox structure. The foundation/footing and floor shall be designed, and engineered as part of precast structure.
   5. The structure foundation/footings shall be "keyed" to match keying of manhole precast wall sections.

2.02 PULLBOXES

A. Pullboxes shall have deep recess conduit knockout concrete extensions at two (2) opposite end walls. Additional shallow recess knockouts shall be provided on the other two (2) walls for conduit entrances.

B. Pullboxes shall be provided with a minimum of one precast concrete 6-inch extension grade ring "tongue and groove" matting surfaces to insure rigid assembly.

C. Pullbox Sizes shall be as indicated on Drawings but in no case less than required by applicable Codes. Minimum depth of the pullbox shall not be less than 42-inches.

D. The pullbox Floor Sump shall extend through the concrete floor into the gravel bedding, below the pullbox.

2.03 COVERS AND FRAME ASSEMBLIES

A. Traffic Rated per AASHO for H20 Loading
   1. Covers shall comply with Federal ADA, UL, State, and Local AHJ for slip resistance.

B. Pullboxes
   1. Hot dip galvanized steel single piece flush fitting with threaded flush hold down, slotted head, stainless steel studs.
   2. Topping frame shall be hot dip galvanized steel angle frame where the pullbox is installed in paving or concrete work.
   3. Top ring frame shall be armor band type where the pull box is installed in exposed earth or landscaping.
4. Cover openings larger than 5-square feet of surface area, shall be provided with "split" two (2) piece cover type. Each "split" cover shall be hinged open-close with Torsion-Spring type cover, to assist in the ease of opening and closing the cover.

5. Cover openings 5-square feet or smaller surface area shall be single piece covers.

C. Covers shall be permanently marked in the cover metal as follows:
   1. "E" or "Electric" for covers on structures containing power circuits under 600-volts and "HV" or "High voltage" for covers on structures containing power circuits over 600 volts.
   2. "Signal" for covers containing signal circuits.

2.04 CABLE RACKS

A. 5/8-inch diameter anchor bolts and concrete inserts to support each cable rack as indicated.

B. Use Inwesco cable rack for each manhole as indicated (length to fit).

C. Use Inwesco cable hooks to mount on each cable rack. Type and length as shown on Plans.

D. Use T&B tie wrap, self-locking, cable ties No. TV528MX, two (2) per insulator, to secure cable to cable hook and cable insulator.

E. Use Inwesco Cat. No. 11A31 porcelain insulators spaced equally distant on each cable hook indicated.

F. Mechanically attach cable racks in as indicated to the concrete side walls with approved masonry fastener or bolts. Racks and support arms shall be hot-dipped galvanized steel construction. Support arms shall be equipped with porcelain, saddle type, double hook insulators. All fastening hardware, bolts, washers, and nuts shall be galvanized steel.

G. Each rack shall contain adjustable heavy-duty support arm(s) of the number indicated on Drawings.

H. Each support arm shall contain a minimum of three each porcelain insulators placed on bracket so that top surface of insulator will be in contact with cable PVC jacket. Use of supporting members made of metallic or other conducting materials in actual physical contact with the cable jacket is prohibited.

I. Ground all cable racks, supports, metal conduits, and the like as indicated.

2.05 PULL-IN-IRONS

A. Pull-in-irons shall be a galvanized steel bar bent in a "U" shape, and cast in the structure walls and floors.

B. A floor pull-in-iron shall be centered under the manhole entry ring in the structure floor.

C. Pull-in-irons shall not be less than 6-inches above or below, in the opposite wall from each knockout panel for conduit/duct entrances.
D. Pull-in-irons shall project from the structure wall into the structure approximately 4-inches.

2.06 DRAINAGE SUMPS

A. Provide drainage sump with cast iron metal grate in the floor of each structure. Minimum diameter of 12 inches by 4-inches deep. Provide a removable cast iron grate over the sump.

PART 3 - EXECUTION

3.01 EXCAVATION

A. Excavate for installation of precast structures removes excess excavated material from the site. Saw cut existing paving and concrete as required for excavation.

B. Provide a minimum of 6-inches deep bedding base of the crushed rock 3/8-inch - ½-inch size in the bottom of the excavation. Bedding shall be level and well compacted by a minimum of four (4) passes with a plate type mechanical vibrator.

C. Back fills and compact earth around precast structure after installation of the structure to 90% minimum compaction in 12-inch lifts. Replace paving concrete, landscaping above structure to match existing.

3.02 INSTALLATION

A. Install precast structures per Manufacturer recommendations to provide a dry watertight installation. Set cover flush with existing grade or finish surface. Where precast structure is installed in pedestrian walkway or vehicular traffic way with a sloping finish grade. Slope cover to match existing finish surface slope.

B. Install structures to avoid surface water drainage flow lines, and existing utilities.

C. Exterior concrete walls, tops, necks and bases of precast structure shall be wet-proofed with two (2) coats of a bituminous for concrete wet-proofing material, minimum finish thickness not less than 0.10 millimeters.

D. Connections to Precast Structure
   1. Lines connecting to precast structures shall be constructed to have a cast in place concrete tapered section adjacent to the structure and extending a minimum of 48-inches out from the structure to provide shear strength.
   2. Precast structure shall be constructed to provide for keying the concrete envelope of the conduit/duct line into the wall of the structure. Mechanical vibrators shall be used when this portion of the envelope is poured to assure a seal between the envelope and the wall of the precast structure.

E. Entrances of conduits/ducts shall terminate with endbells inside the precast structure. Slope conduit entrances into manhole to insure top of conduit entrances into manhole are a minimum of 6-inches below manhole ceiling. Maximum conduit slope shall not exceed 1-inch per "running" foot of conduit.

F. Manholes and pullboxes shown to intercept existing conduit, remove portion of existing conduit approximately 4-feet back from manhole wall, regrade and excavate conduit entrance and extend existing conduit into manhole or pullbox to match
existing conduit quantity and size. Provide "horizontal, split" conduit and split conduit coupling to extend existing conduit into manholes and pullboxes.

3.03 GROUNDING

A. Provide 10-feet long by 0.75-inch diameter copper clad, steel, driven ground rods through the floor of the precast structure. Provide a minimum of two (2) ground rods in opposite corners in manholes and vaults, one ground rod in pullboxes. Ground rod shall extend 6-inches above the floor line. Where rock bottom is encountered, bury ground rod in horizontal trench with projection into precast structure. Seal off openings around ground rods.

B. Ground permanently and effectively together all metal equipment cases, metallic, cable racks, ladders, etc., with #4 bare copper bonding conductor. Provide UL compression bonding fittings at each ground connection.

END OF SECTION
120415/223015
SECTION 26 0543

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
   2. General provisions and requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Submit Product Data Sheets.

B. Submit Detailed Shop Drawings including dimensioned Plans, Elevations, Details, Structural Calculations signed by a California State Registered Structural ENGINEER and descriptive literature for all component parts.

1.03 SECTION INCLUDES

A. Concrete Encased Ductbanks where indicated on Contract Drawings.

B. Trenching, Backfilling, Compacting, and Concrete Encasement for all 600V, 4.16kV and 12kV Ductbanks shall be Required.

1.04 RELATED WORK SPECIFIED ELSEWHERE

A. Excavating and Backfilling for Utilities: Division 31.

B. Concrete: Division 03.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Duct, Fittings and Spacers:
   1. Carlon, an Indian Head Co.
   2. Queen City Plastics, Inc.
   3. Robintech Inc.
   4. R & G Sloane Manufacturing Co. Inc.
   5. Allied Tube and Conduit.

2.02 MATERIAL AND FABRICATION

   1. Cemented fittings.
3. Riser sweeps for power and communication ducts shall be rigid galvanized steel or Schedule 80 PVC.

B. Rigid Steel Conduit, Elbows and Nipples:
1. Threaded, hot-dipped galvanized conduit manufactured in accord with ANSI C80.1 and UL 6.
2. Threaded, hot-dipped galvanized fittings manufactured in accord with ANSI C80.4.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Excavate in Accord with Division 31.

B. Exercise Care in Excavating, Trenching, and Working near Existing Utilities.

C. Installation of Ductbanks:
1. Ductbanks for primary electrical power and communication systems shall consist of multiple, single, round bore ducts. Ducts shall consist of PVC Schedule 40 conduits, UL approved only. All fittings and couplings shall be of the same type and Manufacturer of the duct, with UL approval.
2. Galvanized steel conduits installed below grade shall be painted with two coats of Koppers bitumastic paint before installing in ground.
3. All conduit risers into switchgear pad, transformer pad, communication pull boxes or enclosures shall be galvanized steel and have a radius of 60 in. minimum, unless indicated otherwise on Drawings.
4. Concrete encased ductbank shall be completely encased in a minimum of 3 inches of concrete. Concrete shall be Class “B” red tint for 4.16kV and 12kV power and green tint for communication (6 lb. tint per cu. yd.), 2500 psi at 28 days. Ductbanks shall be of a monolithic construction top to bottom and side to side, but not necessarily end to end. All PVC duct shall be protected prior to installation.
5. Prefabricated, interlocking intermediate and base spacers for Schedule 40 PVC conduit shall be used, made of Specification grade high-density polyethylene. Spacers shall be installed not more than 5 feet center-to-center along entire length of ductbank. Each conduit shall be supported by spacers.
6. At connection to manholes, dowel concrete encasement with one No. 4 reinforcing bar 36 in. long per duct.
7. Ductbanks shall be securely anchored to prevent movement during placement of concrete.
8. Where connection to bulkhead of ductbank is made to vaults or existing ductbanks, the concrete encasement shall be doweled with one No. 4 reinforcement rod 36 inches long per conduit to the existing encasement.
9. Ductbank trench shall be shored, framed and braced for installing ducts. Frames, forms, and braces shall be either wood or steel. Variations in outside dimensions of the completed ductbank shall not exceed 2 inches on the vertical or the horizontal from dimensions shown on Drawings. Remove all forms and bracing after 24 hours and before backfilling.
10. Do not place backfill for a period of at least 24 hours after pouring of concrete.
11. Ductbanks shall be laid to a minimum grade slope of 4 inches per 100 feet. This slope may be from one manhole to the next or both ways from a high point.
between manholes, depending upon the contour of the finished grade. See respective Profile Drawings.

12. Ductbanks shall be installed so that the top of the concrete encasement shall be not less than 48 inches below finished grade or pavement for primary 12 kV power, and not less than 36 inches below finished grade or pavement for 5 kV power.

13. Changes in direction of runs either vertical or horizontal shall be accomplished by long sweep bends having a minimum radius of curvature of 30 feet, except that manufactured long radius bends may be used in runs of 100 feet or less on approval from Owner.

14. Duct joints in concrete encasement may be placed side by side horizontally, but shall be staggered at least 6 inches vertically. All joints shall be made in accord with Manufacturer's recommendations for the particular type of duct and coupling selected. In the absence of specific recommendations, various types of duct joints shall be made by the following method:
   a. Plastic duct connections shall be made by brushing a plastic solvent cement on the inside of a plastic coupling fitting and on the outside of duct's ends. The duct and fitting shall then be slipped together with a quick one-quarter turn to set the joint.

15. The electrical system ground conductor shall be a minimum No. 4/0 AWG bare stranded copper cast in ductbank 3 inches below top of concrete, entering each manhole, and grounded to a rod using exothermic method as indicated on Drawings. The electrical system ground shall be connected to substations ground loops. A minimum of 15 feet pigtail shall be provided at each stub-up location noted on Drawings.

16. After the duct line has been completed, three each nonflexible mandrels not less than 12 inches long having a diameter of approximately ¼-inch less than inside diameter of the duct shall be pulled through each duct; after which a brush with stiff bristles shall be pulled through each duct to make certain that no particles of earth, sand or gravel have been left in the line. Leave a 3/8-inch minimum polypropylene pull rope in each duct for future use.


End of Section

120715/223015
PART 1 - GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
   2. General provisions and requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Comply with pertinent provisions of Division 26.
B. Submit product data sheets for vibration isolation devices.
C. Submit detailed Shop Drawings including Dimensioned Plans, showing equipment vibration isolation anchoring.

PART 2 - PRODUCTS AND EXECUTION

2.01 QUIETNESS OF OPERATION

Before the work will be accepted as complete, quietness of operation, to a degree satisfactory to the ARCHITECT, shall be attained for apparatus, equipment, fixtures, etc., included under the electrical work. Provide isolation and vibration protection required.

2.02 VIBRATION ISOLATION FOR ELECTRICAL EQUIPMENT

A. Objective: It is the objective of this specification to provide the necessary design for the avoidance of excessive noise or vibration in the building due to the operation of machinery or transformers, and/or due to interconnected conduit.

B. CONTRACTOR Responsibility
   1. Provide a submittal to the ARCHITECT for review prior to any installation of his equipment, containing the following information:
      a. Catalog cuts and data sheets on specific vibration isolators to be utilized showing compliance with the Specification.
      b. An itemized list showing the items of equipment to be isolated, the isolator loading and deflection and isolator placement.
      c. Drawings showing methods for attachment of conduit to motors.
   2. Furnish and install the vibration isolation devices as specified herein.
   3. Do not install any equipment or conduit as specified in the schedule, which makes rigid contact with the "building" unless it is approved in this Specification, or by the ARCHITECT. "Building" includes slabs, beams, studs, walls, lath, etc.
4. Coordinate work with other trades to avoid rigid contact between equipment or conduit as specified in the schedule and the building. Inform other trades following his work, such as plastering, to avoid any contact that would reduce the vibration isolation.

5. Bring to the ARCHITECT'S attention, prior to installation, any conflicts with other trades which will result in unavoidable contact to the equipment or conduit as specified in the schedule, described herein due to adequate space, etc. Corrective work necessitated by conflicts after installation shall be at the responsible CONTRACTOR'S expense.

6. Bring to the ARCHITECT'S attention any discrepancies between the specifications and field conditions, changes required due to installation. Corrective work necessitated by discrepancies after installation shall be at the CONTRACTOR'S expense.

7. Obtain approval from the ARCHITECT of any installation to be covered on enclosed, prior to such closure.

8. Obtain written and/or oral instructions from the vibration isolation manufacturer as to the proper installation and adjustment of vibration isolation devices.

9. Notify the ARCHITECT, prior to the general installation of vibration isolation devices, so that the ARCHITECT can instruct and demonstrate the technique of proper installation with the CONTRACTOR'S Foreman.

10. Correct, at no additional cost, all installations, which are deemed to be defective workmanship or materials by the ARCHITECT.

2.03 VIBRATION ISOLATION TYPES

A. Isolator Description

1. Isolate all transformers with Type MN molded neoprene units equipped with leveling bolts and design status deflection under load of 0.3-inch.

2. Isolate all switchgear connected directly to transformer with Type PN isolators. Limit loading to a static deflection of 0.06 inch. Choose the area of pad to match the load with the manufacturer's recommended unit loading. An auxiliary steel plate may be required to distribute the load uniformly over the pad area.

B. Equivalent Vibration Isolators

1. Type Description
   Neoprene Mount
   a) 0.2-inch max. deflection N FD R RV CS F T-44
   b) 0.4-inch max. deflection ND FDD RD RFD FU RD T-44
   PN Neoprene Pad W (1) (2) NR R (3) 100W

2. Notes
   Manufacturer's Code
   (1) Elastrogrip A. Mason Industries
   (2) Shearflex B. Korfund
   (3) Kinetic C. Vibration Mounting
   D. Amber/Booth
   E. Sausse
   F. Consolidated Kinetics
   G. Vibration Eliminator

2.04 CONDUIT INSTALLATION

A. Provide flexible conduit or an approved vibration isolation device between any transformer and the building structure.
B. Secure all electrical panels connected to transformers by flexible conduit to the floor. Do not contact stud or masonry partitions. Isolated panels from the floor as specified herein.

C. Provide flexible conduit connections to all connections to air conditioning, plumbing, etc., or any rotating or oscillating equipment requiring electrical motors. Base the length of flexible conduit required for each motor upon the requirements for a 360 degrees loop in the conduit between the electrical motor and electrical box.

D. As an alternative to the 360 degrees loop, a Neoprene or rubber bushing between the conduit and the electric motor to break the metal-to-metal contact may be used. Provide a flexible ground strap to complete the electrical ground.

2.05 DEVICE OUTLET BOXES (INSTALLED IN COMMON PARTY SEPARATION WALLS, IN CORRIDOR WALLS AND SERVICE WALLS)

Device outlet boxes installed in walls shall be sealed on the exterior back and sides of the boxes, including wall openings around the box, with a ⅛-inch minimum thickness resilient sound absorbing, sealant. The sealant shall be free of asbestos, temperature rated from -30°F to 200°F, self-adhesive to metal and plastics, as manufactured by Lowry and Associates Inc. Sun Valley, California or equal.

END OF SECTION
120715/223015
SECTION 26 0910
SUPPLEMENTAL METERING AND SUB-METERING

PART 1 GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other Specification Sections and Drawings for related work required to be included as work under Division 26.
   2. General Provisions and Requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Provide Schematic Control Wiring Diagrams and "Point-to-Point" control wiring diagrams showing control and protective systems interlocks.

B. Provide Nameplate Engraving Schedule.

1.03 APPLICABLE STANDARDS (ADDITIONAL REQUIREMENTS)

A. The Equipment shall be designed, tested and assembled to comply with ANSI, IEEE, and NEMA and UL.
   1. UL 1244 Electrical and Electronic Measuring and Test Equipment.

PART 2 PRODUCTS

2.01 GENERAL

A. Function
   1. Electronic digital metering, microprocessor based data measurement and data recording of simultaneous occurring continuously operating analog conditions, simultaneously with data recording of individual occurrence instantaneous events.
   2. The supplemental metering is secondary to the utility revenue metering, as separate independent sub-metering systems. Shall provide tracking of the status, consumption and flow of the unit-values monitored by the respective supplemental metering systems.
   3. The meters shall connect analog to digital, not less than 24-bit analog to digital conversion, certified to National Accuracy Standards. UL listed and labeled. Provide local readable visual meter displays, local digital data storage and digital data communications with remote locations.
   4. Measurement accuracy shall be better than 0.5-percent and comply with IEC687 (Class 0.5 percent) and ANSI C12.20 (class 0.5 percent). Combined meter and current transformers and related software systems operational accuracy for the electrical power sub-metering systems shall comply with ANSI-C 12.20 and the Public Utility Commission revenue grade accuracy compliance. The sub-metering systems accuracy shall also comply with
Savings-by-Design program requirements and U.S. Green Building Council program requirements, including but not limited to the following:

a. +0.5-percent @ 1.0 power factor and 1-percent through 100-percent of rated current.

b. ±0.75-percent @ 0.5 power factor and 1-percent through 100-percent of rated current.

5. Front of meter operator control of meter functions.

6. Ambient operating temperature range minus 15-degrees centigrade to plus 50-degree centigrade.

7. Flammability rating UL94-5V, self-extinguishing, non-flame propagating.

B. Sub-Metering Communications

1. Each meter shall provide full duplex bi-directional network communications. Shall provide connection ports for laptop portable computer/PDA and for remote data collection and monitoring.

2. Provide the following wired meter network connections in each meter
   a. EIA RS-485 serial port for direct connect locally at each meter.
   b. IEEE compliant TCP/IP Fast Ethernet, with RJ-45 port connect and with Power-Over-Ethernet (POE) for remote communications at each meter.

3. Meters shall record and store monitoring data in static non-volatile memory. Not less than 60-calendar days of memory storage capacity. The stored data shall be available for local display on operator demand at the meter and for downloading from the meter by the following.
   a. Portable laptop computer/PDA connected (plug-in) to the meter communication port.
   b. Metering communications network for Automatic Metering Reading-AMR from remote locations using the metering LAN network.

4. Meter electrical operating power.
   a. Provide meter internal electrical power supplies, batteries shall not be the source of normal meter electrical power.
   b. Meters monitoring electrical power circuits shall connect to the monitored electrical circuit for meter operating power. Provide protective fusing.
   c. Meters monitoring non-electrical systems shall operate on 120 volt 60Hz AC branch circuit electrical power.

5. Bi-directional monitoring for Net-Metering applications.

2.02 ELECTRICAL POWER METERING

A. General

1. The meters shall be microprocessor controlled, digital, measuring and indicating meters.

2. Meter enclosure nominal size 8-inches x 8-inches by 4-inches deep, surface mounting, self-contained, dust proof, insulating electrical housing.

3. The meter shall be rated for direct circuit connects up to 600 volt AC. Single-Phase; Three-phase “WYE” or “Delta” to match the monitored circuit configuration. Provide bus-tap voltage, with current limiting 15-ampere 3-pole circuit breaker or 2-pole circuit breaker, as applicable.

4. The meter shall accommodate input connect through split core instrument Current Transformers (CT). Provide a CT for each phase, compatible with the install location. Three (3) CT’s for three-phase systems and two (2) CT’s for single-phase systems.

5. The meter shall be compatible with the input voltage, CT input/output ratios.
6. Shall provide proper operation over distance of up to 100 feet meter wiring circuit length from the meter to the respective CT location.

7. Meter withstand ratings:
   a. Continuous current overload 100-percent.
   b. Surge 10-times rating for 3-Seconds

8. As manufactured by Electro Industries-Shark Series; or Integrated Metering Systems Inc. – IMS; or E-Mon D-Mon electric sub-meters.

B. Meter Monitoring and Measurements Range.
   1. The meter shall provide multi-function monitoring for three-phase and single-phase as applicable.
      a. Real time kilowatt kW load
      b. Cumulative kilowatt hour kWh load
      c. Peak kilowatt demand with time and date adjustable window of 15-minute or 30-minute intervals
   2. Direct-read at each meter location, 8-digit LCD visual display of measured data parameters.

2.03 AUTOMATIC METER READING-AMR

A. General
   1. Remote AMR communications data recovery and data analysis from the Sub-meters shall occur by the following methods:
      a. Wired meter communications LAN network.
      b. Typical for switchboard Owner metering and panelboard Owner metering.
   2. The monitor and communications software shall communicate with the Supplemental Metering and Sub-metering system using the AMR communications pathways.
   3. Provide meter LAN Network communications Gateway to translate metering system LAN communications protocols with the communications protocols for the Building Automation System BAS-EMCS. Coordinate with BAS EMCS.
   4. Provide communications port-card for the Supplemental Metering and Sub-metering system.
      The port-card shall connect to the PC workstation computer. Operate and communicate with the metering system and the PC workstation monitoring/communicating metering software.

B. Wired Meter Communications Meter LAN Network Pathway
   1. Wired meter network operating over IEEE compliant TCP/IP Fast Ethernet LAN Network. ANSI/EIA/TIA Category-6, 4-pair UTP with RJ-45 connectors.

2.04 MONITORING AND COMMUNICATING SOFTWARE

A. General
   1. The monitoring and communicating software shall provide a complete and comprehensive Enterprise wide operation of the metering system. Provide concurrent multi-user software site license for the entire system.
   2. Graphic User Interface (GUI) operation, programming and configuration of meters.
   3. Real-time viewing capability, data-logging and viewing of historical logs.
   4. Communication with sub-meters through Ethernet TCP/IP, direct (plug-in) Serial port, and remote RF Wireless. Shall operate on pc-computers with Microsoft-Windows© operating system.
5. Provide charting, graphing, and analysis of data. Provide viewing of sub-meter records with comprehensive data analysis.
6. ODBC databases for all collected data.
7. Meter reading full reporting capability, utilizing artificial intelligence to diagnose events and provide possible cause scenarios.
8. Client billing and invoice statements for monthly payment by Clients of consumed measure values.
9. Audible and email alarms of selected conditions.
10. WEB Internet access to all meter data.
11. Install, set up and program all software for a fully functional AMR system.

B. Software Functions
1. Connection between remote meters via Serial, Ethernet, RF wireless or Modem. Shall function with all the meters in the Supplemental Metering and Sub-meter system.
2. Viewing of real-time metered data, configuring of meters, and analyzing of collected information from the remote sub-meters.
   a. View real-time readings of all measured parameters.
   b. Configure and analyze collected data from remote sub-meters.
   c. Collect and archive all data.
3. Computer screen display, graphing and reporting functions for collection and archiving of data. ODBC-compliant database structures, stored metering information integrated automatically into other 3rd party software packages. Shall also support .csv file format, auto-configurable.
   Real-time viewing capability shall include:
   a. Volume, flow, voltage, current, power, and energy
   b. Time of usage and accumulations
   c. Alarms and limits
   d. Max. and min. for each parameter
   e. I/O device information
4. Real-time viewing of data in graphical format. Charting and graphing functions access to any desired data analysis.
   a. Calculation of power quality on a scatter graph
   b. CBEMA plotting information
   c. 3D plots and histograms provided to aid in determining frequency and severity of monitored events.
   d. Graphical data analysis by the base software.
   e. Viewing of stored waveforms, events caused by monitored system problems, faults, transients, and other conditions.

C. Reports
1. Reporting software shall provide a comprehensive report on each meter, making use of Artificial Intelligence (AI) technology to diagnose the events and provide the possible cause of the event.
2. AI generated industry accepted solution as a result of the analysis of the monitored event. The AI program of the reporting software package shall make use of Fuzzy Logic, Neural Networks, embedded knowledge, and embedded rules to generate correct analysis and solutions.
3. Create tenant billing invoice statement for individual tenant consumption of measured values by the sub-metering system.
4. The software shall have a primary Reports server and a Standby Reports server. If the primary server is not running, the user shall be capable of connecting to the standby server.
5. User specify report writing at project startup or other user-defined times, or on
   the occurrence of user-defined triggers or conditions.
6. User specify report printing when run or saved to storage disk for later printing.
   The software shall allow user to format report variables.

D. Remote Server
1. Shall support the receiving of data strings from remote sub-meters in the field.
   The software shall check the monitoring system for connected remote sub-
   meters and assign incoming calls. Display warnings and to send email, pager,
   or phone notification of alarm conditions.

E. Security
1. The software shall have advanced security features, allowing password
   protection through up to five levels of privileges. The password protection shall
   allow restriction of access to specific screens and/or functions.
2. The operator shall be automatically logged out after a specified amount of
   inactivity time. The software shall still be active, but the user shall be restricted
   to 0 privilege level access after automatic logout.
3. Shall run as either a service or a shell under Microsoft Windows, to disable
   switching to other Windows applications while the software is running.
4. Allow disabling of the Ctrl-Alt-Delete shortcut key, to restrict operator access to
   other Windows applications.
5. Not less than two (2) types of alarms: hardware alarms and configurable
   alarms. Issue alarms for devices going offline and other hardware conditions.
   User define alarm conditions for configurable alarms. Allow the following four
   types of configurable alarms: digital alarms, time-stamped alarms, analog
   alarms, and advanced alarms. Create a project page to display alarms and
   allow for operator intervention. Alarms must be able to be ordered into
   categories for prioritization and display.
6. Online Help functions, including a complete Help guide, navigable with forward
   and back buttons, an Index, and a Search function. Shall have complete
   context-sensitive help in all of the development screens.

F. Configuration
1. The software shall contain Wizards that allow quick and easy setup of
   configurable devices and the main control unit.
2. Shall provide Genies already programmed for metering devices. These Genies
   shall be configured to access and show real-time readings.
3. Shall contain pre-programmed tags for trending and graphing, reporting, events
   logging, and alarm conditions.
4. The configuration mode shall use forms and templates for data entry during
   development.
5. The configuration shall utilize Vectoral Graphics. The end user shall be
   capable of:
   a. Importing graphics and editing them
   b. Creating custom symbols and other objects and animating them, copying
      them, and moving them on the screen
   c. Connecting symbols and objects and moving them around on the screen
   d. Assigning tags to objects, such as metering devices, to display information
      and perform functions
   e. Creating links to other screens and programs from devices and/or buttons
   f. Assigning access rights to objects on the screen
g. Assigning keyboard commands to objects on the screen, activated by clicking on an object, moving over an object, or releasing a “click” on an object

h. Configuring objects to change when the project is in Runtime Mode, or when a pre-defined condition exists, e.g., a metering device has gone offline

i. Assigning actions consequent on an object being clicked

j. Configuring more than one project at a time, utilizing the same workstation

PART 3 EXECUTION

3.01 INSTALLATION

A. A Branch Circuit Breaker shall be provided at the metering location to allow safe access to metering components without powering down the entire electrical system.

B. All Meters, Metering Equipment and Software shall be installed to comply with Manufacturer’s installation instructions and recommendations.

C. Wiring Connects (additional requirements)
   1. Provide communication connections,
   2. One (1) 0.75-inch conduit with two (2) Category-6 cables, homerun to nearest IDF/MDF room patch panel.
      a. From each meter location

3.02 SYSTEM COMMISSIONING AND START-UP

A. Contractor to provide setup, testing and programming of metering system and “Commissioning”. Shall be performed prior to occupancy.
   1. Record the “cross reference” or the meter serial number (unique ID), meter point, to monitor load relationship.
   2. Check for power to the meter.
   3. Check the serial number inside the meter.
   4. Open the panel so that all CT’s are visible.
   5. Verify the CT ratio and write up the cross reference information for the meter.
   6. Confirm the “cross reference”. Turn on a known load in the respective monitor load unit on each phase.
   7. Verify the meter’s phase diagnostics for the assigned monitor load. Confirm that there is a significant increase on the load for each phase of the meter point.
   8. After phases have been checked and loads are still running, turn off the breaker serving the monitor load and confirm that all loads are disconnected.

B. Test Results:
   1. Submit two (2) draft copies of Test results to the OWNER’S Representative.
   2. After approval submit the test results in two (2) final printed copies and one computer readable copy.

C. Testing shall include testing of Communications between Sub-meters, Communications modules, Transponders, and Remote monitoring AMR locations.
   1. Testing shall confirm that all power meters included in cross-reference are properly communicating.
   2. Testing shall confirm that remote connection is complete.
3. Testing shall confirm that all Transponders and the networks are communicating properly.

END OF SECTION
120715/223015
SECTION 26 0923

OCCUPANCY MOTION SENSORS

PART 1 - GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other Specification Sections and Drawings for related work required to be included as work under Division 26.
   2. General Provisions and Requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Submit data sheets on sensors, wiring diagrams, relays, transformers, junction and outlet boxes, and mounting accessories. Submit wiring diagrams. Submit Agency Certifications/Approvals.

B. Submit details of pendant-mounted sensor installation.

1.03 APPLICABLE STANDARDS (ADDITIONAL REQUIREMENTS)

A. General
   1. All ultrasonic sensors shall comply with the State of California Safety and Health Requirements. Decibel levels for ultrasonic sensors shall comply with the following criteria and the State of California Energy Commission for ultrasonic emissions:
      MAXIMUM DECIBEL LEVELS FOR ULTRASONIC EMISSIONS
      Mid-frequency of Sound Pressure Minimum dB Level Within Third Octave
      Third-Octave Bank (kHz) Band (in dB reference 20 micropascals)
      Less than 20 80
      20 or more to less than 25 105
      25 or more to less than 31.5 110
      31.5 or more 115
   2. The CONTRACTOR and Manufacturer shall certify in writing that all proposed and installed occupancy motion sensors comply with the Federal Environmental Protection Agency (EPA) and State of California Energy Commission criteria.
   3. Occupancy motion sensors shall be:
      a. UL listed and labeled.
PART 2 - PRODUCTS

2.01 MOTION SENSORS

A. General

1. Motion sensors and power supply shall be self-contained. The motion sensors shall be solid state low voltage devices designed specifically for energy conservation lighting control. Combined dual function ultrasonic and infrared motion sensing.
   a. Ultrasonic crystal controlled to within +/- 0.01% motion sensor technology.
   b. Passive infrared (PIR) motion sensor technology.

2. Occupancy motion sensor shall also include available ambient light sensor, in addition to the motion sensor. The ambient light sensor shall prevent the occupancy motion sensor from automatically turning "on" the respective lighting when the ambient day-lighting intensity detected by photoelectric cell contained in the motion sensor exceeds a selected intensity. The ambient light sensor circuit shall not control the automatic off function. The ambient lighting intensity detection sensitivity shall be adjustable in the sensor, adjustment range not less than 15 through 140 ambient day-lighting footcandles.

3. Automatic-off: sensor shall automatically turn "off" lighting when there is no movement after the preset time delay interval. Lights shall remain "on" with movement. There shall be a "dead band" time period after the unit turns itself off (because of lack of motion) during which a new motion will automatically turn lights on without the manual switch having to be activated.

4. Automatic-on: Sensor shall automatically turn "on" lighting when movement is detected in the monitored space. Lights shall remain on with movement. An internal control shall provide a mechanism to bypass the automatic-on control feature and allow only automatic-off functions. Where manual on/off [dimming] lighting control switches are shown on the Drawings, in addition to the occupancy motion sensors in the same space, the manual controls shall override the automatic "on" control feature of the occupancy motion sensor. Override of the automatic "off" feature shall not be affected by the respective manual switches.

5. Motion detection sensitivity, time delays to turn "ON" after activation and time delays to turn "OFF", shall be adjustable to ensure there will be no nuisance on/off switching of the lights by the motion sensor while the room is occupied. Adjustable settings shall be tamper resistant, concealed behind an access protection cover.
   a. Fluorescent light fixtures with Instant Start or Rapid Start lamp ballast set the minimum lamp "on" time at not less than 15-minutes. Program Start lamp ballast, set the minimum lamp "on" time at not less than 5-minutes.

6. Automatic self-adjusting Adaptive-Learning for time delay and sensitivity variable conditions in the monitored space.

7. Fail-to-on, the failure of a sensor shall cause the occupancy motion sensor load relay contacts to activate, so the occupancy motion sensor function is automatically bypassed and lighting is turned-on.

8. All occupancy motion sensors shall be provided with an indicator light to display when motion is being detected and the unit is operating correctly.

9. Non-volatile internal memory shall store and maintain in memory all occupancy motion sensor settings during any electric power failure.

10. Where multiple occupancy motion sensors are installed with overlapping monitoring spaces, the sensors shall not cause false triggering or malfunctions to adjacent occupancy motion sensors.
11. Occupancy motion sensors shall incorporate mechanical vibration-damping. The vibration-damping shall prevent normal building vibrations from causing “false” sensor operation.
12. As manufactured by WattStopper; or Leviton; or Hubbell; or Greargate.

B. Area Control Coverage
1. Space coverage of motion sensor transponder shall remain constant after sensitivity control has been set. No automatic reduction/increase in coverage nor sensitivity shall occur when air motion caused by air conditioning or heating fans are in operation nor when the occupancy motion sensor has turned off lighting due to not detecting any motion.
2. Occupancy motion sensors in spaces 300 square feet area or less may be a wall switch mounted unit.
   a. Wall switch sensors shall provide detection of motion at desk top, for up to 300 square feet, 180-degree range within a volume dimension of up to approximately 20-feet by 15-feet by 10-feet high, extending from the wall mounting height of the unit to the finish floor.
   b. Wall switch occupancy motion sensors shall be a minimum load capacity of 500 watts 120V; 1000 watts 277V, but in no case shall the load rating be less than the lighting loads shown on the Drawings.
3. Motion sensors in spaces exceeding 300 square feet in size and where shown on the Drawing as mounted on the ceiling, shall be ceiling mounted. The sensor shall not protrude more than 1.6-inches below the ceiling line.
   a. Sensor area coverage shall be 360 degrees three (3) dimensional diameter surrounding the sensor installation location.
   b. The sensor shall be rated to provide coverage of the space volume/room length/width/height shown in the contract documents. Provide additional ceiling mounted motion sensors to provide complete coverage of each area.
   c. Corridor/hallway sensor area coverage shall not be less than 80-feet linear feet extending from the sensor installation location. Sensor shall be bi-directional or uni-directional to provide complete area motion detection at the installation location shown on the Drawings.

2.02 CONTROL UNITS

A. General
1. Control unit shall be an integrated, self-contained unit consisting internally of load switching control relay(s); internal power supply and power supply transformer. The power supply shall be sufficient capacity to provide low-voltage power to a minimum of two (2) motion sensors.
2. Occupancy motion sensors directly controlling line voltage electrical loads, the line voltage load relay contacts shall be “dry” type electrically isolated, with load ratings as follows:
   a. 15A – 120 volt single phase 60Hz AC.
   b. 15A – 277 volt single phase 60Hz AC.
3. Load relay contacts shall be rated to control load types up to the full ampere rating. Incandescent Tungsten lamps for lighting equipment. Rapid start and instant start and Program Start solid state electronic ballast (both low power factor and high power factor) for lighting equipment.
4. The quantity of individual internal load switching relays shall be not less than the quantity of individual “switchleg” circuits to be controlled shown on the Drawings.

B. Occupancy Management Control/Building Automation
1. Provide each occupancy motion sensor control unit with auxiliary dedicated single pole double throw relay contacts operated by the motion sensors that shall be interfaced with building Energy Management Control/Building Automation (EMCS/BAS) energy management and/or building security systems. Relay contacts serving security function shall activate when motion is detected, regardless of whether the respective room manual light switches are on or off.

C. Occupancy Motion Sensors that Connect to Low Voltage Remote Control Relays (LVRCR) Systems.
1. LVRCR systems and occupancy motion sensor shall be rated and certified by the Occupancy Sensor Manufacturer and the LVRCR Manufacturer for proper operation with the LVRCR control port inputs and the occupancy motion sensor control output interface relay contacts. Occupancy sensor normally open, normally closed, maintained control relay contact, momentary control relay contact, control operation sequences in coordination with the LVRCR requirements for automatic “on and off” load control by the LVRCR.
2. The occupancy motion sensor power supply input, voltage rating and current rating control interface should comply with LVRCR requirements.

2.03 OCCUPANCY MOTION SENSOR HOUSING ENCLOSURE

A. General
1. Enclosures for occupancy motion sensor control units shall be pressed steel or high impact resistant nonflammable non-metallic enclosure. Enclosure finish color white. Semi-flush mounting installation, NEMA I “dead front” construction with mounting plates and barriers to provide separation between line voltage and low voltage wiring.

B. Mounting
1. Flush mounting 4.67-inches square by 2.125-inches deep outlet junction box with extension ring and occupancy motion sensor cover mounting plate.
2. Occupancy sensor shall be semi-flush mount into outlet box with tamper resistant attachment of the sensor and the outlet box.
3. Motion sensor shall be approved for installation in environmental air plenum.

PART 3 – EXECUTION

3.01 MOTION SENSOR QUANTITIES AND TYPES

A. General
1. The CONTRACTOR shall provide the quantity and types of motion sensors required for complete and proper volumetric coverage without gaps within the range of coverage(s) of controlled areas.
2. Rooms shall be 90% to 100% volumetric coverage of the sensing coverage area, to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). Motion sensing detection coverage shall extend from the finish floor to not less than 48-inches above finish floor.
3. The locations and quantities of sensors shown on the Drawings are diagrammatic and indicate only rooms, which are to be provided with sensors. The CONTRACTOR shall provide additional sensors if required to properly cover the respective rooms.

4. Ceiling mounted sensors shall also be pendant-mounted in rooms in which the controlled lighting fixtures are chain, cable or pendant suspension mounted. The mounting height of the sensor shall be approximately 6-inches below the bottom of the light fixtures to be controlled.

5. Wall mounted sensors shall be installed at a height not higher than the bottom of the respective ceiling lighting fixtures. For Wall switches with integrated manual switch for “on” or “off” applications, mounting height shall not exceed 42-inches above finish floor.

6. Occupancy sensors may be affected by various conditions in the room. Make adjustments, change the location and/or type of occupancy motion sensor to obtain proper operation in each specific room location.

7. Install occupancy motion sensors a minimum of 72-inches horizontal distance from environmental air supply/return registers, fans and moving objects.

3.02 SETUP AND TESTING

A. Commissioning (Additional Requirements)

1. Setup, testing, startup and commissioning shall be performed by factory technician(s) trained, certified and authorized by the equipment Manufacturer. Final commissioning shall be performed after installation and connections are complete.

2. Provide system programming and setup of all control sequences for lighting control system.

3. Adjust sensitively, time-delay, location and orientation of each occupancy motion sensor; test each sensor/control unit all in accordance with the Manufacturer’s recommendations. Be certain that no obstructions block proper sensor coverage of detection areas and limit sensor pickup zone to the respective room.

4. Test all control system functions after the installation and connections are complete and the system has been energized. Verify each control sequence of operation and each device to be controlled are operating correctly.

5. Verify interconnections and controls with the:
   a. Lighting control systems.
   b. Security/intrusion detection systems.
   c. Building automation systems (BAS and energy management and control systems EMCS).

6. Record and document each sensor setup and program setting.

7. Submit written report (6 copies) to District's Representative certifying commissioning has been performed; all respective systems are operating correctly and documenting all software setup and each device settings.

8. Refer to General Commissioning Section 01 9113 for additional requirements.

3.03 WIRING (ADDITIONAL REQUIREMENTS).

A. General

1. The Drawings do not indicate the quantity of control wires required between various control points. The CONTRACTOR shall provide the quantity and type of control wire required for proper system operation, as recommended by the System Manufacturer. Install all control circuits in conduit.
2. Control wire shall be copper #18AWG minimum, twisted pairs, PVC insulated for control voltage, Color Coded to match relay and switch wiring “pigtail” Color Codes.

3. Network communications wires shall be ANSI/EIA/TIA-568B, 100-OHM, 4-pair shielded twisted pairs STP, Category-5E.

4. Where multiple control wires are installed in a signal conduit or route to a single location provide multi-conductor control cables with outer jacket. Control wires for control of relay controllers which shall be separate twisted shielded 4-wire PVC insulated conductors, with a ground wire and outer jacket for each controller to prevent “RF” inference.

5. Control wire shall be increased in wire gauge size as required to ensure proper system operation and voltage drop over the installation distance shown on the Drawings between equipment and control device locations.

6. Occupancy motions sensor control power shall be powered from line voltage “hot” non-switched, lighting branch circuit. Alternately, control power may be obtained directly from the respective lighting control panel (if available). Provide two (2) additional #12 (AWG) “hot-circuit” and neutral unswitched conductor in conduit homeruns and branch circuits.

7. All wiring shall be installed in conduit.

END OF SECTION
100615/223015
SECTION 26 0943
LIGHTING CONTROL SYSTEM

PART 1 – GENERAL

1.01 RELATED DOCUMENTS
A. NA

1.02 SUMMARY
A. The lighting control system specified in this Section shall provide time-based, sensor-based (both occupancy and daylight), and manual lighting control.
B. The system shall be capable of turning lighting loads on/off as well as dimming lights (if lighting load is capable of being dimmed)
C. All system devices shall be networked together enabling digital communication and shall be individually addressable.
D. The System Architecture shall be capable of enabling stand-alone groups (rooms) of devices to function in some default capacity even if network connectivity to the greater system is lost.
E. The System Architecture shall facilitate remote operation via a computer connection.
F. The system shall not require any centrally hardwired switching equipment.
G. The System shall be capable of Wireless, Wired, or Hybrid Wireless/Wired Architectures.

1.03 DEFINITIONS
A. NA

1.04 SUBMITTALS
A. Product Datasheets (general device descriptions, dimensions, wiring details, nomenclature).
B. Riser Diagrams – typical per room type (detailed Drawings showing device interconnectivity of devices).
C. Other Diagrams – as needed for special operation or interaction with other system(s)
D. Example Contractor Startup/Commissioning Worksheet – must be completed prior to factory start-up.
E. Hardware and Software Operation Manuals
F. Other operational descriptions as needed
1.05 QUALITY ASSURANCE

A. All steps in sensor manufacturing process shall occur in the USA; including population of all electronic components on circuit boards, soldering, programming, wiring, and housing.

B. All components and the manufacturing facility where product was manufactured must be ROHS compliant.

C. In high humidity or cold environments, the sensors shall be conformably coated and rated for condensing humidity and -40 degree Fahrenheit (and Celsius) operation.

D. All applicable products must be UL / CUL Listed or other acceptable National Testing Organization.

1.06 COORDINATION

A. Coordinate lighting control components to form an integrated interconnection of compatible components.

B. Coordinate lighting controls with BAS (if necessary) either through IP based intercommunication of system or hardwired auxiliary relay outputs.

C. The installing contractor shall be responsible for a complete and functional system in accordance with all applicable Local and National Codes.

1.07 WARRANTY

A. All devices in lighting control system shall have a 5 year warranty.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. This Specification is based on the nLight® Network Control System from Sensor Switch, an Acuity Brands Company (800-727-7483, www.sensorswitch.com).

2.02 SYSTEM REQUIREMENTS

A. System shall have an architecture that is based upon three (3) main concepts; 1) Intelligent lighting control devices; 2) Standalone lighting control zones; 3) Network backbone for remote or time based operation.

B. Intelligent lighting control devices shall consist of one or more basic lighting control components; occupancy sensors, photocell sensors, relays, dimming outputs, manual switch stations, and manual dimming stations. Combining one or more of these components into a single device enclosure should be permissible so as to minimize overall device count of system.

C. System must interface directly with intelligent LED luminaires such that only CAT-5 cabling is required to interconnect luminaires with control components such as sensors and switches (see Networked LED Luminaire section).
D. Intelligent lighting control devices shall communicate digitally, require <4 mA of current to function (Graphic wall stations excluded), and possess RJ-45 style connectors.

E. Lighting Control Zones shall consist of one (1) or more intelligent lighting control components, be capable of stand-alone operation, and be capable of being connected to a higher level network backbone.

F. Devices within a lighting control zone shall be connected with CAT-5e low voltage cabling in any order.

G. Lighting Control Zone shall be capable of automatically configuring itself for default operation without any start-up labor required.

H. Individual Lighting Zones must continue to provide a user defined default level of lighting control in the event of a system communication failure with the backbone network or the management software becoming unavailable.

I. Power for devices within a lighting control zone shall come from either resident devices already present for switching (relay device) or dimming purposes, or from the network backbone. Standalone “bus power supplies” shall not be required in all cases.

J. All switching and dimming for a specific lighting zone shall take place within the devices located in the zone itself (i.e. not in a remotely located devices such as panels) to facilitate system robustness and minimize wiring requirements. Specific applications that require centralized or remote switching shall be capable of being accommodated.

K. System shall have one (1) or more primary wall mounted network control “gateway” devices that are capable of accessing and controlling connected system devices and linking into an Ethernet LAN.

L. System shall use “bridge” devices that route communication and distribute power for up to eight (8) directly connected lighting zones together for purposes of decreasing system wiring requirements.

M. System shall be capable of wirelessly connecting a lighting zone to a WiFi (802.11n) wireless data network for purposes of eliminating the “bridge” devices and all cabling that connects zones to bridge devices.

N. WiFi enabled devices shall be able to detect when WiFi Network is down and revert to a user directed default state.

O. WiFi enabled devices shall be capable of current monitoring

P. WiFi enabled devices shall utilize WPA2 AES encryption

Q. WiFi enabled devices shall be able to connect to 802.11b/g/n WiFi Networks

R. WiFi enabled devices shall have at least one local RJ-45 port for communicating with nonWiFi enabled system devices

S. System shall have a web-based software management program that enables remote system control, status monitoring, and creation of lighting control profiles.
T. Individual lighting zones shall be capable of being segmented into several “local” channels of occupancy, photocell, and switch functionality for more advanced configurations and sequences of operation.

U. Devices located in different lighting zones shall be able to communicate occupancy, photocell, and switch information via either the wired or WiFi backbone.

V. System shall be capable of operating a lighting control zone according to several sequences of operation. System shall be able to change a spaces sequence of operation according to a time schedule so as to enable customized time-of-day, day-of-week utilization of a space. Note operating modes should be utilized only in manners consistent with local energy codes.

1. Auto-On / Auto-Off (via occupancy sensors)
   - Zones with occupancy sensors automatically turn lights on when occupant is detected.
   - Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
   - Pressing a switch will turn lights off. The lights will remain off regardless of occupancy until switch is pressed again, restoring the sensor to Automatic On functionality.

2. Manual-On / Auto-Off (also called Semi-Automatic)
   - Pushing a switch will turn lights on.
   - Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.

   - Pushing a switch will turn lights on.
   - After initial lights on, zones with occupancy and/or photocell sensors turn lights on/off according to occupancy/vacancy and/or daylight conditions.
   - Sequence can be reset via scheduled (ex. daily each morning) events

5. Auto-to-Override On
   - Zones with occupancy sensors automatically turn lights on when occupant is detected.
   - Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.
   - Sequence can be reset via scheduled (ex. daily each morning) events

   - Pushing a switch will turn lights on.
   - Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.
   - Sequence can be reset via scheduled (ex. daily each morning) events

7. Auto On / Predictive Off
   - Zones with occupancy sensors automatically turn lights on when occupant is detected.
   - Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
   - If switch is pressed, lights turn off and a short “exit timer” begins. After timer expires, sensor scans the room to detect whether occupant is still present. If no occupancy is detected, zone returns to auto-on. If occupancy is detected, lights must be turned on via the switch.

8. Multi-Level Operation (multiple lighting levels per manual button press)
   - Operating mode designed specifically for bi-level applications
• Enables the user to cycle through the up to four potential on/off lighting states using only a single button.
• Eliminates user confusion as to which of two buttons controls which load
• Three different transition sequences are available in order to comply with energy codes or user preference)
• Mode available as a setting on all nLight devices that have single manual on/off switch (ex. nWSX, nPODM, nPODM-DX).
• Depending on the sequence selected, every button push steps through relays states according to below table
• In addition to achieving bi-level lighting control by switching loads with relays, the ability to command dimming outputs to “step” in a sequence that achieves bi-level operation is present.

<table>
<thead>
<tr>
<th>Sequence State #</th>
<th>Alternating Sequence</th>
<th>Full On Sequence</th>
<th>3 Step On Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Relay 1</td>
<td>Relay 2</td>
<td>Relay 1</td>
</tr>
<tr>
<td>1</td>
<td>On</td>
<td>Off</td>
<td>On</td>
</tr>
<tr>
<td>2</td>
<td>Off</td>
<td>On</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>-</td>
<td>On</td>
</tr>
<tr>
<td>4*</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
</tr>
</tbody>
</table>

(*step only present for devices without separate off button)

W. A taskbar style desktop application shall be available for personal lighting control.

X. An application that runs on “smart” handheld devices (such as an Apple® IPhone®) shall be available for personal lighting control.

Y. Control software shall enable logging of system performance data and presenting useful information in a web-based graphical format and downloadable to .CSV files.

Z. Control software shall enable integration with a BMS via BACnet IP.

AA. System shall provide the option of having pre-terminated plenum rated CAT-5 cabling supplied with hardware.

2.03 INDIVIDUAL DEVICE SPECIFICATIONS

A. Control Module (Gateway)
1. Control module shall be a device that facilitates communication and time-based control of downstream network devices and linking into an Ethernet.
2. Devices shall have a user interface that is capable of wall mounting, powered by low voltage, and have a touch screen.
3. Control device shall have three RJ-45 ports for connection to other backbone devices (bridges) or directly to lighting control devices.
4. Device shall automatically detect all devices downstream of it.
5. Device shall have a standard and astronomical internal time clock.
6. Device shall have one RJ-45 10/100 BaseT Ethernet connection.
7. Device shall have a USB port
8. Each control gateway device shall be capable of linking 1500 devices to the management software.
9. Device shall be capable of using a dedicated or DHCP assigned IP address.
10. Network Control Gateway device shall be the following Sensor Switch model Series: nGWY2

B. Networked System Occupancy Sensors
1. Occupancy sensors system shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
2. Sensors shall utilize Passive Infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state; thus preventing false on conditions. Ultrasonic or Microwave based sensing technologies shall not be accepted.
3. For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions), a sensor with an additional “dual” technology shall be used.
4. Dual technology sensors shall have one (1) of its two (2) technologies not require motion to detect occupancy. Acceptable dual technology includes PIR/Microphonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants. Sensors where both technologies detect motion (PIR/Ultrasonic) shall not be acceptable.
5. All sensing technologies shall be acoustically passive meaning they do not transmit sounds waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonics technology. Ultrasonic or Microwave based sensing technologies shall not be accepted.
6. Sensors shall be available with zero, one, or two (2) integrated Class 1 switching relays, and up to one (1) 0-10 VDC dimming output. Sensors shall be capable of switching 120 / 277 / 347 VAC. Load ratings shall be 800 W at 120 VAC, 1200 W at 277 VAC, 1500 W at 347 VAC, and ¼ HP motor. Relays shall be dry contacts.
7. Sensors shall be available with one or two (2) occupancy “poles”, each of which provides a programmable time delay.
8. Sensors shall be available in multiple lens options which are customized for specific applications.
9. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
10. All sensors shall have two (2) RJ-45 ports or capable of utilizing a splitter.
11. All sensors shall have the ability to detect when it is not receiving valid communication (via CAT-5 connections) and blink its LED in a pattern to visually indicate of a potential wiring issue.
12. Every sensor parameter shall be available and configurable remotely from the software and locally via the device push-button.
13. Sensors shall be able to function together with other sensors in order to provide expanded coverage areas by simply daisy-chain wiring together the units with CAT-5 cabling.
14. Sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements.
15. Wall switch sensors shall recess into single-gang switch box and fit a standard GFI opening.

16. Wall switch sensors must meet NEC grounding requirements by providing a dedicated ground connection and grounding to mounting strap. Line and load wire connections shall be interchangeable. Sensor shall not allow current to pass to the load when sensor is in the unoccupied (Off) condition.

17. Wall switch sensors shall have optional features for photocell/daylight override, vandal resistant lens, and low temperature/high humidity operation.

18. Wall switch sensors shall be available in four (4) standard colors (Ivory, White, Light Almond, Gray).

19. Wall switch sensors shall be available with optional raise/lower dimming adjustment controls.

20. Wall switch sensors shall be the following Sensor Switch model numbers, with device color and optional features as specified:
   - nWSD or nWSX (PIR, 1 Relay)
   - nWSD PDT or nWSX PDT (Dual Tech, 1 Relay)
   - nWSD NL (PIR w/ Night Light, 1 Relay)
   - nWSD PDT NL (Dual Tech w/ Night Light, 1 Relay)
   - nWSX NL LV (PIR w/ Night Light, No Relay)
   - nWSD PDT NL LV (Dual Tech w/ Night Light, No Relay)
   - nWSX LV or nWSX LV (PIR, No Relay, Raise/Lower Dim Ctrl)
   - nWSD PDT LV or nWSX PDT LV (Dual Tech w/ Night Light, No Relay, Raise/Lower Dim Ctrl)

21. Network system shall have sensors that can be embedded into luminaire such that only the lens shows on luminaire face.

22. Embedded sensors shall be capable of both PIR and Dual Technology occupancy detection.

23. Embedded sensors shall have an optional photocell.

24. Embedded sensors shall be the following Sensor Switch model number:
   - nES 7 (PIR, No Relay)
   - nES 7 ADCX (PIR w/ Photocell, No Relay)
   - nES PDT 7 (Dual Technology, No Relay)
   - nES PDT 7 ADCX (Dual Technology w/ Photocell, No Relay)

25. Network system shall also have ceiling, fixture, recessed, and corner mounted sensors available.

26. Fixture mount sensors shall be capable of powering themselves via a line power feed.

27. Sensors shall have optional features for photocell/daylight override, dimming control, and low temperature/high humidity operation.

28. Sensors with dimming can control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of Class 2 current (typically 40 or more ballasts).

29. Sensors shall be the following Sensor Switch model numbers, with device options as specified:

<table>
<thead>
<tr>
<th>Model # Series</th>
<th>Occupancy Poles</th>
<th># of Relays</th>
<th>Lens Type</th>
<th>Detection Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>nCM(B) 9</td>
<td>1</td>
<td>-</td>
<td>Standard</td>
<td>PIR</td>
</tr>
<tr>
<td>nCM(B) 9 2P</td>
<td>2</td>
<td>-</td>
<td>Standard</td>
<td>PIR</td>
</tr>
<tr>
<td>nCMR(B) 9</td>
<td>1</td>
<td>1</td>
<td>Standard</td>
<td>PIR</td>
</tr>
<tr>
<td>nCMR(B) 9 2P</td>
<td>2</td>
<td>2</td>
<td>Standard</td>
<td>PIR</td>
</tr>
<tr>
<td>Model</td>
<td>Quantity</td>
<td>Mount Type</td>
<td>Control Mode</td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>----------</td>
<td>------------</td>
<td>---------------</td>
<td></td>
</tr>
<tr>
<td>nCM(B) PDT 9</td>
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<td>Standard</td>
<td>Dual</td>
<td></td>
</tr>
<tr>
<td>nCM(B) PDT 9 2P</td>
<td>2</td>
<td>Standard</td>
<td>Dual</td>
<td></td>
</tr>
<tr>
<td>nCMR(B) PDT 9</td>
<td>1</td>
<td>1</td>
<td>Standard</td>
<td></td>
</tr>
<tr>
<td>nCMR(B) PDT 9 2P</td>
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<td>2</td>
<td>Standard</td>
<td></td>
</tr>
<tr>
<td>nCM(B) 10</td>
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<td>-</td>
<td>Extended PIR</td>
<td></td>
</tr>
<tr>
<td>nCM(B) 10 2P</td>
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<td>-</td>
<td>Extended PIR</td>
<td></td>
</tr>
<tr>
<td>nCMR(B) 10</td>
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<td>1</td>
<td>Extended PIR</td>
<td></td>
</tr>
<tr>
<td>nCMR(B) 10 2P</td>
<td>2</td>
<td>2</td>
<td>Extended PIR</td>
<td></td>
</tr>
<tr>
<td>nCM(B) PDT 10</td>
<td>1</td>
<td>-</td>
<td>Extended Dual</td>
<td></td>
</tr>
<tr>
<td>nCM(B) PDT 10 2P</td>
<td>2</td>
<td>-</td>
<td>Extended Dual</td>
<td></td>
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<td>1</td>
<td>Extended Dual</td>
<td></td>
</tr>
<tr>
<td>nCMR(B) PDT 10 2P</td>
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<td>2</td>
<td>Extended Dual</td>
<td></td>
</tr>
<tr>
<td>nWV 16</td>
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<td>-</td>
<td>Wide View PIR</td>
<td></td>
</tr>
<tr>
<td>nWV PDT 16</td>
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<td>-</td>
<td>Wide View Dual</td>
<td></td>
</tr>
<tr>
<td>nHW13</td>
<td>1</td>
<td>-</td>
<td>Hallway PIR</td>
<td></td>
</tr>
<tr>
<td>nCM(B) 6</td>
<td>1</td>
<td>-</td>
<td>High Bay PIR</td>
<td></td>
</tr>
<tr>
<td>nCMR(B) 6</td>
<td>1</td>
<td>1</td>
<td>High Bay PIR</td>
<td></td>
</tr>
<tr>
<td>nCMR(B) 6 2P</td>
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<td>2</td>
<td>High Bay PIR</td>
<td></td>
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<tr>
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<td>1</td>
<td>2</td>
<td>High Bay PIR</td>
<td></td>
</tr>
</tbody>
</table>

Note: Recessed mount versions of the above ceiling (fixture) mount versions also shall be available (e.g. nCMR(B) 9 => nRMR 9)

30. System shall have WiFi enabled fixture mountable sensors available.
31. Embedded sensors shall have an optional photocell and 0-10 VDC dimming output.
32. WiFi enable sensors shall be one of the Sensor Switch model numbers:
   - nCMRB 6 WIFI (PIR, w/ Relay)
   - nCMRB 10 WIFI (PIR, w/ Relay)
   - nCMRB 50 WIFI (PIR, w/ Relay)
   - nCMRB 9 WIFI (PIR, w/ Relay)

C. Networked System Daylight (Photocell and or Dimming) Sensors
1. Photocell shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
2. Photocell and dimming sensor's set-point and deadband shall be automatically calibrated through the sensor’s microprocessor by initiating an “Automatic Set-point Programming” procedure. Min and max dim settings as well as set-point may be manually entered.
3. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).

4. Dimming sensors shall control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of Class 2 current (typically 40 or more ballasts).

5. Photocell and dimming sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements. (Note: This function should be performed prior to any dimming of the lamps including the "auto set-point" setting).

6. Combination units that have all features of on/off photocell and dimming sensors shall also be available.

7. A dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The second zone shall be capable of being controlled as an "offset" from the primary zone.

8. Line voltage versions of the above described photocell and combination photocell/ dimming sensors shall be capable of switching both 120 VAC, 277 VAC, and 347 VAC. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor load. Relays shall be dry contacts.

9. Sensors shall be the following Sensor Switch model numbers, with device options as specified:
   - nCM(B) PC (on/off)
   - nCM(B) ADC (dimming)
   - nCM(B) PC ADC (on/off, 0-10 VDC dimming)
   - nCMR(B) PC (on/off, single relay)
   - nCMR(B) PC ADC (on/off, 0-10 VDC dimming, single relay)
   - Note: Recessed mount versions of the above ceiling (fixture) mount versions also shall be available (e.g. nCMR(B) PC => nRMR PC)

10. Network system shall have dimming photocells that can be embedded into luminaire such that only the lens shows on luminaire face.

11. Embedded sensors shall be the following Sensor Switch model number:
    - nES ADCX (Dimming Photocell)

D. Networked System Power (Relay) Packs

1. Power Pack shall incorporate one or more Class 1 relays and contribute low voltage power to the rest of the system. Secondary Packs shall incorporate the relay(s), shall have an optional 2nd relay, 0-10 VDC dimming output, or line voltage dimming output, but shall not be required to contribute system power. Power Supplies shall provide system power only, but are not required to switch line voltage circuit. Auxiliary Relay Packs shall switch low voltage circuits only.

2. Power Packs shall accept 120 or 277 VAC (or optionally 347 VAC), be plenum rated, and provide Class 2 power to the system.

3. All devices shall have two RJ-45 ports.

4. Every Power Pack parameter shall be available and configurable remotely from the software and locally via the device push-button.

5. Power Pack shall securely mount to junction location through a threaded ½ inch chase nipple or be capable of being secured within a luminaire ballast channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.

6. When required by local code, Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1
wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.

7. Power Packs and Power Supplies shall be available that are WiFi enabled.

8. Power (Secondary) Packs shall be available that provide up to 16 Amp switching of all lighting load types.

9. Power (Secondary) Packs shall be available that provide up to 5 Amps switching of all lighting load types as well as 0-10 VDC dimming or fluorescent ballasts/LED drivers.

10. Specific Secondary Packs shall be available that provide up to 5 Amps of switching as well as 0-10 VDC dimming of fluorescent ballasts/LED drivers.

11. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120 VAC incandescent lighting loads or 120/277 VAC line voltage dimmable fluorescent ballasts (2-wire and 3-wire versions).

12. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120/277 VAC magnetic low voltage transformers.

13. Specific Secondary Packs shall be available that provide up to 4 Amps of switching and can dim 120 VAC electronic low voltage transformers.

14. Specific Secondary Packs shall be available that provide up to 5 Amps of switching of dual phase (208/240/480 VAC) lighting loads.

15. Specific Secondary Packs shall be available that require a manual switch signal (via a networked Wall Station) in order to close its relay.

16. Specific Power/Secondary Packs shall be available that are UL924 listed for switching of Emergency Power circuits.

17. Specific Secondary Packs shall be available that control louver/damper motors for skylights.

18. Specific Secondary Packs shall be available that provide a pulse on/pulse off signal for purposes of controlling shade systems via relay inputs.

19. Power (Relay) Packs and Supplies shall be the following Sensor Switch model Series:

   - nPP16 (Power Pack w/ 16A relay)
   - nPP16 WIFI (Power Pack w/ 16A relay, WiFi enabled)
   - nEPP5 D (Power Pack w/ 5A relay and 0-10VDC dimming output)
   - nSP16 (Secondary Pack w/ 16A relay)
   - nSP5 2P (Secondary Pack w/ two 5A relays)
   - nSP5 D (Secondary Pack w/ 5A relay and 0-10VDC dimming output)
   - nPP16 ER (UL924 Listed Secondary Pack w/ 16A relay for switching emergency power circuits)
   - nSP5 D ER (UL924 Listed Secondary Pack w/ 5A relay and 0-10VDC dimming output for switching emergency power circuits)
   - nSP5 PCD 2W (Secondary Pack w/ 5A relay and incandescent dimming or 2-wire line voltage fluorescent dimming output)
   - nSP5 PCD 3W (Secondary Pack w/ 5A relay and 3-wire line voltage fluorescent dimming output)
   - nSP5 PCD MLV (Secondary Pack w/ 5A relay and magnetic low voltage dimming output)
   - nSP5 PCD ELV 120 (Secondary Pack w/ 4A relay and electronic low voltage dimming output)
   - nSP5 480 (Secondary Pack w/ 5A relay for switching 208/240/480 VAC loads)
   - nSP5 2P LVR (Louver/Damper Control Pack)
   - nSHADE (Pulse On/Off Control Pack)
   - nPS 80 (Auxiliary Bus Power Supply)
   - nPS 80 WIFI (Auxiliary Bus Power Supply, WiFi enabled)
   - nAR 40 (Low voltage auxiliary relay pack)
E. Networked System Relay and Dimming Panels.
1. Panel shall incorporate up to four (4) normally closed latching relays capable of switching 120/277 VAC or up to two (2) Dual Phase relays capable of switching 208/240/480 VAC loads.
2. Relays shall be rated to switch up to a 30A ballast load at 277 VAC.
3. Panel shall provide one (1) 0-10VDC dimming output paired with each relay.
4. Panel shall power itself from an integrated 120/277 VAC supply.
5. Panel shall be capable of operating as either two (2) networked devices or as one.
6. Panel shall supply current limited low voltage power to other networked devices connected via CAT-5.
7. Panel shall provide auxiliary low voltage device power connected wired directly to a dedicated terminal connection.
8. Power (Relay) Packs and Supplies shall be the following Sensor Switch model numbers:
   - nPANEL 4 (Panel w/ four (4) 120/277 VAC relays and four (4) 0-10 VDC dimming outputs)
   - nPANEL 2 480 (Panel w/ two (2) dual phase relays (208/240/480 VAC) and two (2) 0-10 VDC dimming outputs)

F. Networked Auxiliary Input / Output (I/O) Devices
1. Devices shall be plenum rated and be inline wired, screw mountable, or have an extended chase nipple for mounting to a ½-inch knockout.
2. Devices shall have two (2) RJ-45 ports.
3. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
4. Specific I/O devices shall have a dimming control output that can control 0-10 VDC dimmable ballasts or LED drivers by sinking up to 20 mA of current (typically forty (40) or more ballasts).
5. Specific I/O devices shall have an input that read a 0-10 VDC signal from an external device.
6. Specific I/O devices shall have a switch input that can interface with either a maintained or momentary switch and run a switch event, run a local/remote control profile, or raise/lower a dimming output.
7. Specific I/O devices shall sense state of low voltage outdoor photocells.
8. Specific I/O devices shall enable RS-232 communication between lighting control system and Touch Screen based A/V control systems.
9. Specific I/O devices shall sense.
10. Auxiliary Input/Output Devices shall be the following Sensor Switch model numbers:
    - nIO D (I/O device with 0-10 dimming output)
    - nIO 1S or nIO RLX (I/O device with contact closure or 0-10VDC dimming input)
    - nIO NLI (Input device for detecting state of low voltage outdoor photocell; sold in nIO PC KIT only)
    - nIO X (Interface device for communicating with RS-232 enabled AV Touch Screens)

G. Networked LED Luminaires
1. Networked LED luminaire shall have a mechanically integrated control device.
2. Networked LED luminaire shall have two RJ-45 ports.
3. Networked LED luminaire shall be able to digitally network directly to other network control devices (sensors, photocells, switches, dimmers).
4. Networked LED luminaire shall provide low voltage power to other networked control devices.
5. System shall be able to turn on/off LED luminaire without using a relay.
6. System shall be able to maintain constant lumen output over the specified life of the LED luminaire (also called lumen compensation) by varying the input control power (and thus saving up to 20% power usage).
7. System shall indicate (via a blink warning) when the LED luminaire has reached its expected life (in hours).
8. LED Luminaires shall be the following Lithonia model families:
   RTLED
   TLED
   VLED
   ACLED
   AL LED
   WLED
   STLED
   MINO

H. Networked System Wall Switches and Dimmers
1. Devices shall recess into single-gang switch box and fit a standard GFI opening.
2. Devices shall be available with zero or one (1) integrated Class 1 switching relay.
3. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
4. All sensors shall have two (2) RJ-45 ports.
5. All devices shall provide toggle switch control. Dimming control and low temperature/high humidity operation are available options.
6. Devices shall be available in four (4) colors (Ivory, White, Light Almond, and Gray).
7. Devices with dimming control outputs can control 0-10 VDC dimmable ballasts by sinking up to 20 mA of current (typically forty (40) or more ballasts).
8. Devices with capacitive touch buttons shall provide audible user feedback with different sounds for on/off, raise/lower, start-up, and communication offline.
9. Devices with mechanical push-buttons shall provide tactile and LED user feedback.
10. Devices with mechanical push-buttons shall be made available with custom button labeling.
11. Devices with a single on button shall be capable of selecting all possible lighting combinations for a bi-level lighting zone such that the user confusion as to which of two (2) buttons (as is present in multi-button scenarios) controls which load is eliminated.
12. Wall switches and dimmers shall be the following Sensor Switch model numbers, with device options as specified:
    nPOD (single on/off, capacitive touch, audible user feedback)
    nPOD 2P (dual on/off, capacitive touch, audible user feedback)
    nPODOR (single on/off, one relay, capacitive touch, audible user feedback)
    nPODM (single on/off, push-buttons, LED user feedback)
    nPODM 2P (dual on/off, push-buttons, LED user feedback)
    nPODM DX (single on/off, single dimming raise/lower, push-buttons, LED user feedback)
    nPODM 2P DX (dual on/off, dual dimming raise/lower, push-buttons, LED user feedback)
I. Networked System Graphic Wall Station
1. Device shall have a 3.5-inches full color touch screen for selecting up to eight (8) programmable lighting control presets or acting as up to sixteen (16) on/off/ dim control switches.
2. Device shall enable configuration of lighting presets, switched, and dimmers via password protected setup screens.
3. Device shall enable user supplied .jpg screen saver image to be uploaded.
4. Device shall surface mount to single-gang switch box.
5. Device shall have a micro-USB style connector for local computer connectivity.
6. Device shall have two RJ-45 ports for communication.
7. Device shall be the following Sensor Switch model number:
   nPOD GFX

J. Networked System Scene Controllers
1. Device shall have two (2) to four (4) buttons for selecting programmable lighting control profiles or acting as on/off switches.
2. Device shall recess into single-gang switch box and fit a standard GFI opening.
3. Devices shall provide LED user feedback.
4. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
5. All sensors shall have two (2) RJ-45 ports.
6. Device shall be capable of reprogramming other devices in its zone so as to implement user selected lighting scene.
7. Device shall be capable of selecting a lighting profile be run by the system’s upstream Gateway so as to implement selected lighting profile across multiple zones (and not just its local zone).
8. Device shall have LEDs indicating current selection.
9. Scene Selector device shall be the following Sensor Switch model number:
   nPODM 2S (2 Scene, push-button)
   nPODM 4S (4 Scene, push-button)
   nPODM 4S DX (4 Scene, push-button, On/Off/Raise/Lower)
   nPODM 4L DX (4 Adjustable Presets, push-button, On/Off/Raise/Lower)

K. Communication Bridges
1. Device shall surface mount to a standard 4-inches x 4-inches square junction box.
2. Device shall have 8 RJ-45 ports.
3. Device shall be capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to Control Gateway.
4. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply or delivered via a CAT-5 cabled connection.
5. Device shall be careful of redistributing power from its local supply and connect lighting control zones with excess power to lighting control zones with insufficient local power. This Architecture also enables loss of power to a particular area to be less impactful on network lighting control system.
6. Communication Bridge devices shall be the following Sensor Switch model numbers:
   nBRG 8 (8 Ports)
2.04 LIGHTING CONTROL PROFILES

A. Changes to the operation of the system shall be capable of being made in real-time or scheduled via lighting control profiles. These profiles are outlines of settings that direct how a collection of devices function for a defined time period.

B. Lighting control profiles shall be capable of being created and applied to a single device, zone of devices, or customized group of zones.

C. All relays and dimming outputs shall be capable of being scheduled to track or ignore information regarding occupancy, daylight, and local user switches via lighting control profiles.

D. Every device parameter (e.g. sensor time delay and photocell set-point) shall be configurable via a lighting control profile.

E. All lighting control profiles shall be stored on the network control gateway device and on the software’s host server.

F. Lighting control profiles shall be capable of being scheduled to run according to the following calendar options: start date/hour/minute, end date/hour/minute, and sunrise/sunset +/- timed offsets.

G. Sunrise/sunset times shall be automatically derived from location information using an astronomical clock.

H. Daylight savings time adjustments shall be capable of being performed automatically, if desired.

I. Lighting control profile schedules shall be capable of being given the following recurrence settings: daily, weekday, weekend, weekly, monthly, and yearly.

J. Software shall provide a graphical tool for easily viewing scheduled lighting control profiles.

2.05 MANAGEMENT SOFTWARE

A. Every device parameter (e.g. sensor time delay and photocell set-point) shall be available and configurable remotely from the software.

B. The following status monitoring information shall be made available from the software for all devices for which it is applicable: current occupancy status, current PIR Status, current Microphonics Status, remaining occupancy time delay(s), current photocell reading, current photocell inhibiting state, photocell transitions time remaining, current dim level, device temperature, and device relay state(s).

C. The following device identification information shall be made available from the software: model number, model description, serial number, manufacturing date code, custom label(s), and parent network device.

D. A printable network inventory report shall be available via the software.

E. A printable report detailing all system profiles shall be available via the software.

F. Software shall require all users to login with a User Name and Password.
G. Software shall provide at least three permission levels for users.

H. All sensitive stored information and privileged communication by the software shall be encrypted.

I. All device firmware and system software updates must be available for automatic download and installation via the internet.

J. Software shall be capable of managing systems interconnected via a WAN (wide area network).

2.06 BMS COMPATIBILITY

A. System shall provide a BACnet IP gateway as a downloadable software plug-in to its management software. No additional hardware shall be required.

B. BACnet IP gateway software shall communicate information gathered by networked system to other building management systems.

C. BACnet IP gateway software shall translate and forward lighting relay and other select control commands from BMS system to networked control devices.

2.07 SYSTEM ENERGY ANALYSIS AND REPORTING SOFTWARE

A. System shall be capable of reporting lighting system events and performance data back to the management software for display and analysis.

B. Intuitive graphical screens shall be displayed in order to facilitate simple viewing of system energy performance.

C. An "Energy Scorecard" shall be displayed that shows calculated energy savings in dollars, KWHr, or CO₂.

D. Software shall calculate the allocation of energy savings to different control measures (occupancy sensors, photocells, manual switching, etc.).

E. Energy savings data shall be calculated for the system as a whole or for individual zones.

F. A time scaled graph showing all relay transitions shall be presented.

G. A time scaled graph showing a zones occupancy time delay shall be presented.

H. A time scaled graph showing the total light level shall be presented.

I. User shall be able to customize the baseline run-time hours for a space.

J. User shall be able to customize up to four (4) time-of-day billing rates and schedules.

K. Data shall be made available via a .CSV file.

2.08 START-UP AND SUPPORT FEATURES

A. To facilitate start-up, all devices daisy-chained together (using CAT-5) shall automatically be grouped together into a functional lighting control zone.
B. All lighting control zones shall be able to function according to default settings once adequate power is applied and before any system software is installed.

C. Once software is installed, system shall be able to auto-discover all system devices without requiring any commissioning.

D. All system devices shall be capable of being given user defined names.

E. All devices within the network shall be able to have their firmware reprogrammed remotely and without being physically uninstalled for purposes of upgrading functionality at a later date.

F. All sensor devices shall have the ability to detect improper communication wiring and blink it's LED in a specific cadence as to alert installation/startup personnel.
SECTION 26 1005

POWER DISTRIBUTION (OVER 600 VOLTS)

PART 1 - GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
   2. General provisions and requirements for electrical work.

B. Additional Requirements for Conductors and Raceways of Circuits Greater than 600 volts.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Submit Product Data Sheets for all Wire, Conduit, Fittings, Splicing, and Terminating Materials.

B. Submit Material List for all Conduit and Fittings.

C. Perform Factory High Voltage AC and DC and Corona Level Conductor Tests per ICEA Standards on each length of cable. Submit Certified Reports of Factory Tests, together with all data necessary to determine that cable is as specified, including type of conductor, AWG size and stranding; type and thickness of insulation and jacket; type of shielding; insulation resistance constant corrected to standard temperature; voltage rating. Use standard ICEA terminology in reports.

D. Submit the AEIC Qualification Test Reports Data.

1.03 FACTORY TESTING

A. Final Testing on Shipping Reel
   Each completed length of conductor shall be subjected to a 1-minute AC test voltage prior to shipping after the conductor’s have been placed on the shipping reels. AC test voltage shall be 25kV for 5/8kV insulated conductors and 34kV for 15kV insulated conductors.

B. Conductors, which fail the specified Factory Tests, are unacceptable and shall not be used. Submit eight (8) copies of Factory Test Reports for review. Conductors shall not be installed until the ARCHITECT has reviewed the Factory Test Reports.
PART 2 - PRODUCTS

2.01 CONDUCTORS

A. General
1. Cables conductor sizes and quantity as indicated on Drawings.
2. Cable shall be in compliance with the latest applicable requirements of UL, OSHA, NEMA, NEC, ASTM, AEIC and ICEA for installations indicated.
3. All cable must have been manufactured within 1-year of award of Contract. As manufactured by Okonite "Okoguard-Okoseal"; or Prysmian Cable Systems; or Kerite Company.
4. The following minimum information shall be factory imprinted on the cable jacket, a minimum of 36-inches on center.
   a. Manufacturers name.
   b. Insulation type and voltage level.
   c. Date of manufacture.
   d. Conductor size and material.
   e. Jacket type.
5. Cable shall be shipped and stored on cable reels and cable ends shall be sealed watertight at all times. Cables not so shipped, stored and sealed shall be rejected.
6. The cable shall be rated 105 degrees C for normal operation, 140 degrees C for emergency overload operation, and 250 degrees C for short circuit conditions.
7. UL listed as type MV-105 per UL-1072.
8. Jacket shall be oil resistant, complying with “Oil Resistant-1” and “Oil Resistant-2” UL 1072.

B. Power Cable Construction (Phase to Phase System Operating, Voltage, 2000 volt thru 5000 volt.)
2. Conductor Strand Screen – continuous extruded layer over the conductor per ICEA S-68-516, AEIC CS-6, NEMA WC-8, and UL-1072.
3. Insulation – continuous Ethylene Propylene Rubber (EPR). 115 mil for 8 KV 100% insulation level, 5KV 133% insulation levels. Extruded over and bonded to conductor strand screen meeting or exceeding ICEA S-68-516, NEMA WC-8, AEIC CS-6, and UL 1072.
4. Insulating Screen – continuous, extruded, semi-conducting screen over the insulation meeting or exceeding ICEA S-68-516, AEIC CS-6 and UL-1072.
5. Shield – 5-mil copper tape shield applied with not less than a 12.5% overlap and full 100% coverage over insulation screen. Per UL-1072, ICEA S-68-516, and NEMA WC-8 (shield shall be omitted on cable utilized as a neutral conductor).
6. Jacket – non-metallic black sunlight resistant PVC (polyvinylchloride) extruded over shield, per ICEA S-68-516, NEMA WC-8, and UL-1072.

C. Power Cables Construction (Phase to Phase System Operating Voltage 5001 volt thru 13000 volt).
2. Conductor strand screen - continuous extruded layer over conductor per ICEA S-68-516, AEIC CS-6, NEMA WC-8, and UL-1072.
3. Insulation - continuous Ethylene Propylene Rubber (EPR). 220 MIL for 15KV, 133% insulation levels. Extruded over and bonded to conductor strandscreen meeting or exceeding ICEA S-68-516, NEMA WC-8 AEIC CS-6, and UL-1072.

4. Insulating screen - continuous, extruded, semi-conducting screen over the insulation meeting or exceeding ICEA S-68-516, AEIC CS-6, and UL-1072.

5. Shield - 5-mil copper tape shield applied with not less than a minimum of 12.5% overlap and 100% coverage over insulation screen. Per UL 1072, ICEA S-68-516, NEMA WC-8.

6. Jacket - non-metallic black sunlight resistant PVC (polyvinylchloride) extruded over shield, per ICEA S-68-516, NEMA WC-8, and UL-1072.

2.02 CONDUCTOR SPLICING AND TERMINATIONS

A. General

1. All material used shall be compatible with specific cable installed and shall be rated for 90 degrees centigrade normal operation, 130 degrees centigrade emergency overload operation, and 250 degrees centigrade for short circuit conditions.

2. Shall be in compliance with Manufacturer's standard recommendations.

3. Splices and terminations shall meet Class-1 requirements.

4. The splices and terminations shall match and be compatible with the respective cable type, insulation, shielding and jacket.

5. Ground cable shield at each splice and termination.

B. Splices - (Built-Up Tape Type, for PVC Jacket Cables)

1. General

   a. Conductors shall be joined by "T" type, "Y"-type or inline (as applicable) compression, tinned copper sleeves connectors, installed with hydraulic "die" compression tool. Sleeves shall have chamfered ends, and cable stops to properly center on conductor. Ampacity equal to conductor. 3M- "Scotchlok", Burndy-"144 splice".

2. Built-up tape type for PVC jacket cables

   a. Individual splices shall be hand laid built-up self-vulcanizing, insulating tape, with stress relief. Splice kits as manufacturing by Kerite, 3M or Plymouth.

3. Polymeric cable splices kits:

   a. Heat shrink or mechanical preshrink (cold shrink) uniform cross section, with linear stress relief and dielectric insulating layers; metallic shielding across splice with ground lead out; overall jacket sleeve.

   b. Comply with IEEE 48 and 404; seal environmental to provide ANSI C119.2 water immersion test, latest revisions.

   c. Outdoor weather tight construction, anti-tracking ultraviolet solar radiation overall jacket protection. As manufactured by Raychem or 3M.

C. Terminations (Indoor built-up tape type, or polymeric termination kit for PVC jacket cables where cable terminator is not specified with equipment).

1. General

   a. Conductor shall be terminated with compression tinned copper seamless, barrel terminal lugs installed with hydraulic "die" compression tool. Terminal lug shall be 4-bolt spade lug type for bus connections or stud type for other locations. Burndy- "Hylug" or 3M- "Scotchlok".
2. Individual cable terminations shall be hand laid, built-up self-vulcanizing insulating tape with stress relief. Termination kits as manufactured by Kerite, 3M or Plymouth.

3. Polymeric cable termination kits:
   a. The incoming line feeders shall be provided with premolded insulated primary conductor termination kits. The termination kits shall conform properly to compatible with the conductors shown on the Drawings, including out of round cables as defined on AEIC and ICEA heat shrink or mechanical preshrink. The termination shall environmentally seal the cable jacket. Stress relief and feeder insulation shield grounding. Provide anti-tracking skirts on terminations.
   b. Provide 4-bolt copper spade lug cable connector compression connectors, and bolt each termination to respective phase lug landings. Grade 5 Hex head bolts and Belleville washers. As manufactured by 3M or Raychem.

4. Terminations shall comply with IEEE-48- (latest revision) Class 1 conductor terminations shall all be 15kV Class:
   a. AC withstand input (kV) ................................................. 50
   b. DC withstands, 15-minute (kV) ...................................... 75
   c. Partial discharge, minimum kV for 3pC or less ............... 15.6
   d. BIL basic impulse withstand ........................................... 1.2 x 50 micro seconds crest 1.2 x 50 micro seconds crest kV (outdoor) 110
   e. BIL basic impulse withstand 1.2 x 50 micro seconds crest kV (indoor) .......................................................... 95
   f. Continuous current rating (normal, overload, emergency) ................................................. equal to connected cable
   g. Nominal overall length (inch) ....................................... 15.5
   h. Wet withstand, 10 seconds (kV rms) ............................. 45
   i. Dry withstand, 6 hours (kV rms) ................................. 35
   j. To match connected cable and type.

5. Provide a minimum of two conductor cable landings for each incoming line phase termination.

6. Provide removable, electrically insulated, "boots" to completely cover each termination connection bolted lug landing and bus connection.

7. Primary cable supports shall be provided to eliminate any strain on cable terminations.

2.03 SEPARABLE INSULATED CONNECTOR, ELBOW CABLE TERMINATORS AND APPARATUS BUSHING WELLS

A. General
   1. Separable insulated connector system cable terminators shall be non-load break, molded thermoplastic and molded rubber 200 amp for wire sizes smaller than 4/0 AWG, 600 Ampere for wire sizes 4/0 AWG and larger, unless noted otherwise on Drawings.
      a. De-energized dead-break bolted connect, unless noted otherwise on Drawings.

2. Assemblies shall be rated for continuous submersion in 10 feet of water.

3. Provide terminators to accommodate the connecting feeder cable type and size.

4. Insulated, shielded, dead front, safety plug, one for each cable phase, complying with ANSI C119 and 386 latest revision. Shall be designed, manufactured, and tested to comply with IEEE-386 and IEEE-592 latest revisions. Suitable for “insulated-hook-stick” insertion and removal.
5. Elbows and apparatus bushing wells shall be mechanically and electrically compatible. Shall be inter-changeable operation between multiple Manufacturers.
6. Provide “parking” stands for each termination and phase, in each location.
7. As manufactured by G & W Electric; or Elastimold/Thomas & Betts.

B. Electrical Ratings

<table>
<thead>
<tr>
<th>System Voltage</th>
<th>System Voltage</th>
<th>above 4160 volt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical Ratings</td>
<td>2400V or 4160V</td>
<td>to 13000 volt</td>
</tr>
<tr>
<td>1. Line to ground rating</td>
<td>8.3kV</td>
<td>15.2kV-RMS</td>
</tr>
<tr>
<td>2. Impulse withstands voltage BIL.</td>
<td>95kV-RMS</td>
<td>125kV</td>
</tr>
<tr>
<td>3. Withstand voltage, 60Hz AC</td>
<td>34kV-RMS</td>
<td>40kV-RMS</td>
</tr>
<tr>
<td>4. Withstand voltage D.C. 15 minute</td>
<td>53kV D.C.</td>
<td>78kV D.C.</td>
</tr>
<tr>
<td>5. Corona Extinction</td>
<td>11kV D.C.</td>
<td>19kV D.C.</td>
</tr>
<tr>
<td>6. 200 amp elbow - momentary withstand for 10Hz</td>
<td>10,000AMP-Sym.</td>
<td>10,000AMP-SYM</td>
</tr>
<tr>
<td>7. 600 amp elbow – momentary withstand for 10Hz</td>
<td>18,000 Sym.</td>
<td>18,000 Sym.</td>
</tr>
<tr>
<td>8. Continuous load current</td>
<td>200AMP-RMS (600 AMP-RMS)</td>
<td>200AMP-RMS (600 AMP-RMS)</td>
</tr>
</tbody>
</table>

C. Elbow Connector Test Point
1. Each elbow shall be provided with front accessible capacitive coupled test point.
2. The test point shall include a protective, removable, voltage insulated, snap-in cap to provide test point access.

D. Fault Indicator
1. Provide a fully automatic, capacitance coupled electrical, visual fault indicator installed in each test point.
2. Self-powered through capacitive coupling when installed in the elbow test point.
3. The fault current indicator pick-up current and operating speed shall be selected based on upstream relay/fuse types and settings, for correct fault indicates. Additionally, it shall prevent false fault-indication caused by normal motor, transformer and conductor charging in rush (turn-on) currents.

E. Multi-Point-Junctions
1. Shall distribute primary voltage multiple circuit taps for separable elbow-connectors. Modular, premolded, insulated, with internal 600 ampere single phase copper distribution bus.
2. Provide quantity of multiport connector ports on each junction for multiple insulated separable elbow connector attachments, plus spares. Electrical characteristics and insulation characteristics shall match the elbow connectors.
3. Fully shielded and fully insulated and fully submersible in water when energized.
4. 304 – stainless steel surface mounting brackets with ground lug. Provide two (2) integral (left-right) “parking” stands for elbow connectors.
5. Provide bushing inserts for electrical and mechanical compatibility with respective elbow connectors.
6. Provide not less than three (3) multi-point-junction assemblies at each location; Phase-A, Phase-B, and Phase-C. Provide not less than two (2) additional spare connection ports on each multi-point-junction assembly for future use.
7. Interface spacing between ports shall be uniform and compatible with respective elbow connectors.

2.04 CONDUIT (ADDITIONAL REQUIREMENTS)

A. Aluminum Conduit, Flexible Metal or Non-metal Conduit and Electrical Metallic Tubing shall not be used.

B. Rigid Galvanized Steel Conduit shall be used for all exposed and concealed conduit above grade and for bends and risers below grade.

C. Nonmetallic Conduits Schedule 40 PVC or type "EB" shall be used for all ducts below grade, and shall be completely concrete encased in a 3-inch concrete envelope the entire length, including below building slabs.

D. Bury Underground Conduit a minimum of 36 inches to top of concrete encasement below final finish grade, including under building slabs.

E. Provide End Bells on All Conduit Terminations.

F. Condulets shall not be used.

G. Provide Molded, Snap Together, Conduit Support Spacers a minimum of 5-feet on center in all underground multiple conduit installations. The spacing between conduits located below grade shall be as follows:
   1. Two inches between conduits for circuits operating above 600 volts.
   2. Six inches between conduits for circuits operating above 600 volts and conduits for circuit operating below 600 volts.
   3. Twelve inches from conduits for any Utility Company circuits and pipes.

2.05 FIREPROOFING

A. The Cable Fireproofing shall consist of a hand applied flexible tape, conformable fabric coated with flame retardant and separate securing tape wrap. As manufactured by 3M or Plymouth.

B. The Tape shall be a flexible polymeric coating and/or chlorinated elastomer not less than 0.03 inch thick, weighing not less than 2.5 pounds per square yard.

C. The Tape shall be non-corrosive to the cable jacket.

D. The Tape shall be self-extinguishing shall not support combustion, and shall withstand high current fault ARC temperatures of 13000 degrees Kelvin for 70Hz.

E. The Tape shall not deteriorate when subjected to oil, water, salt water, sewage and fungus.

PART 3 - EXECUTION

3.01 CONDUCTORS IN RACEWAYS

A. Conduit Preparation
   1. Metallic conduit shall be reamed and cleaned to remove metal cuttings, fillings and cutting oil.
2. Rod all underground raceways, including existing raceways to be used under this Contract, with approved test and flexible mandrels to remove all obstructions. Use test mandrels at least 12-inches long, ¼-inch less than diameter of duct at center, tapering to ½-inch less than duct size at ends. Do all cleaning and testing in the presence of OWNER'S Representative.

3. If test mandrels cannot be pulled through Raceways CONTRACTOR shall perform the following to clear the raceways.
   a. Force rigid or semi-rigid rods through the raceways to clear the obstructions from one or both ends of the raceway.
   b. Force a power driven rotating router device with small diameter cutting blades, in incremental stages to a cutting blade diameter approximately ⅛-inch smaller than the raceway inside diameter.
After clearing the raceway of obstructions pull a test mandrel or brush through the raceway to clear the remaining debris from the raceway.

B. Cable Lubrication:
   1. Cable pulling lubricants shall be specifically approved by the Cable Manufacturer. The following lubricants shall be used where approved by the Cable Manufacturer.
      a. Slip X-300, American Colloid Co.
      b. Bishop #45, Bishop Electric.
      c. MacLube CA51, MacProducts.
      d. Minerallac H2B, Minerallac Electric.
      e. Winter grade #7437-PC, General Machine Products.
      f. Gel-lube 7/5, Cable associates.
   2. Lubricants shall be continuously applied as cable enters raceway.

C. Pulling Tensions "EPR" Insulation PVC Jacket, Copper Conductors.
   1. The maximum pulling-in tensions and stresses on the cable must not exceed the undermentioned values when pulling the cable.
      a. The maximum pulling stress in pounds (tension), shall not exceed 0.008 times the CM (Circular Mil) area of the conductor when pulled with a pulling eye attached directly to each copper conductors, (i.e. (500,000 MCM) x (.008) = 4000 pounds).
      b. The maximum pulling stress shall not exceed 1000 pounds for non-leaded cables when pulled with a Kellums or Greenlee type basket grip on each conductor but in any case shall not exceed item (a) above.
      c. The cable sidewall pressure shall be defined as the pulling tension on the cable out of a bend, expressed in pounds divided by the radius of bend expressed in feet. The maximum cable side wall pressure (pulling tension) in pounds shall not exceed 400 times the raceway bend radius in feet. But in any case shall not exceed 'a' and 'b' above (i.e. (4 feet conduit radius) x (400) = 1600 pounds maximum pulling tension at the 4 feet conduit bend).
      d. Pulling tension calculations shall be submitted to ENGINEER prior to pulling any cable, for each cable run in excess of 100 feet and/or 180 degrees in bends. Similar runs need not be recalculated (i.e. same quantity and type of bends and/or length).
   2. A dynamometer to measure pulling tension shall be used on all cable runs in excess 200 feet or with more than 180 degrees in bends. The actual pulling tension value shall be calculated and recorded for each pull.
   3. Pulling eyes on each conductor shall be used for cable runs in excess of 100 feet or more than 180 degrees in bends, between pull points.
D. The Minimum Radii to which the installed cables can be bent for safe electrical operation and without danger of physical damage to the cable insulation, metallic shielding tapes, and/or outer jacketing materials shall not be less than 12 times the diameter over the finished cable jacket. Bends shall not be made in splices or terminations.

E. Installation

1. Do not pull conductors until factory test reports have been submitted and reviewed.
2. The attachment of the pulling device to the conductor pulling eyes or basket grips shall be made through a swivel connector.
3. The attachment of pulling devices directly to the cables shall be with individual basket grips over each cable jacket or individual pulling eyes attached directly to each cable conductor. Securely tape cable ends to prevent moisture or pulling compound from penetrating cable.
4. The CONTRACTOR shall ensure that the high voltage cables are fed straight into the raceway taking care to avoid short bends, sharp edges and cable "cross-overs".
5. All lashings used for temporary bunching of the individual cables shall be removed before the cables enter the raceway. Leadout the cables at all manholes, pullboxes and conduits taking care to feed them in again by hand for the next run. Cables shall not be pulled directly around a short right angle bend.
6. For each cable pull where a cable direction change is required flexible feed-in tubes, pullout devices, multi-segmented sheaves etc. shall be used to insure proper cable pulling tensions and side wall pressures. Any device or surface the cable comes in contact with when under pull-in tension shall have a minimum radius 50% greater than the final specified minimum installed cable-bending radius. The maximum possible size radius sheaves and feed-in tubes, usable in the available working space, shall be provided in all situations, to insure the minimum possible cable sidewall pulling pressure. Do not use devices with multi-segment "roller" type sheaves.
7. Cable lengths over 50 feet shall be machine pulled not hand pulled. Cables shall be pulled in a continuous, smooth operation without jerking or stop-start motion after initiation of pull. Maximum cable pulling speed shall be less than 50 feet per minute. Minimum cable pulling speed shall be greater than 15 feet per minute.
8. Cables shall be pulled straight into or out of the raceway without bends at the raceway entrance or exit. Pull in cable from the end having the sharpest bend (i.e., bend shall be closest to reel). Keep pulling tension to minimum by liberal use of lubricant, hand turning of reel, and slack feeding of cable into duct entrance. Employ not less than one man at reel and one at manhole or pullhole during this operation. Cables shall be pulled directly from cable reels.
9. Cables shall be trained or racked in trenches, vaults, manholes and pull boxes with consideration given for the minimum specified bending radius of the cable and the possibility of cable movements due to load cycling. The cables shall be racked and supported in such a manner that adequate space is allowed for splicing and the cables shall always be fanned out from the duct or conduit so as not to cross other ducts conduits or cables. To prevent damage from falling objects or personnel entering the manhole the cables shall not pass directly under the manhole opening.
10. Cable shall be supported in manholes; pull boxes and vaults a minimum of 18-inches on center with cable racks. Provide hot dip galvanized, T-slot racks and
support arms. Secure cables to racks with porcelain supports for each cable on the racks. Loosely lash cables to racks. Splices shall be directly supported, on racks. Do not install cables more than one feeder on the same rack hook.

11. Cables shall be routed the long way around manhole, pullhole, etc. unless noted otherwise.

12. Existing conductors shall be protected at all times when Contract Work occurs in the same area, including but not limited to pullboxes, vaults manholes, cable trenches etc. Provide temporary electrical insulating blankets and barriers over existing conductors to reduce the possibility of accidental mechanical damage to existing conductors.

F. Movement, Storage, and Handling of Cable

1. Reels of cable shall not be dropped from any height, from trucks or other transporting equipment.

2. Lift and move cable reels using following methods:
   a. Crane or boom type equipment-insert shaft (heavy rod or pipe) through reel hubs and lift with slings on shaft, with spreader or yoke to reduce or avoid sling pressure against reel head.
   b. Forklift type of equipment may be used to move smaller, narrower width reels. Fork times should be placed so that lift pressure is on reel heads, not on cable, and shall reach all the way across reels so lift is against both reel heads.
   c. Reels may be moved short distances by rolling. Reels shall be rolled in the direction indicated by arrows painted on reel heads. Surfaces over which the reels are to be rolled shall be solid clear or debris, and also clear of protruding stones, humps, etc. which might damage the cable if the reel straddles them.

3. Storage of Reels of Cable
   a. Cable ends shall be sealed prior to shipment to prevent moisture entry into cable. Cable ends shall remain sealed at all times including during installation. Where ends seals are removed, reseal cable ends by stripping cable finishes back 2-inches down to insulation. Then apply four layers of an insulating tape criss-cross over the cable end and carry back at least 4-inches onto cable outer finish. Add a containing cover of two layers of vinyl electrical tape completely over the end seal.
   b. Cable reels shall be shipped with factory applied lagging (protective cover) left in place until removal is absolutely necessary. Additional covering such as tarpaulin, plastic sheeting, etc. shall be used if cable is to be stored outdoors.
   c. Store reels of cable on a firm surface, paved, or on planking to prevent settling into soft ground.
   d. Use fencing or other barriers to protect cables and reels against damage by vehicles or other equipment moving about in the storage area.

G. Cable Testing

1. CONTRACTOR shall have an independent Testing Laboratory perform a high voltage DC acceptance test on each phase or leg of cables in accordance with ICEA Standards S-19-81, latest revision. Certified Test Reports shall be submitted to ENGINEER in the form of time versus current graph showing initial leakage current after test voltage is applied and for each 15 second interval up to 1-minute and for each one minute interval thereafter. Each graph shall be identified to correspond with the Cable Section and feeder name.
Information on temperature, humidity and type of test equipment used during test shall also be submitted.

2. Cables shall be tested as follows:
   a. Each segment and phase shall be tested after installation and prior to splicing or terminating to other equipment or cables.
   b. Each conductor feeder and phase shall be tested after splicing to other new cables is completed, and prior to connection to equipment or other existing cables.
   c. Do not perform D.C. high voltage cable acceptance test into existing conductors, new or existing equipment, connected to the cables being tested.

3. Certified Factory Test Reports performed in accordance with ICEA S-19-81, Tables 2-12 and 6-17. Corona and AC/DC Tests shall be submitted with Shop Drawings for the specific cable to be installed.

4. Field test procedure:
   a. Set up test equipment. Do not connect test lead to cables, but temporarily hang the lead free with a plastic bag over the clip. Raise the voltage to the same final level as the cables test voltage. The leakage current seen on the DC meter is leakage in the test lead, and shall be subtracted from the readings taken later during the cable test. Shut the set off and discharge the lead.
   b. Apply the test voltage to each phase separately, making sure that all other phases, all cable shields, any armoring or neutral conductors, and other nearby metallic objects are grounded to prevent voltage pick-up.
   c. Raise the test voltage from zero gradually in 10% steps to 80% of the final test voltage, then in 5% steps to final test voltage, which shall be left on for 5 minutes. Take current readings at each step after current has been stabilized approximately one-minute intervals. Take current reading each minute period. Record each step voltage/current and time interval. Plot readings on graph paper.
   d. During the test if a breakdown is indicated by a sudden or continuous increase in current, de-energize, disconnect and isolate the trouble. Remedy problem, completely disassemble and redo any defective cable terminations or splices. Retest cable, if breakdown is again indicated, remove, discard and replace defective cable and retest replacement cable. Defective cable shall be removed from site and shall not be reused.
   e. Upon completion of a successful test, shut down the test set and allow the voltage to decay to one-fourth the full value. Record the decay time.
   f. Solidly ground the conductor and allow the ground to remain in place for a period at least as long as the test time.
   g. Repeat the same test sequence for each phase cable and cable section.
   h. Proper precautions shall be taken to eliminate "end corona" during the test procedure. The leakage currents and the voltage decay times should be fairly similar for the individual phases of the same cable circuit. Also, a graphic plot of the current versus voltage values of the step-rise test should show a reasonably straight line (equal increments of current rise for equal increments of voltage increases), the current readings always being taken after the same duration of time (one minute) after reaching each voltage level. To insure proper testing procedures the CONTRACTOR shall do the following:
      1) The cable ends (or terminations) are clean and dry.
      2) The cable or terminal ends are as far away from surrounding structures as practical.
3) The creepage distance from conductor back to cable shield is at least 1" for each 5kV of test voltage (this applies to newly installed cable, which has not yet been terminated).
4) The irregularly shaped clip or connector where the test lead joins to the cable is wrapped with a few layers of plastic sheet to form a smooth tube to reduce corona.
5) The free ends of cable have a glass jar or plastic bag over the end to reduce corona.
   i. The final D.C. test voltages for shielded cable shall be 30kV for 5kV or 8kV cable and 56kV for 15kV cable.

3.02 ARC PROOFING (FIREPROOFING)

A. All Wires and Cables which will carry current at 600 volts or more in manholes, pullboxes, and vaults shall be fireproofed.

B. Strips of Fire Proofing Tape approximately 1/16 inch thick by 3 inches wide shall be wrapped tightly around cable spirally in wrapping. The tape shall be applied with the coated side toward the cable and shall extend one inch into the ducts. To prevent unraveling, the fireproofing tape shall be spirally "Half-Lap" wrapped the entire length of the cable.

C. Fire Proofing shall be applied separately on each individual conductor. Secure fireproofing with two (2) layers of spirally wrapped glass cloth electrical tape.

3.03 CABLE SPLICES AND TERMINATIONS

A. Cable Splicing and Terminations shall be performed by Personnel with a minimum of 5 years-qualified experience with specific splicing and termination methods used. Submit letter-certifying qualifications.

B. Each Conductor shall be spliced in each manhole and pullbox whether or not shown on the Drawings. No splices or terminations will be allowed in conduit or ducts.

C. Cable Shield shall be brought out and grounded at each splice and termination point to the equipment bond grounding system.

D. Splices (Built-Up Tape Type for PVC Jacket Cables)
   1. Cables shall be striped, tapered rasped with creepage distances per Manufacturer recommendations. Apply fill sealing putty on conductor compression sleeve indent and conductor, prior to beginning of splice taping.
   2. Conductor compression connectors shall be crimped with tools and specifically designed for the connector.
   3. Apply tape over conductor and connector sleeve.
   4. Apply splicing cement to rasped insulation and insulation screen.
   5. Apply insulating tape.
   6. Apply friction tape over insulation tape.
   7. Apply conducting fabric tape.
   8. Apply open spiral of tinned copper wire braid to carry shield continuity across the splice. Tack solders to 5-mil copper shield tape on each side of splice an additional single ground braid. Ground braid shall be brought out at splice, minimum 18-inches long and connected to ground bonding conductor, bind down braid with friction tape.
E. Terminations (indoor built-up) Tape Type, for PVC Jacket Cables where cable terminator is not specified with equipment).
   1. Cables shall be striped tapered, rasped with creepage distances per Manufacturer recommendations.
   2. Conductor compression connectors shall be crimped with tools and dies specifically designed for the connector.
   3. Tack solder to 5 mil copper shield tape, tinned copper shield tape, Bind down with friction tape. Bring out approximately 18-inches of ground braid and connect to ground bonding conductor.
   4. Apply sealing putty at tape shield/insulation joint and connector lug indents.
   5. Apply insulating tape.
   6. Apply friction and electrical tape.
   7. Make lug seal applying insulating tape, friction tape and electrical tape.
   8. Apply friction and electrical tape.

F. Polymeric Cable Splice Kits and Termination Kits
   1. Install in strict compliance with the Manufacturer instructions.

3.04 IDENTIFICATION (ADDITIONAL REQUIREMENTS)

A. Each Cable and Cable Tap shall be identified with nametags in manhole pullboxes, terminations and vaults.

B. Identification Tags shall include the following information:
   1. Feeder name as indicated on Drawings (i.e. HV1, F4, MSB3 etc.).
   2. Conductor phase (i.e. phase A, or phase B, or phase C, or neutral).
   3. Installation month and date (i.e. 3/85, 4/78 etc.).
   4. Conductor size conductor type (copper or aluminum) and insulation type (i.e. 4/0 CU-EPR, 500 AL VCL, etc.).
   5. Insulation voltage (i.e. 5kV, 8KV, 15kV, etc.).
   6. Feeder taps to equipment or building shall also be identified with equipment name or building (i.e. library, SW1, XMRA, etc.).

C. Tags shall be ⅛-inch thick 98% lead, approximately 2-inches square with chamfered corners. Two holes shall be drilled for attachment to primary cable. Lettering shall be ⅛-inch high, engraved or die stamped. Attach tags to primary cables with two (2) #14 AWG (THWN insulated) solid copper conductors "twist-tied", with insulated CAP wire-nut on the tie-wire ends, to cover sharp edges of tie-wire conductor.

D. Alternate Identification Tags, at the CONTRACTOR'S option in lieu of lead tags. Provide polypropylene tag holders with interchangeable, yellow polypropylene tags with black alphanumeric characters sets. Characters shall be a minimum of 0.25-inch high. As manufactured by Almetek industries "EZTAG" - Ledgewood, New Jersey, William Frick & Co. - Vernon Hills, ILL.

E. Hot-Phasing
   The CONTRACTOR shall perform and certify phase rotation testing on connections to existing/new circuits and equipment. Testing shall verify equipment and conductors are correctly "Hot-Phase" sequenced, to allow interconnecting and inter switching of any "Hot" circuits of like voltage with correct phase sequencing. The CONTRACTOR shall correct any phasing sequence found to be incorrect as a result of work performed by this Contract.
3.05 GROUNDING ADDITIONAL REQUIREMENTS

A. Raceways
   1. Provide all raceways and conduits containing circuits operating at line to line or line to ground voltages exceeding 600 volts with an internal dedicated equipment ground/bond wire, copper conductors, 600 volt insulation.
   2. Typical for metallic and non-metallic raceways and conduits.

B. Splices and Terminations
   1. Provide cable shield ground/bond lead out at each conductor splice and termination location. Extend and connect to respective equipment ground bus; each pull box/manhole respective ground rods and feeder ground conductors; etc.

END OF SECTION
120715/223015
SECTION 26 1105

SUBSTATION

PART 1 - GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:

1. Examine all other Specification Sections and Drawings for related work required to be included as work under Division 26.
2. General provisions and requirements for electrical work.

B. Scope (PCB Transformer Replacement)

1. Furnish and install transformer for the purpose of replacing existing PCB transformers. The furnished dry type transformer shall be fabricated in such a manner as to be realigned with the existing primary and secondary electrical equipment.
2. CONTRACTOR and Manufacturer's Engineering Representative shall be required to make site visit to ascertain critical dimensions for replacing PCB liquid or PCB contaminated transformers and to ensure proposed transformer replacement meets Local, State and NEC Codes working clearances.
3. Materials not normally furnished by the Manufacturer with the equipment shall be provided in accordance with other applicable Sections of these Specifications.
4. CONTRACTOR and Manufacturer shall be fully responsible to align new transformer into existing limited space including mating with existing primary and secondary switchgear and coordination to match existing bus and other termination using cables or insulated flexible links or bus connections.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Submit product data sheets for all wire, transformers, device plates, switches, lamps, circuit breakers, relays, cooling equipment, timeswitches, disconnects, fuses and meters.

B. Provide nameplate engraving schedule.

C. Submit Detailed Shop Drawings including Dimensioned Plans, elevations, details, interface details, schematic single line, point to point control wiring diagrams and descriptive literature for all component parts. Submit Scaled Plans and Elevation View Drawings.

D. Submit full-scale time/current transparencies on log/log paper for all fuses, circuit breakers, ground fault system devices, and relays. Additionally, provide software to generate time/current curves of each circuit protection device.

E. SHORT CIRCUIT, COORDINATION AND ARC-FLASH

1. Perform and submit Engineered Settings for each equipment location, fuse and adjustable circuit breaker device, showing the correct time and current settings.
to provide the selective coordination within the limits of the specified equipment, per the latest applicable standards of IEEE and ANSI. Provide electrical system short circuit fault analysis, both 3-phase line-to-line and 1-phase line-to-ground calculations as part of the Coordination Analysis recommendations. Provide Electric ARC-FLASH calculations as part of the Coordination Analysis recommendations.

2. The information shall be submitted in both tabular form and on time current log-log graph paper, with an engineering narrative. Written narrative describing data, assumptions, analysis of results and prioritized recommendations, six (6) copies.

3. The goal is to minimize an unexpected but necessary electrical system outage and personnel exposure to the smallest extent possible within the fault occurrence location, using the specified Contract Equipment. Shall comply with, but not limited to:
   b. IEEE-399, Recommended Practice for Industrial and Commercial Power System Analysis.
   d. CEC/NEC

4. Electrical equipment including switchgear, switchboards, electric panels, unit substations, motor control centers, combination motor starters, transformers, disconnects, etc., shall each be labeled by the Manufacturer with "Electric-ARC-FLASH" warning signs. The signs shall explain a hazard to personnel may exist if the equipment is worked on while energized or operated by personnel while energized. The sign shall instruct personnel to wear the correct Protective Equipment/clothing (PPE) when working “Live”, or operating “Live” electrical equipment and circuits.

F. Submit Transformer Test Reports.

G. Factory Tests: Equipment tests - ANSI C37.20. Certified copies of design tests, production tests, and conformance tests of the switchgear shall be submitted and review the Project Site. In lieu of the above tests, a report of these tests previously performed on identical units of each rating will be acceptable.

1.03 APPLICABLE STANDARDS

A. The equipment shall be designed, tested, and assembled in accordance with the latest applicable standards of CEC/ NEC, ANSI, IEEE, and NEMA and UL including not limited to the following latest revisions:
   1. ANSI C57.12.01, C57.12.50, C57.12.51, C57.12.54, C57.12.56, C57.12.57, C57.12.58, C57.12.90, C57.12.91, C57.12.96 and ST1 NEMA ST20, NEMA TR1-27, and NEMA TRI, NFPA 70:
   2. The entire unit substation assembly shall be UL listed and labeled.

B. All materials selected for the Manufacturer of the transformers shall be the best available for the purpose for which they are used, considering strength, ductility, durability and the best Engineering Practice.

C. Equipment, components/devices, switchboards, switchgear and transformers shall be manufactured by: General Electric; or Cutler-Hammer; or Square-D; or Siemens.
PART 2 - PRODUCTS

2.01 GENERAL

A. Integrated and Tested Assembly
   1. The secondary unit substation shall be self-contained factory assembled, tested and coordinated unit consisting of incoming line section(s), transformer section, and secondary outgoing section(s), totally metal enclosed, free-standing housings.
   2. All sections shall be combined in close coupled steel structure having internal barriers segregating the incoming line, transformer and outgoing sections, into separate compartments.
   3. Provisions for jacking, lifting, skidding, and rolling shall be made as an integral part of the equipment design for all sections.
   4. Construction shall be left to right or right to left as indicated on the Drawings.
   5. Individual sections structure and the entire unit substation assembly shall be fabricated to comply with seismic earthquake occurring at the install location, without loss of continuous operation during an earthquake. Provide testing and documentation.

B. Structure
   1. The unit substation shall have structural anchor points permanently attached to the assembly, to provide for bolting the unit sections securely to the floor.
   2. Interconnections between the transformer, primary and secondary equipment sections shall be provided by the factory.
   3. The unit shall be front accessible for normal maintenance. Rear access of primary incoming cables and secondary outgoing cables shall be provided, top or bottom conduit entrance as indicated on Drawings.
   4. Ventilating openings in the enclosure shall be located to insure proper cooling at installed equipment location shown on the Drawings. Provide expanded metal screens on vent openings. Construction shall prevent entry of rodents into the unit substation interior, including rodent screens on bottoms of all equipment sections.
   5. External and internal surfaces shall be painted. Clean and prime coat all metal structural surfaces with hot phosphatized rust-inhibitor prime coat prior to application of high quality hard dried acrylic enamel finish. Standard Manufacturers color. All sections shall be the same color.
   6. A prominent nameplate bearing equipment ratings, tap-changing information, Manufacturer identification, and reference serial numbers shall be mounted on the front of the unit.
   7. Provide a continuous and permanent mimic-bus on the front of each equipment section to graphically show electrical power flow through the equipment.

C. Special Configurations
   1. Special consideration shall be required for installation to fit into limited space to include but not limited to, cutouts or flanged throats to facilitate mating with other primary and secondary switchgear and equipment (and/or coordination to match existing use and other terminations).

D. Seismic Earthquake and Wind Loading Withstand, Testing and Certification (ADDITIONAL REQUIREMENTS)
   1. The complete unit substation assembly; including attached circuit protection devices, transformer, switchboards-switchgear, housings/enclosures,
accessories, supports/anchors etc., shall be designed, manufactured and
tested for:
   a. Wind loading all outdoor equipment locations.
   b. Earthquake Seismic Zone-4 and CBC/IBC withstand, all indoor and all
      outdoor equipment locations.
2. Shall withstand, survive and maintain continuous non-interrupted energized
   operation (running) during the seismic event occurrences. Continued normal
   energized operation after the wind event and seismic event occurrences have
   abated.
3. Shall include demonstrations of successful operation-and-run test after
   completion of seismic event shake-table simulation.
4. Provide three (3) dimensional finite element analysis demonstrating anchorage
   and operational withstand of wind loading not less than as follows and as
   required by AHJ:
   a. 100MPH-West Coast States USA and Hawaii.
   b. 150MPH-East Coast States USA, Gulf Coast States USA and Alaska
      State.
   c. 90MPH-all other USA locations.
5. Acceptance Test Seismic Qualification of proposed unit substations shall
   employ triple axis shake-table simulation of the Required Response Spectrum
   (RRS) seismic event motion, certified and approved by the AHJ.
6. Seismic test shall be performed by a third party independent Test Laboratory.
   Wind Analysis and Seismic Testing and reports shall be certified, signed and
   "stamped" by PE Professional Engineer licensed and in good standing in the
   State, Civil Engineer or Structural Engineer.

2.02 WEATHERPROOF ENCLOSURES

A. Equipment indicated as Weather Proof (W.P.) or outdoors shall be NEMA 3R, non-
   walk-in, tamper resistant construction. Provide full height hinged doors with
   provisions for padlocking the doors in the closed position.

B. Provide a nominal 300 watt sealed, resistance type, anti-condensation heater in
   each equipment section. Heaters shall be controlled automatically by Thermostats
   and humidistsats. A circuit breaker shall be provided to supply equipment buss
   secondary voltage to the heaters, all prewired by the Manufacturer.

C. Finish shall be electrostatically applied finish paint over iron oxide rust inhibitor
   primer. Finish color shall be Manufacturers standard color, olive green Munsel
   #7GY3.29/1.5. The bottom side and bottom 6 inches of the equipment shall be
   coated with 4 mil minimum thickness rust inhibitor undercoating over finish paint, on
   all interior surfaces. Finish withstand test without face corrosion or blistering:

D. Exposed Hardware and Hinges shall be Stainless Steel type 302 or 304, tamper
   resistant.

2.03 BUSSING

A. Horizontal and Vertical Busses shall be full length. Busses shall have a minimum
   withstand rating equal to available fault current indicated on Drawings, plus a 25%
   additional capacity (safety margin). However, in no case shall the bus rating be less
than 50,000 Amp, RMS symmetrical, secondary side: 50,000 amp, RMS symmetrical primary side, at indicated operating voltages.

B. Provide interconnected full capacity secondary neutral bus in each section with the same ratings and construction as the phase busses.

C. Provide Interconnected Ground Bus in each Section.

D. Provide Space, all hardware and mounting attachments for future devices as indicated on the Drawings.

E. Main Horizontal Bussing shall be full capacity in all equipment sections.

F. Vertical Riser Buss may be tapered, to not less than one third the ampacity rating of the main horizontal buss; but in no case shall the vertical buss be of less capacity than the sum of the frame size ampacities of overcurrent devices mounted in the respective sections including any indicated spares and spaces.

G. The Equipment Bussing shall be of sufficient cross-sectional area to meet UL Standard 891 on temperature rise. Bus shall be copper or extruded aluminum with silver-plated bus joints. The through buss shall have provisions for the addition of future equipment sections. The through bus supports, connections and joints shall be bolted with grade 5 hex head bolts and Belleville washers to minimize maintenance requirements.

H. Primary Bussing shall be fully insulated with a factory applied, extruded bus insulating material. All primary bussing shall be supported on porcelain insulators. Primary bussing BIL shall be 95kV for 15kV class and 60KV for 5kV and 2.5kV class.

I. The Minimum Bussing Capacity shall be rated for unit full load capacity plus the additional capacity with fan cooling installed, but in no case less then indicated on the Drawings.

2.04 INCOMING LINE

A. The Incoming Line shall be provided with factory filled porcelain "slip-on" type cable terminations for the incoming feeder entering the section as indicated on the Drawings, provide support brackets on equipment frame for cable terminators. Provide 4-bolt spade lug connector, bolt to bus with grade 5 HEX head bolts and Belleville washers.

1. BIL 110 kV
2. Current Rating same as feeder cable
3. 1 minute dry AC test 50 kV
4. 6 hour dry, AC test 35 kV
5. 10 second wet, AC test 45 kV
6. 15 minute dry, DC test 75 kV
7. Compatible with cable diameter, quantity and type as shown on Drawings.
8. Provide cross support channels with porcelain cable cradles for incoming feeder conductors.

B. The Primary Disconnect Switch(es) shall be load interrupting with quick-make, quick-break stored energy manual operating mechanism. Switches shall be 3-pole, two position gang operated with a current rating of 600 amperes continuous and full load break. Switches shall be designed to meet NEMA Standards for a Class-A device.
Arc interruption shall take place in air, aided by de-ionizing arc chutes operating in conjunction with high speed moving arcing contacts.

C. A Door Mounted Viewing Window shall provide observation of switch contacts.

D. The Switch and all Components within the Primary Incoming Section shall have a minimum NEMA Basic Impulse Level (BIL) corresponding to the system voltage class of 60kV BIL (for 2.5kV class and 5kV class) 95kV - BIL (for 15kV class) as indicated on the Drawings. 50,000 ampere RMS asymmetrical momentary fused withstand rating and 40,000 ampere RMS asymmetrical close and latch.

E. Means shall be provided to padlock the switch in the open or closed position.

F. Provide Lightning Surge Arresters Mounted inside the Compartment, one per phase distribution type, connected between the switch and fuses. Surge arrestors shall be non-fragmenting type and comply with ANSI-C62.1.

G. Non-expulsion current limiting primary fuses with a short circuit interrupting rating of 50,000 amperes RMS symmetrical shall be supplied fixed mounted on the load side of each switch pole. The fuse continuous current rating shall be in accordance with the Manufacturer's recommendation to adequately protect the transformer from damaging overloads and short circuits. Fuses shall provide a visible "Blown-fuse" indication. Fuses shall be removable from the front without special tools.

H. Access to Fuses While Energized shall be positively prevented through a mechanical interlock system which keeps the section front door locked closed when the switch is in the closed position. Provide warning-labels if switch/fuse “back-feed” may occur and provide mechanical/electrical interlocks between “main” secondary disconnect and primary switch/fuse to prevent access for the duration of the back feed condition.

I. Any Internal Parts that Remain Energized with the Switch Open shall be guarded by a fixed internal safety barrier to prevent inadvertent contact by Operating or Maintenance Personnel with the door open. Interphase insulating barriers shall be provided for the system voltage class, to isolate switch and fuse poles from each other and from grounded metal.

J. Incoming Line shall be close-coupled to the unit substation transformer.

2.05 TRANSFORMER SECTION (DRY TYPE VENTILATED)

A. A Three Phase, 60Hz AC, Two Winding, Ventilated Dry Type Transformer shall be provided as part of the unit substation assembly. Transformers shall comply with NEMA TR-1 and TP-1 latest revisions.
   1. Refined Cold Rolled optimized Grain-Oriented (CRGO) electro-magnetic silicon steel fabricated transformer core (ANSI-M5 or better grade), insulated core laminations and finished to protect against corrosion and improve transformer operational efficiencies.
   2. Shall reduce the transformer core no load losses to approximately 0.18% or less of the transformer nameplate rating.

B. Insulation
   1. The insulation system shall be based on 220 degrees C insulating materials, vacuum pressure impregnated, non-hygroscope, thermosetting insulating
varnish/resin. Transformer temperature rating of 150 degrees C rise. The transformer temperature rise rating shall be in a 40 degree C ambient, with an average ambient for any 24-Hour period of 30 degrees.

2. The transformer core and coil assemblies shall be VPI – Vacuum Pressure Impregnated high temperature varnish/resin with not less than two (2) standard full cycles of vacuum pressure impregnation and drying process. Transformers employing “dip-and-bake” process are not acceptable.

3. Transformer insulation Basic Impulse Level-BIL rating,

<table>
<thead>
<tr>
<th>Nominal Voltage</th>
<th>Primary- BIL</th>
<th>Secondary- BIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-kV Class</td>
<td>95kV</td>
<td>30kV</td>
</tr>
<tr>
<td>5-kV Class</td>
<td>60kV</td>
<td>30kV</td>
</tr>
<tr>
<td>2.4-kV Class</td>
<td>60kV</td>
<td>30kV</td>
</tr>
</tbody>
</table>

BIL Rating prior to use of surge arrestors.

4. Dry type transformers shall meet or exceed NEMA TP-1 (latest revision), Class-1 efficiency levels and shall be marked as energy efficient for United States Department of Energy and Environmental Protection Agency DOE/EPA “Energy-Star” Certification.

C. Transformer Impedance shall be NEMA standard but not be less than indicated on the Drawings or exceed the value indicated on the Drawings by more than 15% of the indicated value.

D. Load Rating

1. The ambient air (AA) self-cooling KVA rating, primary and secondary voltage ratings shall be as shown on the Drawings.
2. Provide automatic forced (FA) air fan cooling (AA/FA) to increase the transformer capacity to not less than 130% of the self-cooling (AA) rating.
3. All unit substation sections and bus capacity shall be increased to equal or exceed the forced air fan cooling transformer rating.

E. Taps (Deenergized Operation)

1. Taps shall be conveniently located at the front of the coils for accessibility.
2. Full kVA capacity primary taps shall consist of two (2) 2.5% above normal and three (3) 2.5% below normal voltage full load rated.
3. When dual primary voltage windings are specified, both windings shall have taps.

F. A Transformer Winding Temperature Gauge shall be provided, visible from the exterior of the transformer housing. An external resetable peak temperature pointer shall be incorporated in the gauge.

G. The Sound Levels (without forced air cooling sound contribution) shall be guaranteed by the Manufacturer not to exceed the following values:

<table>
<thead>
<tr>
<th>KVA Range</th>
<th>Sound Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>151 to 300kVA</td>
<td>58dB</td>
</tr>
<tr>
<td>301 to 500kVA</td>
<td>60dB</td>
</tr>
<tr>
<td>501 to 700kVA</td>
<td>62dB</td>
</tr>
<tr>
<td>701 to 1000kVA</td>
<td>64dB</td>
</tr>
<tr>
<td>1001 to 1500kVA</td>
<td>65dB</td>
</tr>
<tr>
<td>1501 to 2000kVA</td>
<td>66dB</td>
</tr>
<tr>
<td>2001 to 3000kVA</td>
<td>68dB</td>
</tr>
</tbody>
</table>

H. The Transformer Core and Coil Assembly shall be completely isolated from the transformer enclosure. There shall be no metal to metal rigid contact. Vibration isolation pads shall be provided between the core and coil and the enclosure.
I. The Transformer Assembly and Transformer Core shall be visibly grounded to the ground bus with a flexible grounding conductor.

J. The Transformer Assembly, Transformer Core and Coil shall be earthquake restrained for the install location earthquake seismic CBC/IBC rated.

K. Enclosure
   1. For indoor applications, an air ventilated metal enclosure shall be provided. The base shall be structural steel of sufficient strength to permit jacking, rolling, and skidding in any direction. Removable panels shall be provided for access to the tap connections and for inspection and maintenance. Front and rear panels shall be provided with top and bottom ventilation openings backed with a mesh made of non-corrosive wire to provide adequate cooling airflow.
   2. Outdoor application, an outdoor weather and tamper resistant air ventilated metal enclosure shall be provided. The base shall be structural steel of sufficient strength to permit jacking, rolling, and skidding in any direction. Front and rear panels shall be provided with top and bottom weather resistant ventilation grills and rain-shields to provide adequate cooling air flow and to prevent rain and snow from entering the enclosure.
   3. Provide rodent continuous shields on the transformer bottom.

L. Transformer Windings and Lead-outs shall be insulated copper or aluminum. Current carrying bolted connections shall incorporate Belleville compression type washers.

M. Electrostatic Shield: Provide full width, copper, and 100% electrostatic shield, between primary and secondary transformer windings on each transformer phase. Shields shall be low impedance/inductance grounded to the transformer metal frame and shall attenuate common mode and transverse mode electrical noise.

N. Transformers shall be rated K4 in accordance with IEEE-C57.110.

2.06 TRANSFORMER SECTION (EPOXY CAST COIL VENTILATED)

A. Transformer
   1. A three phase, 60Hz AC two (2) winding ventilated cast coil transformer (both primary and secondary winding). Shall be provided as part of the unitized assembly. Transformers shall comply with NEMA TR-1 and TP-1 latest revisions.
   2. The transformer shall be of dry type non-hydroscopic epoxy resin vacuum cast coil construction. Solid epoxy-cast materials shall provide protection resulting from transformer exposure to severe load cycles (cold start to maximum load) and harsh environment/climates (freezing, heat, chemicals and contaminated air and air borne condensing moisture). Two-winding, 80 degree C rise above 40 degrees C maximum ambient temperature with a 30 degree C, 24 hour average in a NEMA enclosure as defined in NEMA ICS6 unless otherwise noted. 185 degree C rated insulation systems.
   3. Transformer efficiency shall meet or exceed NEMA-TP1 (latest revisions) requirements, Class-1 efficiency levels and shall be marked as energy efficient for United States Department of Energy DOE/EPA “Energy-Star” Certification.
   4. Transformer shall be Class AA (Ambient Air) self-cooling below 300kVA and Class AA/FA (forced air fan) for 300kVA and above.
      a. The (AA) self-cooling kVA rating, primary and secondary voltage ratings shall be as shown on the Drawings.
b. A transformer winding temperature gauge shall be provided, visible from the exterior of the transformer housing. An external resetable peak temperature pointer shall be incorporated in the gauge.

c. Provide automatic forced air fan cooling (AA/FA) to increase the transformer capacity to not less than 130% of the self-cooling (AA) rating.

d. Solid epoxy-cast materials shall provide protection resulting from transformer exposure to severe load cycles (thermal cycling cold start to maximum load) and harsh environment/climates (freezing, heat, chemicals and contaminated air and air borne condensing moisture).

e. All unit substation sections and bus capacity shall be increased to equal or exceed the forced air fan cooling transformer rating.

5. Voltage, kVA, connections, and other special requirements shall be as indicated on the Drawings.

6. Primary and secondary winding coils shall be made of conductors, both individually cast in metal molds under vacuum to form rigid tubular coils. The 185 degrees centigrade rated, cast epoxy resin insulation shall be utilized to insure complete void-free encapsulation of the conductors. Around the inside diameter and outside diameter of each primary voltage and secondary voltage winding, full height sheets of fiberglass cloth and fiberglass matting shall be employed to insure maximum mechanical and short-circuit strength. The epoxy resin shall fully impregnate the windings and shall be free of voids and free of contaminants, including free of paint in the casting mixture.

a. Shall be computer controlled in the casting mixture, shall be computer controlled in the casting, drying, and oven curing process.

b. The completed epoxy casting shall be self-fire extinguishing and fire resistant and not support combustion.

c. All joints and leads to the transformer coils shall be brazed or welded.

d. Transformer windings and lead-outs shall be insulated copper or aluminum. Current carrying bolted connections shall incorporate Belleville compression.

7. The windings shall not absorb moisture and shall be suitable for both storage and operation in adverse environments including prolonged storage in 100% humidity at temperatures ranging from -40 degree C to +40 degree C and shall be capable of being switched on immediately after storage without predrying.

8. Refined Cold Rolled Optimized Grain-Oriented (CRGO) electro-magnetic silicon steel fabricated transformer core (ANSI-M5 or better grade), insulated core laminations and finish to protect against corrosion and improve operational efficiencies.

a. Shall reduce the transformer core no load loses to approximately 0.18% or less of the transformer nameplate rating.

9. Both primary and secondary windings shall be arranged coaxially around a stacked core with a maximum of three steps and with miter cut joints to assure lower no load losses and maximum cooling channels between the core and secondary coils. To insure that cooling air can freely circulate between the core and secondary coils, non-blocking or jacking of the secondary coils against the core shall be employed in obtaining suitable short circuit and mechanical strength. The coils shall be fixed in-place by epoxy cast blocks at the top and bottom only.

10. The core and coil assemblies shall be isolated from its case by sound dampening pads in order to reduce transmission or core vibration to the case and insuring low-noise transformer operation.
B. Transformer Insulation Basic Impulse Level-BIL rating.

<table>
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<td>2.4kV Class</td>
<td>60kV</td>
<td>30kV</td>
</tr>
</tbody>
</table>

BIL Rating prior to use of surge arrestors.

C. Taps (De-energized Operation)
   1. Full kVA capacity primary taps shall be conveniently located at the front of the coils for accessibility.
   2. Taps shall allow transformers to deliver rated kVA at any tap settings. Taps shall be two (2) 2.5% above and three (3) 2.5% below rated normal primary voltage.
   3. When Dual Primary Voltage Windings are specified, both windings shall have Taps.
   4. Interconnecting jumper wires shall be insulated for 133% of the rated voltage.

D. Sound Level
   1. The sound levels (without forced air cooling sound contribution) shall be guaranteed by the Manufacturer not to exceed the following values;
      a. 151 to 300kVA - 58dB
      b. 301 to 500kVA - 60dB
      c. 501 to 700kVA - 62dB
      d. 701 to 1000kVA - 64dB
      e. 1001 to 1500kVA - 65dB
      f. 1501 to 2000kVA - 66dB
      g. 2001 to 3000kVA - 68dB

E. Transformer Impedance shall be NEMA standard but not less than indicated on the Drawings or exceed the value indicated on the Drawings by more than 15% of the indicated value.

F. Enclosure
   1. For indoor applications, an air ventilated metal enclosure shall be provided. The base shall be structural steel of sufficient strength to permit jacking, rolling, and skidding in any direction. Removable panels shall be provided for access to the tap connections and for inspection and maintenance. Front and rear panels shall be provided with top and bottom ventilation openings backed with a mesh made of non-corrosive wire to provide adequate cooling airflow.
   2. Outdoor application, an outdoor weather and tamper resistant air ventilated metal enclosure shall be provided. The base shall be structural steel of sufficient strength to permit jacking, rolling, and skidding in any direction. Front and rear panels shall be provided with top and bottom weather resistant ventilation grills and rain-shields to provide adequate cooling and to prevent rain and snow from entering the enclosure.
   3. Provide rodent continuous shields on the transformer bottom.

G. Tests
   1. Tests shall be as those listed below and shall be defined as those existing and required by ANSI C.57 for Cast Coil Transformers.
   2. The accuracy of the calibration of all instruments to be utilized during the tests shall be ascertained and recorded at the beginning of the tests.
   3. The tests shall be certified and include, but not be limited to, the following:
4. **Design Tests**
   a. Heat run at rated voltage, conducted on one transformer of each kVA rating. The transformer to be so tested will be selected by the engineer at the time of inspection and test. The test shall incorporate 100% of rated voltage core losses at stated temperature. Certified test results of previously built similar units will be accepted in lieu of actual tests.
   b. Short circuit test - certified test results on previously built and similarly constructed units will be accepted in lieu of actual tests.

5. **Production Tests**
   a. Impulse test on one transformer of each kVA rating. The transformer to be so tested will be selected by the engineer at the time of inspection and test. If one unit fails the test, all other units shall be tested.
   b. Power frequency test at two (2) times insulation system rated voltage.
   c. Resistance measurement for each winding on the rated voltage connections prorated to the reference. Date sheets shall indicate resistance of each individual coil.
   d. Turns Ratio at rated voltage connection and on all taps.
   e. Polarity and phase rotation on the rated voltage connection.
   f. Excitation loss at rated voltage and 110% rated voltage.
   g. Excitation current at rated voltage and 110% rated voltage.
   h. Impedance and losses (no load and full load).
   i. Applied potential.
   j. Induced potential.
   k. Partial discharge test shall be performed on each fully assembled unit. All transformers shall be partial discharge tested with less than 10 pico - coulombs detected at 150% of primary voltage for 30 seconds and then 1.1 times the rated primary voltage for three minutes. All tests to be performed at highest voltage tap.

6. Six (6) copies of Manufacturer Certified test results shall be furnished to the Owner's Representative.

**H. Shields**

1. Electrostatic Shield: Provide full width, copper, and 100% electrostatic shield, between primary and secondary transformer windings, on each transformer phase. Shields shall be low inductance/impedance grounded to the transformer metal frame and shall attenuate common mode and transverse mode electrical noise.

2. Transformers shall be rated K4, in accordance with IEEE-C57.110.

**I. The Transformer Assembly, Transformer Core, and Coil shall be earth quake restrained for the install location earth quake seismic CBC/IBC rated.**

**2.07 TRANSFORMER SECTION (LIQUID FILLED)**

**A. General**

1. A three phase, 60Hz AC, two (2) winding, liquid filled transformer shall be provided as part of the unit substation assembly. Transformers shall comply with NEMA TR-1 and TP-1 latest revisions.

2. Core and coil shall be immersed in insulating liquid fluid. The transformer self-cooled Outside Air (OA) dual rating shall be 55/65 centigrade rise. The transformer shall be rated for a 12% continuous additional overload capacity at rated voltage without exceeding 65 degree centigrade winding temperature.
rise. The transformer temperature rise rating shall be in 40 degrees ambient, with an average ambient for any 14-hour period of 30 degrees C.

3. Transformer assembly, transformer core and coil shall be earthquake restrained for the installation location earthquake seismic CBC/IBC rated.

4. Refined Cold Rolled Optimized Grain-Oriented (CRGO) electro-magnetic silicon steel fabricated transformer core (ANSI-M5 or better grade), insulated core laminations and finish to protect against corrosion and improve transformer operational efficiencies.
   a. Shall reduce the transformer core no load loses to approximately 0.18% or less of the transformer nameplate rating.

B. Transformer Efficiency shall meet or exceed NEMA-TP1 (latest revision) requirements, Class-1 efficiency levels and shall be marked as energy efficient for United States Department of Energy DOE/EPA “Energy-Star” Certification.

C. Less-Flammable Transformer Liquids:
   1. NFPA 70, FM P7825/3990 and UL-EOVK/EOUV listed for less-flammable liquids. Fire point not less than 360 degrees centigrade and flash-point not less than 330 degrees centigrade, testing in accordance with ASTM D92. Dielectric strength not less than 33kV tested in accordance with ASTM D877. Shall be fully miscible with mineral based fluids.
   2. Transformer liquid fluids shall be biodegradable, non-toxic, non-bio accumulating, non-mutagenic; produce no EPRI (Furhns); produce no formal dehides; produce no PCDD (Dioxins). Renewable resource based transformer insulating fluid. Shall be non-contaminating during electrical load break operations and energizing switching operations, occurring with switching devices and/or fuses immersed inside the transformer fluid.
   3. Do not provide transformer liquids including askarel and insulating liquids containing Polychlorinated Biphenyl’s (PCB’s), tetrachloroethylene (perchloroethylene), chlorine compounds, or halogenated compounds.
   4. Shall be compatible with transformer insulation, gaskets and seals. Envirotemp-FR3 transformer fluid.

D. Transformer Impedance shall be NEMA standard but not be less than indicated on the Drawings or exceed the value indicated on the Drawings by more than 15% of the indicated value.

E. The Transformer Tank shall be completely welded, sealed metal tank construction. Gas space shall be provided in the tank to limit internal pressure due to normal load cycle operation, minimum 7.0 PSI. The transformer tank shall withstand not less than 15PSI positive internal pressure and 5PSI negative internal pressure without leaking or rupture.

F. Taps (Deenergized Operation):
   1. Tap changer external transformer tank operation, manual handle operator.
   2. Full kVA capacity external primary manual tap changer shall provide two (2) 2.5% above normal three (3) 2.5% below normal, voltage adjustments. Tap changer handle shall be pad-lockable.
   3. When dual primary voltage windings are specified, both windings shall have taps.

G. Porcelain Insulated Connector Bushing Connectors shall be provided on the line and load sides (opposite sides) of the transformer tank.
H. Transformer Throat Flanges to Enclose the Connector Bushings shall be provided on the line and load side of the transformer tank. The flanges shall provide connection to the incoming line and outgoing equipment sections.

I. The Following Transformer Components shall be provided.
   1. Combination drain and sampling valve.
   2. 1-inch top filter press connection.
   3. Pressure test connection.
   4. Dial type transformer winding temperature gauge, with resettable peak indicating pointer, “high-temp” alarm contacts and on-off relay for stop-start cooling fan operation.
   5. Liquid level gauge.
   7. Ground pad.
   8. Handhole on cover, gasketed and bolted connections.
   9. Pressure/vacuum gauge.
   10. Pressure relief device for positive over pressure and negative under pressure automatic protection.
   11. Instruction nameplate.
   12. Continuous welded tank cover.

J. Cooling
   1. Transformer cooling fins shall be welded to the transformer tank.
   2. Transformer shall be Class OA (Liquid Immersed Outside Air) self-cooling below 300kVA and Class OA/FA (forced air fan) for 300kVA and above.
      a. The (OA) self-cooling kVA rating, primary and secondary voltage ratings shall be as shown on the Drawings.
      b. Provide Automatic Forced Air fan cooling (OA/FA) to increase the transformer capacity to not less than 120% of the self-cooling (OA) rating.
      c. All unit substation sections and bus capacity shall be increased to equal or exceed the forced air fan cooling transformer rating.

K. Transformer insulation Basic Impulse Level-BIL rating.

<table>
<thead>
<tr>
<th>Nominal Voltage</th>
<th>Primary- BIL</th>
<th>Secondary- BIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>12kV Class</td>
<td>95kV</td>
<td>30kV</td>
</tr>
<tr>
<td>5kV Class</td>
<td>60kV</td>
<td>30kV</td>
</tr>
<tr>
<td>2.4kV Class</td>
<td>60kV</td>
<td>30kV</td>
</tr>
</tbody>
</table>

BIL Rating prior to use of surge arrestors.

L. Transformer Windings and Lead-outs shall be insulated copper or aluminum. Current carrying bolted connections shall incorporate Belleville compression washers.

M. Electrostatic Shield: Provide full width, copper, and 100% electrostatic shield, between primary and secondary transformer windings, on each transformer phase. Shields shall be low impedance/inductance grounded to the transformer metal frame and shall attenuate common mode and transverse mode electrical noise.

N. Transformers shall be rated K4, in accordance with IEEE-C57.110.
2.08 OUTGOING SECONDARY SECTIONS

A. General
1. The outgoing section shall terminate the outgoing feeder cables and contain the Main, Tie and Feeder circuit protective devices, metering equipment, and auxiliary components described herein and on the Drawings.
2. Conduit entrance area for secondary-voltage feeder cables shall be provided in the top and bottom of the sections. The presence of conduit and cable feeders shall not interfere with proper equipment ventilation or with access to the transformer for inspection and maintenance.
3. Outgoing section devices and equipment short circuit “bolted” fault current withstand and interrupt rating shall equal or exceed the available secondary short circuit current let-thru of the unit substation transformer, plus a 25% additional safety factor.

B. CIRCUIT BREAKERS
1. General
   a. Circuit protective devices as indicated on the Drawings. All devices shall have a short circuit interrupting capacity not less than the maximum bolted fault current let-thru from the unit substation transformer secondary at the circuit breaker and as indicated on the Drawings, plus a 25% additional capacity (safety margin). However, in no case shall the circuit breaker interrupting capacity be less than 30,000 ampere symmetrical interrupting for 480/277 volt devices and 42,000 ampere symmetrical for 240 volt or 208/120 volt devices.
   b. Provide padlock-off devices on each device. Breakers shall provide automatic time over-current and instantaneous circuit protection. Shall be suitable for use as “Main” service disconnect, “Feeder” and “Branch-Circuit” functions.
   c. Circuit breakers shall employ a self-powered stored energy, quick make-quick break, and trip free operating system on each phase, with common trip. Circuit breakers shall not trip in the event of short term or long term electrical power failure. Dead front cover accessible close-open controls, monitors and visual indicator flags.
   d. Circuit breakers noted as “100%” on the Drawings shall be tested and rated to carry the breaker full rated (100%) ampere load continuously including the assemblies the circuit breakers are installed into.
   e. Provide conductor lugs for circuit protection devices to accept conductor temperature rating, sizes and quantities shown on Drawings. Circuit protection devices shall be UL-listed suitable for normal and reverse feed.
   f. Provide auxiliary contacts on circuit breakers. Auxiliary “DRY” contacts shall provide supervised remote monitoring of “Open-Close-Trip” circuit breaker status. Typical for circuit breakers supplying the following types of connected electrical loads.
      1) Fire alarm equipment and devices.
      2) Mass-evacuation equipment and devices.
      3) HVAC smoke control and smoke evacuation equipment.
      4) HVAC fire/smoke electrically operated dampers.
      5) Intrusion detection and access control equipment and devices.
      6) Elevators and escalators.
      7) Fire sprinkler pumps.
   g. Plug-in communications port for circuit breaker portable test instrument connects.
2. Circuit breaker data monitoring and communications:
   a. The circuit protection devices shall monitor, communicate and report
      circuit voltage, ampere, power, and harmonic parameters for the
      respective connected circuit. The circuit protection device monitor and
      communication parameters shall be the same and compatible with the
      specified “METERING” devices.
   b. Additionally the circuit protection devices shall monitor and communicate
      the respective device status as follows:
      1) Open/close/trip device status
      2) Ground fault trip status (where applicable)
   c. Provide circuit breaker data monitoring and communications for each of
      the individual feeder protection devices and main protection devices
      located in switchgear and switchboards, rated 400 ampere or greater trip
      rating.
   d. Monitoring shall also connect to transformer gauges, alarms and control
      panel.
      1) Temperature/fan control panel.
      2) Internal pressure and liquid level for liquid filled transformer.
   e. The respective “METER” display selection control functions shall provide
      selection and display of all information monitored and communicated by
      individual protection devices on the respective meter alphanumeric
      display.

3. Circuit breakers shall be Power Circuit Breaker type, Insulated Case Circuit
   Breaker type or Molded Case Circuit Breaker type. Time/current and
   instantaneous characteristics and selection of circuit breaker type shall comply
   with the recommendations in the coordination study and insure optimal code
   mandated time/current and instantaneous coordinated sequential tripping
   throughout the electrical system.
   The Contract Document intent requires providing the selection and use of the
   circuit breaker types and performance characteristics for time/current and
   instantaneous trip coordination during electrical circuit overload conditions and
   during electrical short circuit fault conditions. Combined with the specified
   circuit breaker protection time/current performance characteristics.
   a. Power Circuit Breaker type-PCB:
      1) UL-1066, comply with latest revision.
      2) NEMA-SG3, comply with latest revision.
      3) ANSI-C37.13, C37.16, C37.17, C37.50, comply with latest revision.
      4) 5Hz AC closing and up to 30Hz AC withstand duration delay trip
         and clear.
      5) Enclosed housing accessible for internal visual inspection,
         maintenance, repairs, and parts replacement.
      6) Extended function on-off instantaneous trip selection.
      7) Push-to-trip button.
      8) Mechanical operations counter.
   b. Insulated Case Circuit Breaker type-ICCB:
      1) NEMA-AB1 and AB3, comply with latest revision.
      2) UL-1087, UL-489 and IEC-60.947 comply with latest revision.
      3) 5Hz AC closing and 3Hz AC trip and clear.
      4) Hybrid combination of MCCB type and PCB type circuit breakers
         with enclosed insulated housing and limited internal maintenance
         access.
      5) Two-step stored energy close mechanism.
      6) Extended function on-off instantaneous trip selection.
7) Push-to-trip button.
8) Mechanical operations counter.

c. Molded Case Circuit Breaker type – MCCB:
   1) NEMA-AB1 and AB3, comply with latest revision.
   2) UL-1087, UL-489 and IEC-60.947.2 rated devices, comply with latest revision.
   3) 5Hz AC closing and 3Hz AC trip and clear.
   4) Sealed enclosed housing.

<table>
<thead>
<tr>
<th>Molded Case Breakers</th>
<th>Insulated Case Breakers</th>
<th>Current Limited Breakers</th>
<th>Power Circuit Breakers</th>
<th>Fused Circuit Breakers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molded plastic case, 80% or 100% rated in larger sizes, interrupting duties from 10 to 100kAIC; commonly used for residential and most branch circuit applications, also used in retail and commercial switchboards</td>
<td>Class reinforced case, 80% or 100% rated from 100 to 4,000amps; interrupting duties from 42 to 150kAIC, solid-state digital tripping; typical uses are in commercial and light industrial applications</td>
<td>Generally molded or insulated case breakers, interrupting duties form 10 to 200kAIC, trip sizes from 15 through 600 amps, 80% rated</td>
<td>Rigid, open metal frame for longer life, 100% rated, interrupting duties from 42 to 100kAIC, trip ranges from 200 to 5,000 amps; drawout only; 800 amp smallest frame size; reusable after fully rated fault interruptions</td>
<td>Interrupting duty of 200kAIC, generally molded case breaker, 80% or 100% rated</td>
</tr>
<tr>
<td>Smaller size, lowest in cost group mounting only; group mount, individual mount, or drawout; frame sizes from 15 amp thru 5000 amp</td>
<td>Fiberglass reinforced case fully adjustable; limited short time rating; group mount, individual mount or drawout; 800 amp smallest frame size.</td>
<td>Inherently current-limiting both for themselves and for downstream devices; same case size as molded case breakers; digital, adjustable trip unit; group mount, or individual mount</td>
<td>Fully adjustable, microprocessor trip unit; may be fully repaired, maintained and adjusted; expected life on the order of 40 to 50 yrs; depending on usage and maintenance, short time rating allows better coordination with downstream equipment; individual mount or drawout</td>
<td>High interrupting duty, small size for maximum interrupting duty; fuses must be replaced each time it trips; group mount, individual mount or drawout</td>
</tr>
<tr>
<td>Cannot be maintained or repaired; limited adjustability without selecting operational tripping unit; useful life in the 10 to 20yr range; may not be operational after a fully rated fault interruption</td>
<td>Cannot be maintained or repaired; useful life from 20 to 25yrs; may not be operational after a fully rated fault interruption; solid-state electronic/digital trip</td>
<td>Same disadvantages as other molded case breakers; solid-state electronic/digital trip</td>
<td>Large size, highest cost breaker; rear access required all sizes; solid-state electronic/digital trip. Can be fully maintained and repaired or rebuilt. +40yrs useful life.</td>
<td>Protects only selected downstream lower rated over-current devices; solid-state electronic/digital trip</td>
</tr>
<tr>
<td>Thermal/magnetic or electronic trip unit</td>
<td>May be electrically opened or closed</td>
<td>May be electrically open or closed</td>
<td>Every possible option is available; electronic/ solid-state only tripping</td>
<td>Same concept can be found on power air circuit breakers</td>
</tr>
</tbody>
</table>

4. Protection performance requirements for circuit breakers conforming to one (1) or more of the following applications:
   • 600 Ampere or larger frame size.
   • Larger than 400 Ampere trip.
   • Service entrance in main switchboard or switchgear.
   • Noted as Main or Main Circuit breakers on the Drawings.
   a. Circuit breaker shall employ current sensors and solid-state static digital electronic automatic trip system. Three phase, or single-phase operation as noted on the Drawings. Current carrying components shall be completely isolated from the static trip units. The trip unit shall be independent of external power sources. Circuit breakers shall be rated for reverse connection.
   b. Circuit breaker solid state digital trip control functions shall provide the following time/current curve shaping field adjustable features;
      1) Adjustable ampere setting to vary the long-time continuous current carrying capacity, minimum range of 80% through 100% of full load trip rating.
2) Adjustable long-time delay setting to vary the time the breaker will trip under sustained overload conditions. Minimum of three settings, "minimum - intermediate - maximum".

3) Adjustable short-time pickup to vary the level of high current the breaker can carry for short periods of time, minimum range of 2 times through 8 times of ampere setting.

4) Adjustable short time delay to vary the time of the short-time pickup. Minimum of three (3) settings "minimum-intermediate-maximum".

5) Short time "I^2t" switch to allow a current-squared multiplied by time ramp function in the short-time system. Two (2) position setting "In-out".

6) Adjustable instantaneous pickup to vary the breaker ampere setting for immediate (instantaneous) interruption of severe overloads (short circuits). Adjustable minimum range of 2.0 times thru 9 times of circuit breaker ampere sensor rating. Instantaneous selective override trip setting shall also include "on-off" function. When "off", or "override" is selected, shall then function with the adjustable short time delay and adjustable short time pick-up (note where the coordination study requires a higher instantaneous setting, change the specified adjustable instantaneous trip to fixed instantaneous trip at 15 times the breaker ampere sensor setting also with on-off function).

7) Individual fault trip indicators (flags) shall provide local indication on the breaker for overload and short circuit (and ground fault where applicable) conditions.

8) Provide quantity of one, Manufacturer’s standard test set for solid state trip circuit breakers.

5. Protection performance requirements for circuit breakers conforming to one (1) or more of the following applications:
   • Smaller than 600 ampere frame size.
   • 400 ampere and smaller trip.
   • Larger than 100 ampere frame size.
   • Larger than 100 ampere trip.
   a. Circuit breaker shall employ current sensors and solid-state static digital electronic automatic trip system. Time/current curve shaping field adjustable features
   b. Solid state digital trip breakers shall conform to the requirements described above for solid state breakers larger than 400 ampere trip. However, only the following field adjustments are required;
      1) Long-time ampere setting adjustable minimum range of 80% through 100% of full load trip rating.
      2) Short time pickup adjustable minimum range of 2 times through 8 times of the ampere setting.
      3) Fixed or field adjustable instantaneous trip (depending on the results of the Coordination Study).

6. Performance requirements for circuit breakers conforming to the following applications:
   • 100 ampere frame size and smaller.
   • 100 ampere and smaller trip.
   a. Circuit breaker shall be fixed or adjustable instantaneous current trip with thermal-magnetic trip or with solid-state static digital electronic automatic time/over current automatic trip (depending on the results of the Coordination Study).
7. Current Limiting Circuit Breakers (CLCB)
   a. Protection performance requirements for circuit breakers conforming to the following applications:
      • 600 ampere and smaller trip and identified as Current Limiting (CLCB) in the Contract Documents.
      1) Current limiting circuit breakers shall be supplied in integral fully enclosed insulating housing construction and shall consist of a common trip, thermal-magnetic or solid state static digital trip conventional circuit breaker (depending on the results of the coordination study), with an independently operating limiter section in series with each pole.
      2) The conventional breaker section shall have an over center, trip-free, toggle-type mechanism with quick-make, quick-break action and positive handle indication. A button shall be provided on the cover for mechanically tripping the circuit breaker. The current limiting breaker shall have permanent trip units containing solid state static digital trip or individual thermal and magnetic trip elements, in each pole. Calibrated for 40 degrees C ambient temperature. The limiter section shall consist of current limiting elements on each phase, electrically coordinated with the conventional circuit breaker trip elements. The contacts of the limiter section shall be electro-magnetically and electrodynamically opened and held open until interruption is complete.
      3) Current and Energy Limitations: On high-level fault currents the limiter portion of the circuit breaker shall operate to limit the rise of fault current. Integral resistance shall be introduced into the faulted circuit to dissipate and limit let-through energy and to provide a voltage transient-free interruption at near unity power factor. The Let-through short circuit fault current and energy levels shall be less than that permitted by Underwriters Laboratories to a value less than I²t of a half cycle wave of the symmetrical prospective current. The CLCB limiter shall limit the asymmetrical short circuit fault current below the equipment symmetrical short circuit fault current.
      4) On fault currents below the threshold of current limitation, the normal non-limiter breaker section shall provide conventional time/current overload and short circuit fault protection.
   b. Protection performance requirements for circuit breakers conforming to the following applications:
      • Trip ratings over 600 ampere through 5000 ampere or less. Identified as current limiting (CLCB) in the Contract Documents.
      1) Integrally fused circuit breaker integrated with solid state static digital electronic automatic trip. Combined standard circuit breaker providing overload-short circuit protection within its interrupting capacity and ON-OFF switching function and on each phase current limiters internally mounted on the load side of the circuit breaker of such ratings that their time current limiting characteristics will coordinate with the time current tripping characteristics of the circuit breaker elements.
      2) The coordination shall result in the interruption by the circuit breaker alone of fault level currents up to the interrupting capacity of the circuit breaker and interruption by the current limiter in conjunction with the circuit breaker of fault level currents above the interrupting capacity of the circuit breaker.
3) A removable cover shall be provided over the current limiter section of the integrally fused circuit breaker. The current limiter housing covers shall be interlocked with the breaker tripping mechanism to insure the breaker will trip upon removal of the cover. The cover shall be interlocked with the breaker to insure the circuit breaker cannot be turned to the ON position with the cover removed. Current limiters shall have a spring loaded plunger which, when the limiter blows, is released to actuate the circuit breaker common trip bar mechanism opening all breaker poles simultaneously.

4) The limiters shall be individually interlocked with the breaker element tripping mechanism to insure the limiter cannot be inserted until the breaker is in the OFF position. The circuit breaker and limiters shall be interlocked to insure the circuit breaker cannot be closed if a limiter is either missing or has blown.

5) Fuse limiters shall be individually removable from the molded case housing.

6) The circuit breaker shall be ambient temperature compensating. The circuit breaker shall be provided with thermal magnetic or solid state static digital trip (depending on the Coordination Study).

7) The integrally fused circuit breaker shall be capable of interrupting available short circuit currents up to 200,000 RMS symmetrical amperes at voltage up to 600 VAC.

8) Ratings, clearances, and performance of the integrally fused circuit breaker shall be in accordance with applicable standards of NEMA, IEEE, and UL.

C. SWITCH AND FUSE FEEDER PROTECTIVE DEVICES

1. Fusible Switches: Quick-make, quick-break type with rejection clips for use with Class "R" fuses Current Limiting Fuses (CLF). Switches with ratings up to and including 100 amperes at 240 volts shall be twins mounted. Switches rated through 60 amperes and 480 volts shall be twins mounted. Switches shall be removable from front of switchboard without disturbing adjacent units or switchboard bus structure.

2. Fuses shall be time delay current limiting types, UL Class RK-1 unless otherwise indicated on the Drawings. Provide one (1) spare set of fuses of each size and type in each switchboard.

3. Provide auxiliary contact on switch for remote status (on-off) signaling and monitoring. Provide conductor lugs to accept conductor temperature rating, sizes and quantities shown on Drawings.

D. GROUND FAULT PROTECTIVE SYSTEM AS FOLLOWS:

1. One control power transformer rated 480/120 volts of suitable capacity for shunt tripping of the main circuit breaker and subfeed circuit breakers as indicated on the Drawings. Fuse transformer on the 480-volt side.

2. Ground sensor current transformer for each indicated ground fault relay, zero sequence type with integral test winding for each circuit indicated on Drawings. (The three phases and neutral conductor shall be brought through the current transformer window per Manufacturer's recommendations).

3. One ground break, solid-state relay, and monitor and test panel for each device indicated on the Drawings. Pick-up adjustment shall be continuous 100 through 1200 ampere; time adjustment shall be continuous from instantaneous through sixty (60) cycles. Monitor panel shall indicate relay operation and provide means for system testing with or without interruption of service, and
shall not permit system to be inadvertently left in an inactive or off state.
Provide re-settable trip indicators.

a. Ground fault system shall provide selective trip coordination with other
upstream/down-stream ground fault and phase over current circuit
protection devices as determined by the coordination study.

1) Ground fault protection devices shall incorporate adjustable
time/current trip settings.

2) Ground fault protection devices shall incorporate adjustable inverse
time and very inverse time adjustable/selective settings.

4. Zone Selective

a. Ground fault System shall be zone selective interlock type.

b. The farthest, downstream ground fault relay zone, sensing a ground fault,
shall block all upstream relay zones for their present time delay, but shall
allow each upstream relay zone to trip instantaneously for ground faults
sensed in its own zone.

5. The ground fault system may be integrated into each circuit breaker with solid
state trip units, in lieu of the separate specified ground fault relay and monitor
panel system. The solid state circuit breaker ground fault system shall provide
the identical specified operational features of the described separate system.

6. Each circuit breaker 100 ampere and larger, located in the main switchboard(s)
and distribution switchboard or main switchgear where the main bus is larger
than 800 ampere and operating above 240 volt phase-to-phase, shall be
provided with ground fault system whether or not shown on the Drawings.
Provide all interconnecting control power and interlocking wire in switchboards/
switchgear and between switchboards/switchgear for an operational system.

E. Secondary Switchboard Outgoing Sections

1. Switchboard shall be floor-mounted, dead-front, dead-rear type, front and rear
aligned, self-supporting, consisting of one or more vertical sections with
bussing, circuit protective devices, instrumentation, auxiliary devices and
control wiring as indicated on the Drawings and as specified herein. Close-
coupled to the unit substation transformer.

a. Unit substations located indoors shall be service entrance rated and
approved.

b. Switchboards shall employ mounting configuration for circuit protective
devices as follows:

1) Group-mount, fixed position, non-drawout switchboards. Front
access only, shall not require rear access. Typical for all circuit
protective devices, or as indicated on Drawings.

2) Individual-mount, fixed position, non-drawout employing individual
"cells", rear-accessible load circuit connects switchgear. Typical for
all circuit protective devices, or as indicated on Drawings.

3) Individual-mount with horizontal drawout, employing individual
"cells", rear-accessible load circuit connects switchgear. Typical for
all circuit protective devices, or as indicated on Drawings.

c. Switchboards shall employ circuit breakers types and circuit protection
devices as follows:

1) All Main circuit breaker of all frame sizes – ICCB type circuit
breakers.

2) 800 ampere and larger frame size Feeder circuit breakers, ICCB
type circuit breaker.

3) Smaller than 800-ampere frame size Feeder circuit breakers, ICCB
type; or MCCB type circuit breakers.
4) CLCB type circuit breakers. CLCB circuit type only where noted on the Drawings.

5) CLF with switch and fuse type. CLF with switch and fuse type only where noted on the Drawings.

2. Switchboard shall be designed, built and tested in accordance with applicable portion of the latest editions of NEMA PB-2, Underwriters Laboratories No. UL-891 and the National Electrical Code. Rated for service-entrance operation.

3. Switchboard sections configuration
   a. Floor standing self-supporting, of the universal frame type using die-formed, 12-gauge steel members bolted and welded together.
   b. Provide removable side and rear plates with formed edges all around.
   c. Provide ventilation openings required for maintaining nominal operating temperature.
   d. Provide removable steel cover plates for all usable device spaces. Provide lifting means and provisions for moving by means of rollers or skids to installation location.
   e. Bolt individual sections together to form a single rigid switchboard assembly.
   f. Provide full height, hinged, vertical wireway metal covers, on each vertical wireway, of each distribution section of the switchboard.
   g. Typical for all switchboards, distribution switchboards and switchgear.

4. Switchboard shall include, but not be limited to, the following:
   a. Current transformer space.
   b. Main disconnects devices.
   c. Distribution and feeder circuit protective devices.
   d. Owner metering
   e. Bussing, incoming from transformer and outgoing distribution.
   f. Transient Voltages Surge Supressor Protection – (TVSS).

5. Switchgear Outgoing Sections
   a. Additional requirements for switchgear configuration (in addition to the requirements described for Switchboard configuration).
   b. Each circuit protective device shall be individually metal enclosed cells, isolated from all other circuit protective devices.
   c. “Main” and “Tie” and “Feeder” circuit protective devices shall be individual-mount horizontal drawout rear connected load lugs. Feeder load connections shall be completely isolated from all other “energized” line side bussing.
   d. “Main” and “FEEDER” and “Tie” circuit protective devices shall be individual mount, horizontal drawout, with automatic dead-front shutter devices, protection devices position indication switches, lifting bars, control power source, racking tool, shunt trip with auto charge capacitor trip, electrical “on-off” remote control with electrical “charging” closing-motor and secondary control disconnects.
      1) Provide four (4) position racking of circuit protection devices, “connected-test-disconnected-remove”. Mechanical and electrical interlock Racking position with visible indicators on the front access doors. Provide electric motor operated "racking-unracking" with remote control functions. Shall reduce exposure of Operating Personnel to ARC-FLASH risk during device operation faults. Provide remote control portable operation controller.
      2) Remote “open-close” electric operation of each circuit protection device, typical for “Main”, “Feeders” and “Tie”.
3) Provide a "Dolly", traveling portable lift and transport device for drawout devices. Dolly shall include remote electric motor operation for device racking-unracking insert/withdraw operations. Shall reduce exposure to ARC-FLASH risk during device insertion and removal.

4) In addition to the protection requirements described elsewhere for circuit protection devices, provide loss of phase voltage and reverse power flow (Phase A, Phase B, and Phase (C) detection relays with auxiliary relay contacts for each "Main" device).

5) "Main" and "Tie" circuit protection devices shall be electrically and mechanically interchangeable with each other.

6) Provide electrical and mechanical interlocks on "Main" and "Tie" circuit protection devices. The interlocks shall prevent all parallel "closed" operation of "Main" devices through the "Tie" devices.

e. Circuit protective devices both fixed individual-mount and horizontal-drawout types, shall be electric motor operated remote control "on-off" for open/close functions. Shall reduce exposure of operating personnel to ARC-FLASH risk during device operation faults. Provide remote control portable operation controller, with not less than 25 foot portable plug-in length for operator with controller and cable.

f. Metalized individual compartmentalized and metal barrierd segregated construction:
   1) Segregated individual front accessible each circuit protection device cell.
   2) Segregated between incoming and outgoing cable compartments, rear field accessible.
   3) Segregated horizontal main bus and riser bus. Field removable maintenance access covers for connects hardware.
   4) Dead front automatic plug-in shutters and pad-locking devices for each "racking" operation.

g. Switchgear shall employ circuit breaker types and circuit protection devices as follows:
   1) All Main circuit breakers and Tie circuit breakers – PCB type circuit breakers.
   2) 800 ampere and larger frame size Feeder circuit breakers – PCB type circuit breakers.
   3) Smaller than 800 ampere frame Feeder circuit breakers – PCB type; or ICCB type; or MCCB type circuit breakers.

h. Switchgear shall be designed, built, tested, listed and labeled in accordance with applicable portion of the latest editions of NEMA, Underwriters Laboratories and the National Electrical Code (NEC), including but not limited to:

   1) Switchgear as follows

   |
| --- |
| Standard | Description |
| ANSI C37.20.1 | Metal-enclosed low voltage circuit breaker switchgear. |
| ANSI C.37.51 | Testing of metal-enclosed low voltage AC circuit breaker switchgear |
| NEMA SG-5 | Power switchgear assemblies |
| CAN/CSA C22.2 No. 31-M89 | Switchgear assemblies |
| ICC/IBC and CBC | Local seismic requirements. |
| UL 1558 | Switchgear assemblies |
2) Main and feeder and tie circuit breakers in switchgear shall be designed, tested, manufactured, listed and labeled including but not limited to:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSI C37.13</td>
<td>Low voltage AC power circuit breaker used in equipment.</td>
</tr>
<tr>
<td>ANSI C37.16</td>
<td>Preferred rating, related requirement and application recommendations for low voltage power circuit breakers and AC power circuit breakers.</td>
</tr>
<tr>
<td>ANSI C37.17</td>
<td>Trip devices for AC and general-purpose dc low voltage power circuit breakers.</td>
</tr>
<tr>
<td>ANSI C37.50</td>
<td>Testing of low voltage AC circuit breakers.</td>
</tr>
<tr>
<td>NEMA SG-3</td>
<td>Low voltage circuit breakers.</td>
</tr>
<tr>
<td>UL 1066</td>
<td>Low voltage circuit breakers.</td>
</tr>
</tbody>
</table>

F. Transient Voltage Surge Suppressor – TVSS
1. Provide a 3-phase, 5-wire TVSS in the secondary outgoing section with 30-ampere 3-pole subfeed circuit breaker.
2. See Specification Section 16050 for TVSS additional requirements.

2.09 METERING (OWNER METERING)

A. General
1. The meters shall be microprocessor controlled, digital, multi-function measuring and indicating meters. The meter measurement sensing method shall be true RMS. As manufactured by Electro Industries Model DMMS300, Square D, General Electric, Westinghouse or equal.
2. Meter face size approximately 4.5-inches by 4.5-inches. Overall depth approximately 8.0-inches. Semi flush mounting, self-contained, dust proof, insulating electrical housing.
3. Ambient temperature operating ranges 0 degrees Centigrade to 55 degrees Centigrade.
4. The meter shall be rated to accommodate single phase and "DELTA" or "WYE" three phases, direct voltage connection up to 600 volts AC.
5. The meter shall accommodate input connection through Potential instrument Transformer (P.T.) for voltages in excess of 600 volts. Meter burden shall not exceed 6.0 volt amperes.
6. The meter shall be rated to accommodate input connection through instrument Current Transformer (C.T.) up to 12,000 amperes, with a secondary C.T. current up to 10 ampere.
7. The meter scales shall be field programmable for any C.T. and P.T. ratios.
8. Provide a meter on the secondary side of the unit's substation and as indicated on the Drawings.

B. Meter Indications
1. Meter indications shall be alphanumeric, LED display type, and 0.56-inch minimum character height. Meter indications shall simultaneously display the numerical value(s) being measured and the name of the measured value (i.e. "1586329 TOT. KWH" etc.). Meter display update time 1-second.
2. Minimum meter display operating life shall be 100,000 hours.
3. Meter withstand ratings:
   a. Continuous 200% of rating.
b. Surge 10 times rating for 3 seconds.

C. Meter Monitoring and Measurement Range

1. The meter shall provide multi-function monitoring for all combinations of phase to phase and each phase to neutral of the following parameters in a single self-contained digital meter unit;

<table>
<thead>
<tr>
<th>Measurement Indication</th>
<th>Accuracy</th>
<th>Resolution</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kilowatts</td>
<td>0.5%</td>
<td>0.1%</td>
<td>0 to 1,000,000</td>
</tr>
<tr>
<td>Kilowatt Hours</td>
<td>0.5%</td>
<td>1kW Hr</td>
<td>0 to 1,000,000,000</td>
</tr>
<tr>
<td>Kilowatts Max-Min Demand</td>
<td>0.5%</td>
<td>0.1%</td>
<td>0 to 1,000,000</td>
</tr>
<tr>
<td>Kilovolt Ampere Hours</td>
<td>0.5%</td>
<td>1kVA Hr</td>
<td>0 to 1,000,000,000</td>
</tr>
<tr>
<td>Kilovolt Ampere Reactive</td>
<td>0.5%</td>
<td>0.1%</td>
<td>0 to 1,000,000</td>
</tr>
<tr>
<td>Kilovolt Amperes</td>
<td>0.5%</td>
<td>0.1%</td>
<td>0 to 1,000,000</td>
</tr>
<tr>
<td>Power Factor</td>
<td>1.0</td>
<td>1.0%</td>
<td>1.0 to + 0.5</td>
</tr>
<tr>
<td>Ampere</td>
<td>0.35%</td>
<td>0.1%</td>
<td>0 to 10,000</td>
</tr>
<tr>
<td>Volts</td>
<td>0.35%</td>
<td>0.1%</td>
<td>0 to 100,000</td>
</tr>
<tr>
<td>Frequency</td>
<td>0.02Hz</td>
<td>0.01Hz</td>
<td>10Hz to 125Hz</td>
</tr>
<tr>
<td>Total Harmonic Distortion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current &amp; Voltage Input to 31st Harmonic</td>
<td>0.5%</td>
<td>0.2%</td>
<td>0 to 100%</td>
</tr>
</tbody>
</table>

2. The measurement indications shall display continuously in sequence; by individual continuous measurement; or no display (display-off) when programmed from the meter front control panel.

3. The minimum and maximum average time range shall be adjustable from instantaneous through 9999 seconds. The average time range shall be programmable from the meter front control panel to provide an instantaneous and average over time of any meter measurement indication, in any combination of measurement indications.

4. The minimum and maximum for each measurement indication shall be stored in internal memory and displayed on the alphanumeric meter display when requested from the meter control panel by the operator.

5. The meter shall store in non-volatile internal memory the following information. The stored data shall be retained even during a power failure to the meter. The information shall be recalled to the meter display from the meter front control panel:
   a. Meter preset program parameters.
   b. Maximum and minimum measurement indications.
   c. Total kilowatt-hours.
   d. Total kilovolt ampere-hours.
   e. Kilowatt demand.

D. Meter Programming and Control

1. A control panel on the front of the meter shall provide user access to all meter displays, functions and programming features. A password protection entered from the front control panel shall be provided prior to allowing any programming or set point changes to the meter.

2. The meter shall provide “data logging”; monitoring and communications for each respective circuit breaker located the same equipment at the meter. The meter shall also provide password-protected software programming of circuit breaker operating parameters, and monitoring characteristics.

E. Communications Ports and Protocols Meter Connection.

1. EIA serial port RS-485.
2. IEEE-Fast Ethernet RJ-45 port.

2.10 MISCELLANEOUS INSTRUMENTS

A. Instrument and Control Transformers: ANSI C57.13 and NEMA ST20 as applicable. Transformers shall be specifically designed for use on respective protective relay or metering schemes utilized.

B. Current transformers meter/relay grade shall be multi-ratio tap, tap setting as indicated on Drawings, (minimum of three field adjustable tap settings) with 5-amp secondary, insulation class, 600 volt, 60Hz, single ring type, and shall have an accuracy Classification of 0.3 with the burden of B.01, B.02 and B.03.

C. Control and transfer switches shall be of the rotary, oil-tight multi-position, cam-operated, multi-stage type, with dust cover and silver-to-silver contacts rated 600 volts, 20amp and adequate for the duty performed in excess of 10amp. Equip each switch with engraved plastic escutcheon nameplate identifying its function and position.

2.11 CONTROL WIRING

A. Terminal blocks with barriered terminals for each connection shall be provided for all control wiring terminator points. Control wiring shall be run in horizontal and vertical, isolated, internal metal wireways and shall be carried across hinges in laced bundles. Wire terminators shall be crimp-on type spade terminal

B. Secondary control wiring shall be a minimum of 14 AWG stranded copper type SIS 600-volt insulation.

C. Control circuits shall have circuit number tags at each termination or break in the wire to match circuit numbers on terminal strips and control wiring diagrams.

2.12 MISCELLANEOUS

Provide painted signs on housing doors, minimum 3-inch letters: "WARNING HIGH VOLTAGE AUTHORIZED PERSONNEL ONLY".

2.13 FORCED-AIR COOLING EQUIPMENT:

A. General:
   1. Provide transformer forced air, fan cooling for unit substation transformers 300kVA and larger. The equipment shall consist of cooling fans, temperature-sensing devices, and controls, complete with housing, mounting devices, and wiring. Operation of the cooling fans shall be automatically controlled by temperature-sensing devices. Connect a manually-operable switch in parallel with the automatic control contacts. Enclose the controls in a cabinet located on the side of the transformer or mount the temperature control module on the front panel of the transformer enclosure at a height not greater than 60 inches above.

   2. Cooling fans shall increase the unit substation transformer and outgoing secondary load capacity an additional amount as follows:
      a. Dry type transformers, 30% increase.
      b. Cast coil transformers, 15% increase.
      c. Liquid filled transformers, 15% increase.
B. Operation

1. Cooling Fans: Motors shall be rated for the same voltage as secondary winding or an auxiliary power transformer shall be furnished. The auxiliary transformer shall be provided with primary and secondary over current protection. The fan motors shall be of totally enclosed fan cooled construction, 1 phase, ball bearing, continuous duty rated with 3-wing blades; direct drive blower wheels will also be accepted.

2. Temperature-Sensing Devices: Thermal sensors shall be embedded in the hot spot area of each secondary coil (a single top fluid sensor for liquid filled transformers) to provide the most precise measurement of heat rise performance.

3. Three-phase electronic temperature monitor unit accepting input from three (3) thermal sensors. The monitor shall track the temperature of the transformer with automatic digital displays and functions controlled by the signal received from the hottest phase. Unit features shall include temperature monitoring of each transformer coil, hottest phase temperature display, temperature display of any phase, two (2) SPST contacts for both local and remote fan control, temperature alarm, and trip functions, manual fan operation, local alarm with local and remote silence feature. Monitor unit shall be suitable for use on 120, 240, 277 volts AC, 60Hz supply power. It shall employ an automatic fan exerciser, which shall energize fans for approximately 1-minute every 6-days.

C. TRANSFORMER TEMPERATURE FOR FUTURE FORCED-AIR COOLING EQUIPMENT:

1. Dry-Type: Winding Temperature on Class AA Transformers 300kVA and above: Shall include sensors directly in the air ducts of each coil to monitor coil temperature. Provide for mounting of cooling fans at bottom or top of core/ coils.

2. Liquid filled transformers, provide support brackets for mounting cooling fans on transformer housing and radiator-fins.

3. Provide 60Hz AC operation electrical control power connection/source and disconnect for cooling equipment.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

A. Electrical Installation shall conform to ANSI C2, NFPA 70, and to the requirements specified herein. All equipment and materials shall be new unless indicated or specified otherwise.

B. Prior to Energizing and Testing, Manufacturer’s Field Engineer shall visually inspect and verify devices are operational and bus connects complete.

3.02 ANCHORING OF EQUIPMENT SHALL BE IN COMPLIANCE WITH THE EARTHQUAKE SEISMIC VERTICAL AND LATERAL ACCELERATION INSTALL LOCATION AND CBC/IBC RATED. SUBMIT STRUCTURAL CALCULATIONS AND DETAILS.

3.03 TORQUE INTERCONNECTING BUSSING BOLTS AND ANCHOR BOLTS PER MANUFACTURER’S DIRECTIONS.
3.04 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect equipment and switchgear, furnished under this or other Sections as indicated on Project Drawings, the Shop Drawings, and as specified herein.

3.05 FIELD TESTS, INSPECTIONS, AND COMMISSIONING (ADDITIONAL REQUIREMENTS)

A. Test all equipment after the installation has been completed, and the OWNER’S Representative has been given 10-days’ notice of the proposed tests. The CONTRACTOR shall provide operating tests demonstrating that all equipment and devices operate in accordance with the requirements of the documents.

B. Adjustable Settings
   1. Shall be set and tested after the equipment installation is complete, for proper operation at set points, pickup, and/or drop-out points. Shall be performed by an independent Test Laboratory and Trained Certified Technicians actively engaged in testing and using test instruments designed and manufactured for the purpose.
   2. Provide protection device settings and test, to insure operation and coordination as described in the time/current coordination final submittal, and in accordance with the Contract Documents.
   3. Calibrate and testing shall comply with the Equipment Manufacturer recommendations.
   4. Correct deficiencies, non-compliant equipment and retest to demonstrate compliance.
   5. Submit reports to OWNER’S Representative, six (6) copies.

C. Acceptance Checks and Tests: Perform in accordance with the Manufacturer’s recommendations and NFPA 70B, Appendix I and ANSI C57.94. Perform work in a careful and safe manner so as not to endanger personnel or equipment. Acceptance checks and tests shall include, but not be limited to, the following:
   1. Inspect devices, equipment, etc., for damage or maladjustment caused by shipment or installation.
   2. Remove wedges, ties, and blocks installed by the Manufacturer to prevent damage during shipment.
   3. Verify ground lugs and grounding connections.
   4. Verify that the proper phase sequence in maintained.

3.06 MISCELLANEOUS

A. Provide painted signs on equipment housing doors, minimum 3-inch letters "DANGER HIGH VOLTAGE, KEEP OUT, AUTHORIZED PERSONNEL ONLY".

END OF SECTION
120715/223015
SECTION 26 1800

INTERRUPTER AND SECTIONALIZING SWITCHES

PART 1 - GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
1. Examine all other Specification Sections and Drawings for related work required to be included as work under Division 26.
2. General provisions and requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Submit product data sheets for all transformers, device relays, anti-condensation equipment, enclosures, disconnects, fuses and meters.

B. Submit Detailed Shop Drawings including Dimensioned Plans, elevations, details, schematic single line, point to point wiring diagrams and descriptive literature for all component parts. Submit scaled Plans and Elevation View Drawings.

C. Submit full-scale time/current transparencies on log/log paper for all fuses, circuit breakers, ground fault system devices, and relays.

D. SHORT CIRCUIT, COORDINATION AND ARC-FLASH
1. Perform and submit engineered settings for each equipment location, fuse and adjustable circuit breaker device, showing the correct time and current settings to provide the coordination within the limits of the specified equipment, per the latest applicable standards of IEEE and ANSI. Provide electrical system short circuit fault analysis, both 3-phase line-to-line and 1-phase line-to-ground calculations as part of the Coordination Analysis recommendations. Provide Electric ARC-FLASH calculations as part of the Coordination Analysis recommendations.
2. The information shall be submitted in both tabular form and on time current log-log graph paper, with an Engineering Narrative. Written narrative describing data, assumptions, analysis of results and prioritized recommendations, six (6) copies.
3. The goal is to minimize an unexpected but necessary electrical system outage and personnel exposure to the smallest extent possible within the fault occurrence location, using the specified Contract Equipment. Shall comply with, but not limited to:
   b. IEEE-399, Recommended Practice for Industrial and Commercial Power System Analysis.
   d. CEC/NEC

E. Submit Transformer Test Reports
F. Factory Tests: Switchgear tests - ANSI C37.72.E Certified copies of design tests, production tests, and conformance tests of the switchgear shall be submitted and reviewed on the Project Site. In lieu of the above tests, a report of these tests previously performed on identical units of each rating will be acceptable.

1.03 APPLICABLE STANDARDS

The Switchgear Equipment shall be designed, tested, and assembled in accordance with the latest applicable standards of National Electrical Code, ANSI, IEEE, and NEMA and UL.

PART 2 - PRODUCTS

2.01 FUSED INSULATED LOAD INTERRUPTER SWITCHES

A. General
1. Medium voltage, metal enclosed switchgear, consisting of Current Limiting Fuses, "SF6" or "Vacuum" insulated sealed bottle, current interrupters and integral, visible air gap, isolation switch. As manufactured by McGraw Edison PCME Series or Square D. VISI-VAC Series.
2. The equipment shall be tested to ANSI C37.72.1 and other applicable Standards.
3. The completed metal-enclosed switchgear shall have the following electrical ratings:

<table>
<thead>
<tr>
<th>System</th>
<th>System</th>
</tr>
</thead>
<tbody>
<tr>
<td>4160 Volt</td>
<td>12000 Volt</td>
</tr>
</tbody>
</table>

a. Maximum circuit voltage, to ground 5kV 15kV
b. Continuous Current 600 Amps 600 Amps
c. Impulse BIL 60kV 95kV
d. 60Hz Withstand 36kV 36kV
e. Load Break Interrupting 12,500 Amp 12,500 Amps
f. Momentary Current Without Fuses) 20,000 Amp 20,000 Amp
   (Asym. RMS) (Asym. RMS)
g. Momentary Current with current Limiting Fuses 40,000 Amp 40,000 Amp
   (Asym. RMS) (Asym. RMS)
h. Fault Closing Current 20,000 Amp 20,000 Amp
   (Asym. RMS) (Asym. RMS)
i. One Second Rating with Fuses 20,000 Amp 20,000 Amp
   (Sym. RMS) (Sym. RMS)

B. Switch Structure
1. The switch frame shall have structural anchor points permanently attached to the assembly, to provide for bolting the switch sections securely to floors and walls.
2. The Switch Manufacturer at the factory shall provide internal interconnections.
3. Switch components shall be front and rear accessible for normal maintenance. Rear access of primary incoming line conductors shall be provided. Access shall be provided for outgoing line and load conductors, top or bottom conduit entrance as indicated on the Drawings. Conduit and conductor space shall meet NEC requirements.
4. Ventilating openings (if required by the Manufacturer) in the enclosure shall be located to insure proper cooling at installed equipment at the locations shown
on the Drawings. Provide expanded metal screens on vent opening. Construction shall prevent entry of rodents into the equipment interior.

5. Finish paints indoor equipment. Rust inhibitor primer with Manufacturer's standard finish color, final paint coat over primer.

6. A prominent nameplate bearing equipment ratings, Manufacturer identification, and reference serial numbers operating instructions shall be mounted on the front of the unit.

7. The equipment enclosure shall not require routing of line and load side conductors in front of the switch/fuse compartment.

C. Bussing

1. Horizontal and vertical busses shall be full lengths. Busses shall have a minimum withstand rating equal to available fault current indicated on Drawings, but in no case shall the rating be less than 400 MVA RMS symmetrical at indicated operating voltages.

2. Provide interconnected ground bus in each section.

3. Provide space, all hardware and mounting attachments for future devices as indicated on the Drawings.

4. Main horizontal bussing shall be full capacity in all equipment sections.

5. The bussing shall be of sufficient cross-sectional area to meet UL Standard 891 on temperature rise. Buss shall be copper with silver plated bus joints. The through buss shall have provisions for the addition of future sections. The through bus supports, connections and joints shall be bolted with grade 5 hex head bolts and Belleville washers to minimize maintenance requirements.

6. Primary bussing shall be fully insulated with a factory applied, extruded bus insulating material. All primary bussing shall be supported on porcelain insulators. Primary bussing BIL shall be 95kV for 15kV class and 60kV for 5kV and 2.5kV Class.

D. Conductor Terminations

1. The incoming and outgoing lines shall be provided with factory filled porcelain "slip-on" type with stress cone relief cable terminations for the incoming and outgoing feeders entering the section as indicated on the Drawings, provide support brackets on equipment frame for cable terminators. Provide 4-bolt spade lug connector, bolt to bus with grade 5 HEX head bolts and Belleville washers.

   a. BIL 110kV
   b. Current Rating same as feeder cable
   c. 1 minute dry AC test 50kV
   d. 6 hour dry, AC test 35kV
   e. 10 second wet, AC test 45kV
   f. 15 minute dry, DC test 75kV
   g. Cable diameter and type as show on Drawings.

E. Circuit Interruption

1. The switch mechanism shall be fixed mounted, load interrupting, quick-make, quick-break stored energy operating mechanisms with electrically operated shunt trip to open switch. Switches shall be 3 pole, two-position gang operated. Switches shall be designed to meet NEMA Standards for a Class A device.

2. A electrically operated, stored energy charging mechanism shall be provided, isolated form the line and load voltages and coupled to the stored energy mechanism.
3. A manually operated stored energy charging mechanism shall be provided to allow opening and closing the switch and charging the stored energy mechanism. The manual system shall be operable independent of any of other switch operating mechanism. The manual operator shall be accessible on the front of the switch housing and operable without requiring opening the switch or fuses access doors.

4. The switch operator shall provide positive identification of the switch position "open" - "closed".

5. **Switch Contacts and Operation**
   a. The main circuit load break arc interruption and load make shall occur with open-close moving metal contacts enclosed inside sealed, insulated envelope bottles, one per phase. The insulated bottles shall contain an insulating Vacuum or "SF6" insulating gas as the electric arc quenching medium after the moving main contacts have separated.
   b. A visible air gap, open-close moving switch blade one per phase shall be provided to isolate the load make/break contacts from the incoming line side circuit. The isolation switch shall be integral with the insulated envelope load make/break bottle mechanism or connected upstream in series with the envelope bottles.
   c. Upon initiating a switch "open" action the main load make/break contacts shall separate and open prior to the isolation switch contacts separating and opening. Upon initiating a switch "close" action the main load make/break contacts shall make and close prior to the isolation switch contacts closing.
   d. The operation of the main load make/break contacts and the isolation switch contacts shall be fully integrated with a single operating switch mechanism. Total switch "close" or "open" operating time shall be less than 4 cycles of the 60Hz-line frequency.

5. A door mounted viewing window shall provide observation of the air isolation switch contacts.

6. Means shall be provided to padlock the switch in the open or closed position.

7. Provide lightning arrestors mounted inside the compartment, one per phase distribution type, connected between the switch and fuses.

8. Access to fuses while energized shall be positively prevented through a mechanical interlock system which keeps the fuse section front door locked closed when the switch is in the closed "energized" position.

9. A fixed internal safety barrier to prevent inadvertent contact shall guard any internal parts that remain energized with the switch contacts open by operating or maintenance personnel with the door open. Interphase insulating barriers shall be provided for the system voltage class, to isolate switch and fuse poles from each other and from grounded metal.

10. Non-expulsion current limiting fuses with a short circuit interrupting rating of 50,000 amperes RMS symmetrical shall be supplied fixed mounted on the load side of each main switch pole. The fuse continuous current rating shall be in accordance with the Manufacturer's recommendation to adequately protect the transformer from damaging overloads. Fuses shall provide a visible "Blown-fuse" indication. Fuses shall be removable from the front without special tools.

11. Provide single phasing protection, to automatically cause the switch contacts to open, in the event one or more fuses open due to overload or short circuit conditions.
F. Control Power
   1. Provide a primary fused potential transformer or control power transformers on the incoming line side of the switch provide 120 volt. 60Hz AC power to operate the stored energy charging mechanism, auto charge capacitor trip unit, and pilot lights. Fuses and transformers shall be trunnion mounted.
   2. Provide "auto-charge" capacitor trip device consisting of an automatic battery charger. Under normal conditions, with 120-volt AC control power used for the stored energy charging mechanism, a self-contained, sealed, rechargeable, nickel-cadmium battery shall be maintained at full charge by an automatic battery charger connected to the 120-volt AC source. Upon loss of AC power, a voltage amplifier shall step up the battery voltage to the higher voltage needed to maintain the circuit breaker tripping charge on the capacitor for a minimum of 2-days. The capacitor units shall provide direct current storage and tripping power for each switch.

G. Controls - shall be mounted in the front door of the switch with rear barriers to isolate the components from line and load voltages.
   1. Provide "open-close" switch pushbuttons on electrically operated switches.
      Provide "open" pushbutton on manually charged switches.
   2. Provide separate pilot lights with push-to-test to indicate the following conditions:
      a. Green - indicating switch in the open position.
      b. Red - indicating one or more blown fuses.
      c. Yellow - indicating the incoming line voltage is energized.
   3. Provide automatic zero sequence ground fault relay tripping of the switch.
   4. Provide current transformer and metering as indicated on Drawings.

H. Provide voltage surge arrestors, one per phase on the load side of the switch main contacts.

2.02 SECTIONALIZING SELECTOR SWITCHES

A. General
   1. Manually operated load interrupting, gas SF6, insulated switches for indoor and outdoor pad mounted enclosure application.
   2. The units shall be designed, tested, and assembled in accordance with the latest applicable standards of ANSI-C37.71 and IEC 265.
   3. Switches as manufactured by G & W Electric Co. type RAM (two (2) positions) or RAC (three position) as indicated on Drawings, or equal.

B. Electrical Ratings and Standards
   1. Switches shall be designed, tested and built to the following design voltage:
      a. Maximum circuit voltage to ground .......................................................... 15.5kV
      b. Impulse Level (BIL) .................................................................................. 110kV
      c. 60HZ AC 1 Minute Withstand ................................................................. 34kV
      d. DC 15 Minute Withstand ......................................................................... 53kV
      e. Continuous Current and Load Break, Interrupting .............................. 600 Amp
      f. Momentary Current Withstand ................................................................. 40,000 Amp (Asym. RMS)
      g. Close-and-latch fault-close capability 3time ........... 40,000 Amp (Asym. RMS)
      h. One Second Current Withstand ............................................................ 25,000 Amp (Sym. RMS)

C. Switch Configuration
   1. Switches shall be or vertically or horizontally mounted with bottom or side conductor entrances as shown on the Drawings.
2. Each switch handle shall have three (3) conductor entrance ways for each switched way as shown on the Drawings.
3. Each switch way shall be two (2) positions "open-close" (RAM) or three (3) position "close-open-close" (RAC) as indicated.

D. Switch Construction
1. Switch components and entrances shall be assembled in a single ¼-inch thick mild steel tank with entrances internally connected by copper wire ropes and bus bars capable of handling momentary and continuous current duty. The switch tank shall accept the conductor entrances listed elsewhere in this Specification without the need for field contact alignment prior to energizing.
2. Switches shall be shipped factory filled with SF6 insulating gas. Tank shall be designed to withstand 15 PSIG internal pressures and an external pressure of 14 PSIG without affecting the performance of the switch.
3. The following standard components shall be included:
   a. Filling valve.
   b. Four (4) lifting eye provisions.
   c. Viewing windows to permit inspection of the switch contacts in the open/off position.
   d. Gas pressure gauge.
   e. Grounding provisions for one ground conductor connection per switch way plus provisions for one tank ground conductor connection.
   f. Corrosion resistant tank design using stainless steel and brass fasteners with no external aluminum parts.
   g. One (1) line diagram and stainless steel nameplate fastened with stainless steel mechanical fasteners.
   h. Compression spring operator.
   i. Welded mild steel lids.
   j. Tank coating to be ASA 70 light gray vinyl paints three-mil thick minimum.
   k. Pad-lockable, operating mechanism with position indication.

E. Conductor Entrances
1. Entrances shall be rated 110KV BIL for 15kV and of the following:
   a. Side conductor entrance - 600 amp or 200 amp apparatus bushings, non-load break for connection of non-load break elbow, conductor connections. 200 amp for conductor sizes smaller than 4/0 AWG, 600 amp for conductor sizes 4/0 AWG and larger.
   b. Bottom conductor entrance - 600 amp three single conductor stud bushings with removable compartments filled with non-hardening insulating compound. Bushings shall be rated 40,000 amp asymmetrical momentary, 25,000 amp symmetrical short time current, 110kV BIL for horizontal mounted switch tank units.

F. Switch Operation
1. Each switching way shall be equipped with an internally mounted operating mechanism, providing quick-make, quick-break operation in either switching direction. The mechanism shall deliver sufficient torque and shall be provided with latches for each position to assure load interrupting, fault closing and momentary ratings. The mechanism shall use compression type springs to insure long life and reliability. All switch positions are to be clearly identified and pad-lockable. Pad-lockable ground stops shall be provided on switches with internal grounding capability.
2. The operating mechanism shall be actuated from outside the switch tank by a removable, breakaway handle. The operating handle shall assure operation in the proper direction and prevent rapid reversal of the switch contacts.

3. The operating shaft shall be made of stainless steel for maximum corrosion resistance. A "0" ring type operating shaft seal shall be used for a leak resistant, long life seal.

G. Switch Contacts
Switch contacts shall be plated, high-conductivity copper alloy to assure permanent low resistance and to avoid sticking during operation. The contacts shall be designed so arcing does not occur in the area of main current interchange and the contact pressure shall increase with increasing current flow. Contact travel shall be 60 degrees and have sufficient open contact separation to assure efficient arc extinction and to withstand field DC testing levels and maintain BIL levels. Temperature rise shall not exceed ANSI C37.71 and IEC 265 standards for this type of device. Switch contacts shall be clearly visible in the open position.

H. Mounting Frames
1. For vertical switch tank mounting, frames shall be constructed of steel channels supplied as standard, to the bottom of the switch to provide a 5-inch clearance from the floor and to allow clearance of switch operating handles above floor line and enclosure.

2. For horizontal switch tank mounting, frames shall be of sufficient height to allow bottom termination of conductors at the entrance bushings.

3. Frames and channels shall be of bolted hot dip galvanized steel construction. Galvanized enclosing panels shall be supplied for the cable entrance compartment.

I. Factory Production Tests
Bulk SF6 gas supply shall be tested for dielectric strength and moisture content. Each individual switch shall undergo a mechanical operation check and a leak test. Switch shall be factory filled with SF6 gas and AC hi-pot tested at 40kV, 1 minute phase-to-phase and phase-to-ground and across the open contacts. Circuit resistance shall be checked on all ways.

2.03 CONTROL WIRING

A. Terminal blocks with barriered terminals shall be provided for all control wiring terminator points. Control wiring shall be run in horizontal and vertical, isolated, internal metal wireways and shall be carried across hinges in laced bundles. Wire terminators shall be crimp-on type spade terminals.

B. Secondary control wiring shall be a minimum of #14 AWG stranded copper type SIS 600 volt insulation.

C. Control circuits shall have circuit number tags at each termination to match circuit numbers on terminal strips and control wiring diagrams.

2.04 PROTECTIVE RELAYS

A. General
1. Protective relays shall be semi-flush, dead-front individual case mounting, drawout construction with test and shorting blocks, extended range (induction disk operation) solid state static.
2. Relays shall incorporate visible, seal-in, externally resettable, target indicators to show trip mode (overcurrent, instantaneous as applicable).
3. Repeat operating accuracy shall be plus or minus 7.5% on time settings, plus or minus 3.5% of current pick-up settings.
4. Pick-up trip-initiating setting ranges shall be as indicated on Drawing or as determined by the Coordination Study.
5. Relays shall operate from 5 amp secondary current transformers and 120 volt secondary potential transformers within specified accuracy ranges from 0 load to maximum withstand rating of related circuit breakers. Relays shall operate with the circuit breaker control circuits. Relays shall incorporate auxiliary contacts for external device operation and shall be provided with all auxiliary devices required for complete and correct system operation.
6. Relay time current curve operating characteristics shall provide selective coordination with new and existing upstream and downstream primary protective relays and fuses. Relay settings will be furnished by the CONTRACTOR to the ENGINEER.
7. Provide inverse, very inverse or extremely inverse relay tripping characteristics and Manufacturers standard setting ranges as determined during Shop Drawing submittal phase and by the Coordination Study.
8. Relays shall comply with ANSI/IEEE C37.90 and C37.2.

B. Time Overcurrent Phase Relay (device type 50/51).
   1. One (1) per phase, non-directional, current-sensitive, A.C. device, operating time shall be inversely related to operating current.
   2. Instantaneous unit shall provide relay operation with no intentional time delay for currents exceeding a predetermined level. Instantaneous trip unit shall have external jumpers to defeat the instantaneous trip element.
   3. The relay shall have field adjustable time delay dial, overcurrent pick-up tap settings as multiples of current transformer ratio, instantaneous trip with tap block range adjustment.

C. Time Overcurrent Ground Relay (device Type 50N/51N).
   1. Same as phase relay type 50/51, except connected in residual current arrangement to provide protection upon phase to ground, fault.

D. If solid state type relays are utilized, provide (1) one complete Manufacturer's Relay Testing system installed in the switchboard.

2.05 INSTRUMENT AND CONTROL TRANSFORMERS

A. General
   1. Instrument and Control Transformers: ANSI C57.13 and NEMA ST20 as applicable.
   2. Transformers shall be specifically designed for use on respective protective relay or metering schemes utilized.

B. Current Transformers
   1. Meter/relay grade, shall be multi-ratio tap, initial tap setting as indicated on the Drawings, with 5 amp secondary.
   2. Insulation class, 15,000 volt, (5000 volt) 60Hz, 95kV (60kV) B.I.L., single ring type, and shall have an accuracy classification of 0.3 with the burden of B.01, B.02 and B.03.
C. Potential Transformers
1. Shall be for insulation class, 15,000 volt, (5000 volt) 60Hz, 95kV (60kV) BIL.
2. Bus voltage to 120-volt ratio and shall have an accuracy classification of 0.3 at rated voltage with the burden of B.01, B.02 and B.03 connected to transformers.
3. Potential transformers and primary fuses shall be one piece horizontal drawout construction, or Trunion mount style.

2.06 MISCELLANEOUS SWITCHGEAR DEVICES

A. Control and Transfer Switches shall be of the rotary, oil-tight multi-position, cam-operated, multi-stage type, with dust cover and silver-to-silver contacts rated 6000 volts, 20 amp and adequate for the duty performed in excess of 10 amp. Equip each switch with engraved plastic escutcheon nameplate identifying its function and position.
1. AC voltmeter switch 4-position (7-position) for line-to-line (and line to neutral) and off indications.
2. Ammeter switches 4-position (7-position) for line-to-line (and line to neutral) and off indications.

B. Anti-condensation heater - each switch equipment section shall contain a factory installed sealed 300 watt, nominal, anti-condensation resistance heating element, with automatic on-off adjustable thermostat and humidistat control, factory wired to fused terminals. Voltage 120 volt, 240 volt, 277 volt, or 480 volt, 60Hz, AC as indicated on the Drawings.

2.07 RATING NAMEPLATES

A. The integrated switchgear assembly shall be provided with a nameplate indicating the Manufacturer's drawing number and the following: voltage ratings (kV, nominal; kV, maximum design; kV, BIL); main bus continuous rating (amperes); short-circuit ratings (amperes, rms symmetrical and MVA three-phase symmetrical at rated nominal voltage); and the momentary and fault-closing ratings (amperes, rms asymmetrical).

B. Each individual bay shall bear a nameplate indicating the ratings of the interrupter device (amperes continuous and interrupting); the rating of fuse in amperes; and the catalog number of the fuse units or refill units (if any).

2.08 TAMPER RESISTANT METAL HOUSING OUTDOOR - NON WALKIN

A. Fabricated, NEMA 3R, non-walk-in sectional 11 gauge metal enclosed, modular housings, weatherproof, tamper resistant. Housing shall be constructed with internal structural frames, suitable to house independent free standing medium voltage switchgear, as shown on the Drawings.

B. Provide an open bottom, for bottom entry of underground conduits, with structural frame base for mounting on a concrete slab. Domed roof to shed water. Housing shall be provided with cooling louver air vents, with screen guards behind louver, quantity and size per Manufacturer recommendation.

C. Full height hinged doors, front, sides and rear of each exposed section requiring equipment access for installation, operation or maintenance. Door, stainless steel hinges, pad-lockable three point door latching, with hold open lock rods and
recessed penta-head tamper resistant bolt, accessible behind door latch. Doors shall be removable and full height to provide unobstructed access to equipment inside the housing.

D. The metal enclosure shall be assembled as an integral unit for mounting on a concrete pad. There shall be no exposed screws, bolts, or other fastening devices, which are externally removable. There shall be no unobstructed openings through which foreign objects such as sticks, rods, or wires might contact live parts. There shall be means for padlocking the compartment doors. There shall be means of bolting unit securely to a concrete pad.

E. The metal enclosure shall be sized to allow unobstructed access to operate and maintain the equipment installed inside the enclosure. Enclosure shall be internally braced to comply with California Seismic Zone 4.

F. The hinge and padlocking assemblies shall be made of stainless steel corrosion-resistant material. Stainless steel hinge pins of 3/8-inch minimum diameter shall be provided.

G. Lifting provisions in accordance with ANSI Standards shall be provided. Jacking and rolling provisions shall be provided.

H. Ground pads connections with threaded fittings for grounding.

I. Finish shall be electrostatically applied finish paint over iron oxide rust inhibitor primer. Finish color shall be Manufacturer's standard color olive green Munsel #7GY3.29/1.5. The bottom side and bottom 6 inches of the equipment shall be coated with 4 MIL minimum thickness rust inhibitor undercoating over finish paint, on all interior surfaces. Finish withstand test without face corrosion or blistering:

J. Exposed Hardware and Hinges shall be Stainless Steel type 302 or 304, tamper resistant.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

A. Electrical Installation shall conform to ANSI C2, NFPA 70, and to the requirements specified herein. All equipment and materials shall be new unless indicated or specified otherwise.

B. Anchoring of Switchgear shall be per California Seismic Zone 4.

C. Torque interconnecting bussing bolts and anchor bolts per Manufacturer's directions.

D. Install and connect equipment, furnished under this or other sections as indicated on Project Drawings, the approved Shop Drawing, and as specified herein.

3.02 INSTALLATION PADS FOR PAD-MOUNT EQUIPMENT

A. General
   1. Pad-mount equipment installation shall conform to the Manufacturer's Shop Drawings and mounting instructions and shall include securing the equipment
to the concrete slab with a minimum of six (6) anchor bolts, per California Seismic Zone 4. Complete installation and material shall conform to the requirements of ANSI C2 and AASHO-H20 traffic rated structures.

2. Equipment concrete slabs shall be set level on grade, with 95% minimum machine compacted fill.

3. Precast concrete slab/pullbox combination shall be as manufactured by Brooks, Jensen, or Christy.

B. Pad-Mounted Equipment

1. Install on 6-inches thick precast, steel reinforced concrete slab on grade. Provide a precast steel reinforced concrete cable pullbox located directly below and in direct contact to the slab. The slab shall have a precast opening “slot” located under the equipment internal incoming/outgoing line compartments to allow cable access thru the pullbox(es) into the equipment.

2. The slab shall have a flush, bolt down, removable 30-inches by 48-inches steel cover safety checker plate, outside of and accessible in front of the equipment cable termination compartments. The removable cover shall allow Field Personnel access into the pullbox under the slab without disturbing the pad-mount equipment.

3. The slab size shall be 8-feet x 10-feet. Increase the slab size to not less than 10-feet by 12-feet where equipment housing or compartments will extend past the edge of an 8 feet by 10 feet slab.

4. A 48-inches by 72-inches by 48-inches deep (nominal) precast concrete pullboxes shall be provided under the slab for each cable entrance location into the equipment incoming/outgoing line sections. The pullbox shall be installed on a precast concrete base to spread the equipment weight evenly around the perimeter of the box. The pullbox shall “key” into the concrete slab and base.

5. Provide 10 feet long 5/8-inch diameter copper clad driven ground rod in bottom of each pullbox.

6. Line side and load side cables shall be racked on opposite walls of each pullbox, with cable racks. Support cable on racks with porcelain cable cradles.

7. Install slab flat on grade 12-inches thick compacted sand base. Install cable pullboxes on 12-inches thick compacted crushed rock under the box. Install cable boxes directly below the slab in contact with slab “keys” and box base “keys”.

3.03 FIELD TESTS AND INSPECTIONS

A. Tests: After the installation has been completed, and the ENGINEER has been given 10 day notice of the proposed test, the CONTRACTOR shall conduct an operating test demonstrating that all equipment and devices operate in accordance with the requirements of the Plans and Specifications.

B. The Relay Setting (where relays are supplied) and Testing shall be performed by a Skilled Technician actively engaged in testing and using test instruments specifically designed and manufactured for that purpose.

C. The CONTRACTOR shall provide a skilled Relay Engineer actively engaged in the business of testing and calibrating power relays and circuit breakers. Certification of such experience shall be provided in writing for the review of the ENGINEER 10-days before the actual testing is proposed. The CONTRACTOR shall furnish Certified Test results and all special equipment required.
D. Testing Shall Verify:
   1. Primary Circuit Polarity Test shall include a DC Test from the current transformer to each terminal block and relay terminal.
   2. Phase Sequence Tests of new circuit connections in relation to existing circuits before interconnections are made.
   3. Relay Switch Operation Test by application of power and current from the portable relay test set.
   4. Test insulation of all control and relay circuits to ground with a suitable megohmmeter. Take suitable precautions where electronic devices, instruments and instrument transformers are involved.
   5. Operate each switch manually and check operation of auxiliaries, interlocks, contact wipe and gap clearances as identified in the Manufacturer's instructions. Test each pole of each switch for conductivity with a micrometer. Test insulation of each switch phase-to-ground and phase-to-phase with a megohmmeter. High potential test Vacuum or SF6 gas chambers.
   6. Check positioning, operation of mechanism and interlocking, both mechanically and electrically.
   7. Energize the control circuits, make polarity and voltage checks. Operate through all local control stations. Operate all relay, sensor and interlocking contacts manually to test operation of all circuits related to tripping of equipment.
   8. Adjust each protective relay to setting furnished to the ENGINEER and verify setting using test equipment approved by the Relay Manufacturer, using current sources that do not require correction curves to compensate for wave shape distortion.
   9. Test each instrument and meter for proper operation, correct rotation and circuitry. Instruments and meters energized from Instrument Transformer shall be tested at transformer secondary level.
  10. Test each current and potential transformer for ratio and polarity. Record values and report deficiencies.

E. Equipment and Apparatus Tests: Unless specific factory-witnessed tests are specified, tests normally made by the Manufacturer will be acceptable for all equipment and apparatus.

F. Certified Phase Rotation Testing shall be performed on connections to existing circuits and between equipment buses prior to energizing equipment.

G. Retesting: rectify and deficiencies found and completely retest work affected by such deficiencies at the CONTRACTOR’S expense.

3.04 GROUNDING (ADDITIONAL REQUIREMENTS)

A. Provide ground conductor connections to ground lugs provided on the equipment.

B. Outdoor pad mounted equipment shall be installed with a minimum of two (2) ¾-inch diameter by 10 feet long copper clad steel ground rods. Install the ground rods spaced a minimum of 10 feet apart. Provide precast concrete pullbox 11-inches by 22-inches by 12-inches deep for each ground rod, mark cover "ground". Connect with underground 1¼-inch conduit and 1#2 minimum ground conductor, between ground rods and equipment.

C. Elbow bushings shield shall be individually grounded to insure the shields are at ground potential.
3.05 SIGNS

A. Install "DANGER HIGH VOLTAGE, KEEP OUT, AUTHORIZED PERSONNEL ONLY" on equipment doors, 3-inches high letters.

END OF SECTION
120715/223015
SECTION 26 2416

BRANCH CIRCUIT PANELBOARDS AND TERMINAL CABINETS

PART 1 – GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
1. Examine all other Specification Sections and Drawings for related work required to be included as work under Division 26.
2. General provisions and requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Provide Manufacturers Catalog Data for Panels, Cabinets, and Circuit Breakers.

B. Provide Shop Drawing showing Panel Circuit arrangements, size, voltage, ampacity, overcurrent protective devices, etc.

C. Provide nameplate engraving schedule.

D. Short Circuit, Coordination and ARC-FLASH
1. Perform and submit engineered settings for each equipment location, fuse and adjustable circuit breaker device, showing the correct time and settings to provide the selective coordination within the limits of the specified equipment, per the latest applicable standards of IEEE and ANSI. Provide electrical system short circuit fault analysis, both 3-phase line-to-line and 1-phase line-to-ground calculations as part of the Coordination Analysis recommendations. Provide Electric ARC-FLASH Calculations as part of the Coordination Analysis recommendations.
2. The information shall be submitted in both tabular form and on time current log-log graph paper, with an Engineering Narrative. Written narrative describing data, assumptions, analysis of results and prioritized recommendations, six (6) copies.
3. The goal is to minimize an unexpected but necessary electrical system outage and personnel exposure to the smallest extent possible within the fault occurrence location, using the specified Contract Equipment. Shall comply with, but not limited to:
   b. IEEE-399, Recommended Practice for Industrial and Commercial Power System Analysis.
   d. CEC/NEC
4. Electrical equipment including switchgear, switchboards, electrical panels, and control panels, transformers, disconnects, etc., shall each be labeled by the Manufacturer with “Electrical-ARC-Flash” warning signs. The signs shall explain a hazard to personnel may exist if the equipment is worked on while
energized or operated by personnel, to wear the correct Protective Equipment/clothing (PPE) when working “Live”, or operating “Live” equipment and circuits.

1.03 SEISMIC EARTHQUAKE AND WIND LOADING WITHSTAND, TESTING AND CERTIFICATION. (ADDITIONAL REQUIREMENTS)

A. General
1. The complete panels and terminal cabinet assemblies; including circuit protection devices, meter, housings/enclosures, accessories, supports/anchors etc., shall be designed, manufactured and tested.
   a. Wind loading all outdoor equipment locations.
   b. Earthquake Seismic Zone-4 and CBC/IBC Seismic withstand all indoor and all outdoor equipment locations.
2. Shall withstand, survive and maintain continuous non-interrupted energized operation during the seismic event occurrences and wind event occurrences. Continued normal energized operation after the wind event and seismic event occurrences have abated.
3. Shall include demonstrations of successful operation and run test after completion of seismic event shake-table simulation. Acceptance test seismic qualification shall employ triple axis shake-table simulation of the Required Response Spectrum (RRS) seismic event motion, certified and approved by the AHJ.
4. Provide three (3) dimensional finite element analysis demonstrating anchorage and operational withstand of wind loading not less than as follows and as required by AHJ:
   a. 100MPH – West Coast States USA and Hawaii.
   b. 150MPH – East Coast States USA, Gulf Coast States USA and Alaska State.
   c. 90MPH – all other USA locations.
5. Seismic Test shall be performed by a third party independent Test Laboratory. Wind Analysis and Seismic Testing and Reports shall be Certified, signed and “stamped” by PE Professional Engineer licensed and in good standing in the State, Civil Engineer or Structural Engineer.

B. Refer to General Commissioning Section 01 9113 for additional requirements.

PART 2 - PRODUCTS

2.01 PANELBOARDS AND DISTRIBUTION PANELS

A. Shall be flush or surface mounting as indicated with group-mount circuit protection devices as shown on panel schedule, hinged lockable doors, index cardholders and proper bussing.
1. Panelboards shall comply with the latest versions:
   a. NEMA – PB1.
   b. UL – 50 and 67.
   c. CEC/NEC.
   d. ASTM-B187.
2. Where indicated on the Drawings shall be furnished with subfeed breakers and/or additional conductor lugs, split bussing, contactors, time switches, relays, etc., as required.
   a. Branch circuit panels up through forty-two (42) circuits shall be single section, to accommodate all of the circuits and components.
b. Distribution panels shall be single section or multi-section, to accommodate all of the circuits and components.

3. Panels shall be “Service-Entrance” equipment rated when the panel main incoming supply feeder originates from one of the following:
   a. Originates outdoors exterior of the building in which the respective panel is located.
   b. Originates from an electrical supply source not located in the same building as the respective panel.

B. Housing and Painting, Panels and Terminal Cabinets
1. Shall be finished with one (1) coat of rust inhibitor zinc chromate and coat of primer sealer after a thorough cleaning.
2. Finish color paint as selected by DISTRICT’s Representative where exposed to public view (e.g., corridors, covered passages, offices, etc.). Prime coated panelboard shall be painted to match surroundings after installation in public areas.
3. Manufacturer’s standard color in electrical rooms/closets, janitors, HVAC and storage rooms.
4. Shall be fabricated of sheet steel of the following minimum gauges.
   a. Full height hinged, locking door. Trim #12 gauge steel; enclosure - code gauge steel.
   b. Panels installed in indoor dedicated electrical equipment rooms and dedicated electrical equipment closets, omit full height hinged locking panel door. Dead front cover behind omitted panel door shall remain.
5. NEMA-1 Metal Housing, for indoor locations.
6. NEMA-3R Metal Housing, tamper resistant, for outdoor locations.
7. Furnish all panels and terminal cabinets with the Manufacturers flush locks and keys except where indicated otherwise herein. Keys and locks shall be interchangeable for all panels. Provide two (2) latches and two (2) locks for door heights exceeding 36-inches.
8. Fasten the trim to panel and terminal cabinets by means of concealed, bolted or screwed fasteners accessible only when the door is open.

C. Panels 208/120 volt, three phase, 4-wire, S/N or 120/240 volt, single phase, 3-wire, S/N.
Branch Circuit Panel as manufactured by:
1. Cutler Hammer “Pow-R-Line 1 or 2” Series
2. General Electric “A” Series
3. Square D “NF/NQ” Series
4. Siemens “P1/P2” Series

D. Distribution Panels as manufactured by:
1. Cutler Hammer “Power-R-Line 3 or 4” Series
2. General Electric “Spectra” Series
3. Square D “I-Line” Series
4. Siemens “P4/P5” Series

E. Top and bottom gutter space shall not be less than 6-inches high. Provide 6-inches additional gutter space in all panels where double lugs are required, or where cable ampere size exceeds bus ampere size. Provide 12-inches additional gutter space in all panels for aluminum feeders where used.
F. Panel Dimensions.
   1. Panels with buss sizes 50 ampere thru 400 ampere
      a. Shall be 20-inches wide. Surface or flush mounting as indicated.
      b. Recess mounted type shall have a 20-inches wide (maximum) recess metal enclosure with overlapping edge trim plate cover extending 1-inch on all sides of enclosure.
      c. Depth shall be 5.75-inches nominal. Height of panel as required for devices.
   2. Panels with buss sizes greater than 400 ampere
      a. Narrow panels 24-inches (maximum) wide by 6.5-inches (maximum) deep units. Wide panels 25-inches to 44-inches (maximum) wide by 8-inches to 15-inches (maximum) deep units. Nominal 90-inch panel height.
      b. The wider units shall be used only at locations where the narrow unit is not available with the quantity or size of large-ampere frame branch/subfeed circuit protective devices shown on the panel schedules, or where the main breaker size exceeds the narrow panel maximum.
      c. Distribution panels shall be floor standing and also supported from behind the panels at walls.

G. Distribution panels and branch circuit panels maximum load rating
   1. Panelboards and Distribution Panels exceeding 800-ampere load rating shall not be permitted.
   2. Provide Distribution Switchboards instead of Distribution Panels for bus load and circuit load ratings exceeding 800 ampere.

H. Panel Auxiliary Cabinets
   1. Panelboards shown on the Drawings with relays, time clocks or other control devices shall have a separate auxiliary metal barrier compartment mounted above panel.
   2. Panelboards with circuits controlled by low voltage remote control relays shall be provided with separate auxiliary cabinets to contain the relays, adjacent to the panelboard.
   3. Provide auxiliary cabinets with separate hinged locking door to match panelboard.
   4. Provide mounting subbase in cabinet for control devices and wiring terminal strips.

I. Panels shall have a circuit index cardholder removable type, with clear plastic cover. Index card shall have circuit numbers imprinted to match circuit breaker numbers.
   1. The panel identification nameplate shall describe the respective panel name and voltage, corresponding to the Contract Documents.
   2. The electrical power source, name and location of each panel supply-feeder and supply equipment name shall also be identified and described on the respective panel nameplate.

J. TVSS - Transient Voltage Surge Suppressor
   1. Provide each of the following branch circuit panel and distribution panel types with a TVSS and RF filtering:
      a. 208/120 volt - single phase and/or three phase.
      b. 120/240 volt - single phase.
      c. 480/277 volt - single phase and/or three phase.
      d. All distribution panels.
2. The TVSS shall be installed inside the respective panel housing and shall be factory connected to each main phase, ground and neutral bus inside the panel.

3. The TVSS monitor/annunciator indicators shall be visible only when the panel access door is in the open position.

4. Provide a 20-ampere 3-pole (2-pole for single-phase panels) branch circuit protection device in each panel for TVSS connection.

5. The TVSS device and panel shall be UL labeled and listed for combined use. See related Specification Sections for additional TVSS requirements.

K. Seismic Earthquake and Wind Loading Withstand, Testing and Certification (ADDITIONAL REQUIREMENTS)

1. The complete panel/panelboard assembly; including circuit protection devices, housings/enclosures, accessories, supports/anchors etc., shall be designed, manufactured and tested for wind loading and Earthquake Seismic Zone-4 withstand.

2. Shall withstand, survive and maintain continuous non-interrupted energized operation (running) during the seismic event occurrences. Continued normal energized operation after the wind event and seismic event occurrences have abated.

3. Shall include demonstrations of successful operation and run test after completion of seismic event shake-table simulation.

4. Provide three (3) dimensional finite element analysis demonstrating anchorage and operational withstand of wind loading as follows:
   a. 100MPH – West Coast States USA and Hawaii.
   b. 150MPH – East Coast States USA, Gulf Coast States USA and Alaska State.
   c. 90MPH – all other USA locations.

5. Acceptance test seismic qualification of proposed panels and panelboards shall employ triple axis shake-table simulation of the Required Response Spectrum (RRS) seismic event motion, certified and approved by the AHJ.

6. Seismic test shall be performed by a third party independent test laboratory. Wind analysis and seismic Testing and reports shall be certified, signed and “stamped” by PE Professional Engineer licensed and in good standing in the State, Civil Engineer or Structural Engineer.

2.02 SHORT CIRCUIT RATING

A. Circuit protective devices and bussing as indicated on the Drawings. All devices and bussing shall have a short circuit fault withstand and interrupting capacity not less than the maximum available fault current at the panel and as indicated on the Drawings, plus a 25% additional capacity (safety margin). However, in no case shall the short circuit fault interrupting and withstand capacity be less than the following symmetrical short circuit.

<table>
<thead>
<tr>
<th>C/B and/or Bus Rating</th>
<th>Circuit Voltage</th>
<th>Short Circuit Amp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 400A and less</td>
<td>240V and below</td>
<td>10,000A</td>
</tr>
<tr>
<td>2. 400A and less</td>
<td>over 240V and below 600V</td>
<td>14,000A</td>
</tr>
<tr>
<td>3. Over 400A &amp; 800A &amp;</td>
<td>below 240V and below 600V</td>
<td>42,000A</td>
</tr>
<tr>
<td>4. Over 400A &amp; 800A &amp;</td>
<td>below 240V and below 600V</td>
<td>30,000A</td>
</tr>
</tbody>
</table>
B. Panel short circuit fault rating
   1. General
      a. Provide a “fully rated” for short circuit fault interrupt and full load ampere main circuit breaker in each branch circuit panel and/or each distribution panel. Provide the main circuit breaker whether or not a main circuit breaker is shown otherwise on the Drawings, Schedules or Diagrams. The “utility-source” plus the “motor-load” transient contributions shall be used to establish the available fault duty values, unless indicated otherwise on the Drawings.
      b. The panel main circuit breaker full load ampere capacity rating shall equal the respective panel main bus ampere rating.
      c. The panel assembly, buss and circuit protection devices bolted fault short circuit withstand and bolted fault short circuit interrupt ratings shall not be less than 125% greater (including a 25% safety margin) than the available utility-source symmetrical and asymmetrical bolted fault short circuit current when “series combined rated” with the panel main circuit breaker.
      d. The main circuit breaker rated “bolted-fault” short circuit fault interrupt and withstand short circuit rating shall not be less than 125% (including a 25% safety margin) of the upstream main service entrance “bolted-fault” available (symmetrical and asymmetrical) short circuit current.
   2. Distribution Panelboards
      a. Distribution panel, main circuit breaker, all feeder circuit breakers, and all branch circuit breakers shall be “fully-rated” (plus safety margin) for the available bolted fault short circuit current (including safety margin).
      b. Shall provide time/current-tripping coordination with downstream equipment and upstream equipment.
   3. Non-emergency branch circuit panelboards 400-ampere buss and smaller;
      Non-emergency branch circuit panelboards 400-ampere trip main circuit breaker and smaller.
      a. The branch circuit panel main circuit breaker shall be “fully-rated” (plus safety margin) Current Limiting Circuit Breaker type (CLCB). Shall provide time/current-tripping coordination with upstream equipment.
      b. The branch circuit panel main circuit breaker shall be “series-rated” with the panel downstream branch circuit devices and panel bussing. “The series-rating” shall provide short circuit bolted fault current withstand protection and short circuit bolted fault interrupt rating protection during a downstream 3-phase line-to-line and/or single-phase line-to-ground short circuit bolted faults.
      c. Typical for branch circuit panelboards connected to normal-power (non-emergency) power circuits.
   4. Emergency branch circuit panelboards 400-ampere bus and smaller;
      Emergency branch circuit panelboards 400-ampere trip main circuit breaker and smaller.
      a. The branch circuit panel main circuit breaker shall be short circuit bolted fault “fully-rated” (plus safety margin) Non-Current Limiting circuit breaker type (non-CLCB).
      b. The panel bussing shall also be short circuit bolted fault “fully-rated”.
      c. All of the branch circuit panel, branch circuit breakers shall be “fully-rated” non-fused Current Limiting Circuit Breaker Type (CLCB). Shall provide short circuit bolted fault interrupt rating. Coordinated time/current and instantaneous tripping with the upstream circuit protection devices.
      d. Typical for branch circuit panelboards connected to emergency power circuits.
2.03 PANEL CIRCUIT BREAKERS, CIRCUIT PROTECTION DEVICES

A. Circuit Breakers General, for Distribution Panels and Panelboards
   1. NEMA-AB1 and AB3, comply with latest revision.
   2. UL-1087, UL-489 and IEC-60.947.2 rated devices, comply with latest revision.
   3. 5Hz AC closing and 3Hz AC trip and clear.
   4. Main circuit breakers for distribution panels exceeding 400 ampere and larger;
      a. Shall be Insulated Case Circuit Breaker type ICCB.
   5. Main circuit breakers for branch circuit panelboards 400 ampere buss and smaller;
      a. Shall be Current Limiting Circuit Breaker type-CLCB for non-emergency panelboards.
      b. Shall be Molded Case Circuit Breaker type-MCCB for emergency panelboards.
   6. Branch circuit breakers and feeder circuit breakers smaller than 100-ampere trip shall be Molded Case Circuit Breakers type-MCCB and/or Current Limiting Circuit Breakers type-CLCB.
   7. All circuit breakers 100 ampere and larger trip shall employ sensors and solid state digital electronic automatic trip system. Short-time and long-time time/current curve shaping field adjustable functions and adjustable instantaneous trip. Typical for Molded Case Circuit Breaker type-MCCB, Insulated Case Circuit Breaker type-ICCB and Current Limiting Circuit Breaker type-CLCB.
   8. Refer to Specification Section 16425 and/or 16312 for additional circuit breaker requirements.

B. Manufacturer
   1. Circuit breakers as manufactured by the following companies only are acceptable:
      a. Cutler Hammer
      b. General Electric Co.
      c. Square D Co.
      d. Siemens

C. Configuration
   1. Circuit breakers shall be arranged in the panels so that the breakers of the proper trip settings and numbers correspond to the numbering in the panel schedules on the Drawings.
   2. Circuit numbers of breakers shall be black-on-white micarta tabs or other previously approved method. Circuit number tabs, which can readily be changed from front of panel, will not be accepted. Circuit number tabs shall not be attached to or be a part of the breaker.
   3. Panelboard circuit protection devices shall be bolt on type for connection to panel bus. Removable and installable without disturbing adjacent devices.
   4. Provide conductor wire terminations (lugs) on each circuit protection device for incoming main feeder, branch circuits and outgoing feeder circuits. Dual rated copper/aluminum and compatible with the respective conductor size, type, and quantity.
   5. Where 2-pole or 3-pole breakers occur in the panels, they shall be common trip units. Single pole breakers with tie-bar between handles will not be accepted.
   6. Branch circuit panels shall be field convertible for bottom entry main incoming feeder or top entry main incoming feeder.
7. Each panel section, the feeder and branch circuit protection devices (3-phase and/or 1-phase) shall be “twin-mount”, side-by-side double row construction for the following circuit sizes:
   a. 480/277 volt, 60-ampere circuit size and smaller.
   b. 240 volt – 208/120 volt, 100 ampere circuit size and smaller.

D. Lock-Off and Lock-On
1. All circuit breakers shall be pad-lockable in the “off” position.
2. Where branch circuit breakers supply the power to motors and signal systems, the breakers shall also be furnished with lockout clips, mounted in the “on” position. The breakers shall be able to trip automatically with lockout clips in place.
3. Provide lock-on clips on branch circuit breakers supplying fire alarm equipment and fire alarm panels. Provide identification of the dedicated “fire alarm” circuit function and operation. Color-code the circuit breakers to comply with AHJ requirements.
4. Locking facilities shall be riveted or mechanically attached to the circuit breaker (submit sample for approval. Other means of attachment shall not be accepted without prior written approval of the District's Representative.

E. ARC Fault Interrupter Circuit Breaker (AFCI-C/B)
1. AFCI-C/B provides automatic circuit interruption upon detection of any of these conditions: overload, short circuit fault and electric branch circuit arcing protection.
2. The AFCI-C/B shall detect intermittent “arching” type electrical faults, and provide automatic circuit interruption (tripping).
3. Provide “test-pushbutton” on each C/B for manual AFCI-C/B Testing.
4. Single pole, 120-volt, 60Hz AC UL listed and labeled for installation in panelboard, #14 - #8AWG solid/stranded AL/CU load conductor.

F. Switch and Fuse Feeder Protective Devices for Distribution Panels
1. Locations where the Drawings show distribution panels employing switch-fuse circuit protection devices.
2. Fusible Switches: Quick-make, quick-break type with rejection clips for use with Class “R” fuses Current Limiting Fuses (CLF). Switches with ratings up to and including 100 ampere at 240 volts shall be twins mounted. Switches rated through 60 ampere and 480 volts shall be twins mounted. Provisions for padlocking in the “on” and/or “off” positions. Switches shall be removable from front of panel without disturbing adjacent units or panel bus structure.
3. Fuses shall be time delay current limiting types, UL Class RK-1 unless otherwise indicated on the Drawings. Provide one (1) spare set of fuses of each size and type in each Distribution Panel.
4. Provide auxiliary contact on switch for remote status (on-off) signaling and monitoring. Provide conductor lugs to accept conductor temperature rating, sizes and quantities shown on Drawings.
5. Switch and fuse devices shall be permitted only in distribution panels and only where specifically indicated on the Drawings for feeders.

2.04 PANEL BUSSING

A. Bus Material
1. Bussing shall be rectangular cross section tin-plated copper or alternately silver or tin-plated aluminum.
2. Bussing shall be non-tapped, full length of the enclosure.
B. Ground Bus
   1. Each panel shall be equipped with a ground bus secured to the interior of the
      enclosure. The bus shall have a separate lug for each ground conductor. No
      more than one conductor shall be installed per lug.

C. Provisions
   1. Provide space and all hardware and bus mounting attachments for future
      devices as indicated on the Drawings.

D. Neutral Bus
   1. The ampere rating of the neutral bus of panels and distribution panels shall be
      a minimum of 100% greater ampere capacity than the ampere rating of the
      corresponding phase bus, where the panel is indicated to be provided with an
      "oversize-neutral" or "200%" neutral on the Drawings.

2.05 TERMINAL AND AUXILIARY CABINETS

A. Cabinets
   1. Fabricated of code gauge sheet steel for flush mounting (except where noted
      as surface) of size indicated on the Drawings, and complete with hinged
      lockable doors, provide the quantity of 2-way feed through conductor terminals
      required for termination of all conductors, plus 15% spares of each type.
   2. Cabinet locks to operate from same key used for panelboards. The trim to
      cabinets shall be fastened by means of concealed bolted or screwed fasteners
      accessible behind door into cabinets. All cabinets shall have 3⁄4-inch plywood
      backing, finished with fireproof intumescent primer and finish coat paint.
      Provide equipment ground bus in each cabinet.
   3. Cabinets shall be finished with one coat of zinc chromate and one coat of
      primer sealer after a thorough cleaning. Where exposed to public view (e.g.,
      corridors, covered passages, offices, etc.) finish color paint to match
      surrounding and Manufacturer's standard gray color in switchboard, janitors,
      heater and storage rooms.
   4. Provide grounded metal barriers inside cabinet to isolate and separate line
      voltage and low voltage from each other inside the cabinet.

B. Cabinet Dimensions.
   1. Unless indicated otherwise on Drawings.
      a. Shall be 20-inches wide. Surface or flush mounting as indicated.
      b. Recess mounted type shall have a 20-inches wide (maximum) recess
         metal enclosure with overlapping edge trim plate cover extending 1-inch
         on all sides of enclosure.
   2. Depth shall be 5.75-inches nominal. Height of cabinet as required for devices,
      plus 25% spare unused interior space for future use, but not less than 36-
      inches high.

C. Terminals
   1. Non-digital analog circuits; line and low voltage modular signal systems, 15-
      ampere dual row with isolation barriers, screw-down terminals insulated strips,
      heavy duty.
      a. As manufactured by Molex, or ITT-Cannon, or General Electric.
   2. Digital circuits; low voltage signal systems, ANSI/ EIA/TIA Category-6, 110-
      Block or 66-Block gas-tight punch down style, heavy duty.
      a. As manufactured by: Leviton, or Ortronics, or AMP.
D. Identification (Additional Requirements)
   1. Provide engraved nameplate on each cabinet indicating its designation and system (i.e., “Life Safety System - Panel 2LS”, etc.).
   2. Identify each terminal landing with unique circuit number and provide corresponding alphanumeric text-index card inside panel access door

PART 3 - EXECUTION

3.01 MOUNTING

A. Flush Mounted Panelboards and Terminal Cabinets shall be securely fastened to at least two studs or structural members. Trim shall be flush with finished surface.
   1. Panels and cabinets installed flush (recess or semi-recess) into fire rated or smoke rated walls. The wall recess shall be fully wrapped inside the recess with fire/smoke rated materials. The wrap-materials shall provide the same fire and/or smoke protection rating as the respective wall.

B. Surface Mounted Panels and Terminal Cabinets shall be secured to walls by means of preformed galvanized steel channels securely fastened to at least two (2) studs or structural members.

C. Panelboards and Terminal Cabinets shall be installed to insure the top circuit protective device (including top compartment control devices) are not more than 6-feet-6-inches above finish floor in front of the panel and the bottom device is a minimum of 12-inches above the floor. Manufacturer shall specifically indicate on Shop Drawing submittals each panel where these conditions cannot be met.

3.02 IDENTIFICATION (ADDITIONAL REQUIREMENTS)

A. Provide a red and white Bakelite nameplate with ½-inch high letters in each 277/480 volt panel fastened to face of dead-front plate, to read: “DANGER 480 (or as applicable) VOLTS KEEP OUT AUTHORIZED PERSONNEL ONLY”.

B. Manufacturer shall stencil the panel/cabinet number identification on the inside of door to correspond with the designation on the Drawings.

C. Identification plates and numbers shall be attached with screws or twist lock fasteners. Adhesive attachment of any kind shall not be used.

3.03 SPARE CONDUITS (ADDITIONAL REQUIREMENTS)

Provide three (3) 1-inch conduit only stubs from each panel and terminal cabinet into accessible ceiling space. Where floor level below panel or terminal cabinet is accessible, also provide an additional three (3) 1-inch conduit only stubs into accessible floor space.

END OF SECTION
120715/223015
SECTION 26 2419

MOTOR CONTROL EQUIPMENT

PART 1 - GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment necessary for, and incidental to, performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other Specification Sections and Drawings for related work required to be included as work under Division 26.
   2. General provisions and requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Provide Schematic "Ladder-Type" logic control wiring diagrams and "point-to-point" control wiring diagrams showing the control system for HVAC equipment and other electrical equipment.

B. Provide Nameplate Engraving Schedule.

C. Submit full-scale time/current transparencies on log/log paper for all fuses, circuit breakers, ground fault system devices, and relays.

D. SHORT CIRCUIT, COORDINATION AND ARC-FLASH
   1. Perform and submit engineered settings for each equipment location, fuse and adjustable circuit breaker device, showing the correct time and current settings to provide the coordination within the limits of the specified equipment, per the latest applicable Standards of IEEE and ANSI. Provide electrical system short circuit fault analysis, both 3-phase line-to-line and 1-phase line-to-ground calculations as part of the Coordination Analysis recommendations. Provide Electric ARC-FLASH calculations as part of the Coordination Analysis recommendations.
   2. The information shall be submitted in both tabular form and on time current log-log graph paper, with an engineering narrative. Written narrative describing data, assumptions, analysis of results and prioritized recommendations, six (6) copies.
   3. The goal is to minimize an unexpected but necessary electrical system outage and personnel exposure to the smallest extent possible within the fault occurrence location, using the specified Contract Equipment. Shall comply with, but not limited to:
      b. IEEE-399, Recommended Practice for Industrial and Commercial Power System Analysis.
      d. CEC/NEC
   4. Electrical equipment including switchgear, switchboards, electric panels and control panels, motor control centers, combination motor starters, transformers, disconnects, etc., shall each be labeled by the Manufacturer with "Electrical-ARC-Flash" warning signs. The signs shall explain a hazard to personnel may
exist if the equipment is worked on while energized or operated by personnel while energized. The sign shall instruct personnel to wear the correct Protective Equipment/clothing (PPE) when working “Live”, or operating “Live” electrical equipment and circuits.

PART 2 - PRODUCTS

2.01 GENERAL

A. Division 240000 HVAC/Plumbing
Refer to Division 26 0000 Mechanical and Plumbing Contract Documents and Shop Drawings for additional electrical work and material requirements.
1. Provide all control devices including timeswitches, relays, auxiliary contacts, voltage transformers, and interlocks.
2. Provide all raceways, conduit wire, circuits, outlets, and interconnections of starters as required for HVAC and Plumbing systems.

B. Special Considerations
1. Mount all auxiliary relays and timeswitches in an isolated compartment inside motor control equipment unless otherwise indicated.
2. Whether or not shown on Mechanical and Plumbing Contract Documents and/or control schedules, where motors are controlled by external devices (i.e., thermostats, relays, float or pressure switches, etc.) or interlocked with other motors, provide each magnetic motor starter with a "Hand-Off-Auto" selector switch in starter cover. Other magnetic motor starters provide a "Start-Stop" push-button station in starter cover.
3. Motor starters, motor controllers and circuit feeder tap devices for motor circuits shall be rated and labeled for control of all electric motor design types A, B, C, D, and E pursuant to the requirements of the NEC

C. Seismic Earthquake and Wind Loading Withstand, Testing and Certification (ADDITIONAL REQUIREMENTS)
1. The complete motor control equipment assembly; including circuit protection devices, motor controllers, housings/enclosures, accessories, supports/anchors etc., shall be designed, manufactured and tested.
   a. Wind loading for outdoor locations.
   b. Earthquake Seismic Zone-4 withstand and CBC/IBC Seismic withstand all indoor and all outdoor equipment locations.
2. Shall withstand, survive and maintain continuous non-interrupted energized operation (running) during the seismic event occurrences. Continued normal energized operation after the wind event and seismic event occurrences have abated.
3. Shall include demonstrations of successful operation and run test after completion of seismic event shake-table simulation.
4. Provide three (3) dimensional finite element analysis demonstrating anchorage and operational withstand of wind loading not less than as follows and as required by AHJ:
   a. 100MPH-West Coast States USA and Hawaii.
   b. 150MPH-East Coast States USA, Gulf Coast States USA and Alaska State.
   c. 90MPH-all other USA locations.
5. Acceptance Test Seismic Qualification of proposed motor control equipment shall employ triple axis shake-table simulation of the Required Response Spectrum (RRS) Seismic Event Motion, Certified and Approved by the AHJ.
6. Seismic test shall be performed by a third party independent Test Laboratory. Wind Analysis and Seismic Testing and Reports shall be certified, signed and “stamped” by PE Professional Engineer licensed and in good standing in the State, Civil Engineer or Structural Engineer.

D. Motor Control Equipment as manufactured by:
   1. General Electric; or Square D; or Cutler-Hammer; or Allen-Bradley; or Siemens.

2.02 MANUAL MOTOR STARTERS

A. Provide flush or surface mounting manual motor starters with number of poles and size of thermal overload heaters as required for the motor being controlled (equipped with overload heaters, one (1) for each motor lead). Back boxes shall be supplied with all flush mounting starters, whether they are toggle type requiring only a 4-inch square outlet box or the larger type requiring a special box. Provide cover designed to accept the particular unit.

B. Unless otherwise noted on the Drawings, all manual starters for single phase motors, smaller than 1 h.p. shall be the compact toggle type. Manual starters for all single phase motors, 1 to 5 h.p. and all three phase motors up to 5 h.p. shall be the heavy-duty type.

C. Where manual motor starter is shown with pilot light, the pilot light shall be installed in a separate outlet box adjacent to the starter outlet with engraved nameplate to indicate function of pilot light. Pilot lights shall be push-to-test style.

2.03 MOTOR STARTERS - 50/60HZ AC INDUCTION ELECTRIC MOTORS

A. General
   1. Motor starters shall be horsepower rated for the motor connected to the starter, air insulated, with NEMA rating.
   2. Motor starter coils and controls shall be designed to operate on the control voltage indicated on the control diagrams and specifications. The motor starters shall reliably pick-up and seal-in at 80% through 110% of their coil control voltage.
   3. Under voltage release for motor starter coil circuit shall automatically drop motor starter off the line when the line voltage drops below normal operating voltage. Under voltage release shall be field adjustable 80% to 95% of nominal voltage with field adjustable dropout delay 0.1 to 3 seconds minimum for starters larger than NEMA Size 1. The under voltage release shall reset automatically when line voltage level returns too normal. The reset time delay shall be a 0.1 to 60-second field adjustable time range for starters larger than NEMA Size 1.
   4. Each motor starter control circuit shall be independently fused.
   5. Three phase motor starters controlling three phase motors, five (5) horsepower and larger shall provide integral motor single phasing protection. The starter shall automatically "open", turn off electrical power to the connected motor in the event of the loss of one or more circuit phases, lock out and require manual resetting of the single phase protection to restart the magnetic motor starter. Provide single-phase annunciator. Provide adjustable time delay, minimum range 0.1 to 3 seconds for initiating single phase shut down.
6. Starter units shall be equipped with individual control power transformers (grounded type) with secondary and primary control power fuses. One secondary lead shall be grounded in the unit.
   a. The unit disconnect shall be equipped with a normally open contact to isolate the control circuit from the source when the controller disconnect is open.
   b. The control power transformer VA load rating shall include the motor starter, additional internal and external control devices connected to the motor starter, to insure control power voltage drop does not exceed 5% of nominal rating.

7. Starter units shall be equipped with three (3) motor overload elements, one (1) for each phase, with automatic lockout, external overload indicating flag/pilot light and manual reset external push-button. Trip rating characteristics of the overload elements shall be as recommended by Motor Manufacturer.
   a. Motor overload protection relays shall be bi-metal (non-melting) "heater-element" type or solid-state type, for motor starters NEMA Size 1 and smaller.
   b. Motor overload protection relays for motor starters larger than NEMA Size 1 shall be solid-state type.

8. Pilot light indicators shall be provided with "Push-to-Test" feature. Provide a capacitor in parallel with the starters stop-start control relay circuit, to permit the motor starter control circuit to "drop-out" (turn-off) and prevent "capacitive-holding" (capacitive coupling) on control circuits with "long" (excessive distance) control circuit wiring.

9. Each starter shall be equipped with a minimum of one (1) normally open and one (1) normally closed auxiliary spare contact. Provide additional auxiliary control contacts for interlocking with system control circuits as indicated on the Drawings and Specifications. Auxiliary contacts shall be field convertible for normally open or normally closed operation. Contacts shall be rated not less than 10 amps at 120 volt 60Hz, AC, but in no case shall the auxiliary contacts be rated for less ampere or lower voltage than the connected control circuit.

10. Motor starters larger than NEMA Size 1, provide a running time meter 0 to 99999 hours minimum range, and an operations counter 0 to 9999 meter minimum operations start count range. Meters shall be field resettable with maintained memory during power outages of any length.

11. Minimum starter size shall be NEMA 1, but in no case less than indicated on the Drawings or Specifications.

12. Verify the exact motor connection requirements; motor locked rotor/full load current, NEMA code letter and voltage characteristics with the supplier of each motor. Motor starters shall comply with the identified requirements.

13. Each starter shall be equipped with "Hand-off-Auto" switch or stop-start push-button as required.

14. An auxiliary relay contact for remote alarm annunciation shall provide common trouble annunciation for any of the starter automatic protection systems. The alarm contact shall automatically reset when the starter is reset.

15. Provide each motor starter main "start" control relay or starter coil as applicable, with a magnetic coil auxiliary control "pilot" relay. The contacts of the auxiliary control relay shall directly control the starting, running and stopping control voltage of the motor starter main control coil circuit. The coil of the auxiliary relay shall condition and match the voltage and in rush of each motor starter to the requirements of the incoming control circuit.
16. Provide a transient surge suppressor for each motor starter coil, to limit voltage transients induced by the motor starter coil operation and to protect the motor starting circuit from voltage transients.

17. Motor starters connected to engine generator emergency power supply source (either direct connection or connection through an automatic transfer switch) shall each be provided with a field adjustable (0.1 - 180 seconds) "start" (on delay) time delay, to provide "staggered" sequenced starting of the connected motor load.

B. Full Voltage Non Reversing (FVNR), Unless Noted Otherwise
   1. Across the line full voltage magnetic electromechanical motor starter.
   2. Provide FVNR motor starter for motor sizes through fifty (50) horsepower (241 to 600 volt) and through thirty (30) horsepower (240 volt and under) where the motor is connected to normal power utility source, unless noted otherwise on Drawings.

C. Two Speed Motor Starters
   1. The two (2) speed motor starters shall be compatible with the connected motor and shall provide automatic two (2) speed control of separate high speed and low speed motor winding or consequent pole two (2) speed motors as applicable. The starters shall be constant horsepower, constant torque or variable torque as applicable for the motor connected to the starter.
   2. Low speed compelling control shall compel the motor starter to always start the motor on low speed before switching to high speed. Compelling control shall be manual switch selectable as either "in" or "out" (bypass) of the motor control circuits.

D. Reduced Voltage Non-Reversing (RVNR)
   1. General
      a. The reduced voltage starter shall reduce both motor starting current and motor starting torque.
      b. Reduced voltage starters shall be closed transition types.
      c. Provide RVNR motor starters for motors larger than thirty (30) horsepower (240 volt and below) and larger than fifty (50) horsepower (over 240 volts), reduced voltage type (Where the motor starter circuit is connected to engine generator emergency power source for motors larger than five (5) horsepower, provide each respective motor with RVNR reduced voltage motor starters).
      d. Starters shall provide field adjustable time periods for acceleration (reduced voltage) and transition (transfer to full voltage) modes, with failure to transfer lockouts and pilot light annunciators. Adjustable time range shall be 0.1 to 15 seconds.
      e. Duty cycle - NEMA rated medium duty, starters shall provide for not less than one (1) 15-second duration starter operation in each 4-minute interval for a 1-hour period, followed by a cool down rest period of 2-hours before the duty cycle is repeated. Provide automatic temperature lockout to prevent exceeding starter duty cycle.
      f. Reduced voltage non-reversing RVNR Motor starters shall be types described in the following paragraphs.
   2. Autotransformer type reduced voltage starter
      a. Auto transformers on each phase with field adjustable transformer voltage taps for 50%, 65%, and 80% motor terminal starting voltages.
      b. Magnetic electromechanical motor contactor type.
2.04 COMBINATION MOTOR STARTERS

A. General
1. Combination motor starters shall consist of a feeder tap device, motor starter and enclosure. Voltage and amperage rating as indicated on Drawings.
2. Combination motor starter shall not be less than NEMA Size 1, but in no case less than indicated on the Drawings.
3. Unit shall be self-contained floor standing, wall mounted NEMA 1 enclosures or as indicated on the Drawings. Constructed, Tested and Listed in accordance with NEMA, ANSI and UL standards.
4. Combination motor starters as manufactured by General Electric, Westinghouse, Square D, Cutler Hammer or equal.
5. Provide incoming line and outgoing load terminations, size and capacity to match connections shown.

B. Construction
1. NEMA styles metal enclosed, with full height hinged access door. 12-gauge welded frame members and 14 gauge panel members. All parts shall be removable and accessible from the front for ease of maintenance and rearrangement.
2. Provide removable lifting points and permanent anchor mounting points on the enclosure.
3. Hinged doors shall be mounted with removable pin hinges and secured with quarter turn indicating fasteners. A door interlock with manual defeat override shall prevent access to unit interior when the feeder tap device is in the "on" position.
4. Each metal surface shall be phosphatizing prime rust inhibitor painted and baked Enamel Finish Painted Manufacturer's standard color.

C. Combination Motor Starter Short Circuit Coordination Protection
1. The combination motor starter shall be constructed and tested to comply with the following requirements.
2. Type 1 Coordination:
   Under short circuit conditions the contactor/motor starter shall cause no danger to persons or installation. Continued re-use shall be permitted after service, repair or replacement of parts.
3. Type 2 Coordination:
   a. Under short circuit conditions the contactor/motor starter shall cause no danger to persons or installation. Continued re-use shall be permitted without requiring any service, repair or replacement of parts.
   b. Motor starters shall also comply with International Electromechanical Committee (IEC) Type-2 short circuit protection, as recommended by the Manufacturer's published protection tables and as Certified by UL.

D. Energy Efficient Motor Protection
1. Where a combination motor starter is connected to a high efficiency motor, provide one (1) of the following modifications to the starters or circuit disconnects. The modification shall prevent unnecessary tripping from locked rotor high inrush motor starting current:
   a. Circuit breaker or MCP short circuit protection - Provide circuit breaker/MCP with adjustable magnetic current trip for high inrush motor starting current, or adjustable time delay trip for high magnetic current motor inrush damping.
b. Switch and fuse motor short circuit protection - Provide fuses with sufficient inherent time delay to allow passage of high magnetic current inrush motor starting current.

PART 3 - EXECUTION

3.01 INDIVIDUAL COMBINATION MOTOR STARTERS

A. Install motor control equipment in accordance with Manufacturer’s written instructions and applicable portions of NEMA “Standards of Installations” for switchboards and motor control centers and individual motor starters.

3.02 IDENTIFICATION

A. Provide a red and white bakelite nameplate with ½-inch high letters fastened to face of dead-front plate, to read: "DANGER 480 (actual volts) VOLTS, KEEP OUT, AUTHORIZED PERSONNEL ONLY".

B. Manufacturer shall stencil the panel number and name of the connected motor circuit on each device and equipment section to correspond to identification on the drawing.

C. Identification plates and numbers shall be attached with screws or twist lock fasteners. Adhesive attachment of any kind as the only method of attachment shall not be used.

3.03 SETTINGS AND ADJUSTMENTS

A. Program and set control function sequences, time delays, and protective device settings for correct system operation.

B. Test all timing, control sequences and motor rotation direction for proper operation. Correct deficiencies and retest until proper operation is confirmed.

C. Refer to General Commissioning Section 01 9113 for additional requirements.

END OF SECTION

120715/223015
“L” TOWER BUILDING
SEISMIC AND CODE UPGRADES
RIO HONDO COLLEGE

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SECTION 26 3210

AUTOMATIC TRANSFER SWITCH

PART 1 - GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances tools, equipment, facilities transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not limited to the following:
   1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
   2. General provisions and requirements for electrical work.

B. Emergency Electrical System Operation:
   1. Automatic Transfer Switch - ATS unit(s) in combination with the respective engine generator(s) shall automatically detect and respond to normal source and emergency source electrical system power anomalies and disruptions.
   2. When normal source anomalies or disruptions are detected by ATS unit(s), the engine generator(s) shall automatically start-and-run, subsequently the ATS unit(s) shall automatically transfer the connected (load-add) to the generator(s).
   3. Load-shed and load-add functions shall all be based on assigned emergency load priorities. ATS sequential operations based on load priority assignments.
   4. Total start-run-load-add sequence time shall not exceed 10-seconds for priority #1 life safety emergency electrical loads, after detection of normal source anomalies or disruptions. Total start-run-load-add sequence time shall not exceed 60-seconds for non-life safety emergency electrical loads, after detection of normal source anomalies or disruptions.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Submit product data sheets for all switches, relays, controllers, power supplies, cabinets, etc.

B. Submit Detailed Shop Drawings including Dimensioned Plans, elevations, details, schematic and point-to-point wiring diagrams and descriptive literature for all component parts and cabinets.

C. Submit worst case voltage drop calculations on control circuits.

D. Quality Control Additional Requirements
   1. General
      The equipment shall be listed, labeled and approved for the application shown in the Contract Documents, as Building Code mandated, emergency electrical power supply equipment, complying with the most recent version of the install requirements of the following applicable standards. The following standard shall become requirements of and are included in the Contract Documents:
   2. Underwriters Laboratory – UL
      a. UL – 1008 Standards for Transfer Switch Equipment.
      b. UL – 508 Industrial Control Equipment
4. National Electrical Equipment Manufacturer’s – NEMA
   a. NEMA – ICS-10 AC Automatic Transfer Switches.
5. Institute of Electrical and Electronic Engineers – IEEE
   a. IEC-947.6.1 Low Voltage switchgear and Control gear; Multifunction Equipment; Automatic Transfer Switching Equipment.

E. SHORT CIRCUIT, COORDINATION AND ARC-FLASH (Additional Requirements)
1. Perform and submit engineered settings for each Automatic transfer Switch assembly equipment location, showing the correct time and current settings to provide the selective coordination within the limits of the specified equipment, per the latest applicable standards of IEEE and ANSI. Provide electrical system short circuit fault analysis, both 3-phase line-to-line and 1-phase line-to-ground calculations as part of the Coordination Analysis recommendations. Provide Electric ARC-FLASH calculations as part of the Coordination Analysis recommendations.
2. The information shall be submitted in both tabular form and on time current log-log graph paper, with an engineering narrative. Written narrative describing data, assumptions, analysis of results and prioritized recommendations, six (6) copies.
3. The goal is to minimize an unexpected but necessary electrical system outage and personnel exposure to the smallest extent possible within the fault occurrence location, using the specified Contract Equipment. Shall comply with, but not limited to:
   b. IEEE-399, Recommended Practice for Industrial and Commercial Power System Analysis.
   d. CEC/NEC
4. Automatic Transfer Switch equipment shall each be labeled by the Manufacturer with “Electric-ARC-FLASH” warning signs. The signs shall explain a hazard to personnel may exist if the equipment is worked on while energized or operated by personnel while energized. The sign shall instruct personnel to wear the correct Protective Equipment/clothing (PPE) when working “Live”, or operating “Live” electrical equipment and circuits.

F. Seismic Earthquake and Wind Loading Withstand, Testing and Certification (ADDITIONAL REQUIREMENTS)
1. The complete Automatic Transfer Switch assembly; including circuit protection devices, meter, housings/enclosures, transfer mechanisms, accessories, supports/anchors etc., shall be designed, manufactured and tested.
   a. Wind loading all outdoor equipment locations.
   b. Earthquake Seismic Zone and CBC/IBC Seismic withstand, all indoor and all outdoor equipment locations.
2. Shall withstand, survive and maintain continuous non-interrupted energized operation during the seismic event occurrences and wind event occurrences. Continued normal energized operation after the wind event and seismic event occurrences have abated.

3. Shall include demonstrations of successful operation and transfer test after completion of seismic event shake-table simulation. Acceptance test seismic qualification of proposed ATS equipment shall employ triple axis shake-table simulation of the Required Response Spectrum (RRS) seismic event motion, certified and approved by the AHJ.

4. Provide three (3) dimensional finite element analysis demonstrating anchorage and operational withstand of wind loading not less than as follows and as required by AHJ:
   a. 100MPH-West Coast States USA and Hawaii.
   b. 150MPH-East Coast States USA, Gulf Coast States USA and Alaska State.
   c. 90MPH-all other USA locations.

5. Seismic test shall be performed by a third party independent Test Laboratory. Wind Analysis and Seismic Testing and Reports shall be certified, signed and “stamped” by PE Professional Engineer licensed and in good standing in the State, Civil Engineer or Structural Engineer.

PART 2 - PRODUCTS

2.01 TRANSFER SWITCH MECHANISM

A. General
   1. Provide automatic transfer switch with bypass/isolation switch (ATS) system, with quantity of poles, amperage, voltage and withstand ratings as shown on the Plans. The system shall be the product of one Manufacturer.
   2. The ATS shall be rated for all classes of loads including 100-percent tungsten filament lamp loads, electric induction motor loads and solid state switching power supply loads.
   3. As manufactured by ASCO; or Russell; or Zenith controls.

B. Operation
   1. Electrical operation shall be accomplished by a momentarily energized single direct operating mechanism, which receives power from the source to which the load is being transferred. Fuse or thermal protection of the main operation shall not be required to ensure compliance and/or correct operation. The total operating transfer time shall not exceed one-sixth of a second (10Hz). Mechanical locking in each position shall be accomplished without the aid of springs, latching solenoids, gear mechanisms or motor operators.
   2. Operation shall be inherently double-throw where all contacts move simultaneously and with no programmed delay in a mid-position. Electrical spacing shall not be less than those listed in Table 15.1 of UL Std. #1008. Main contact structures not originally manufactured for transfer switch service are not acceptable. An overload or short circuit shall not cause the switch to go to a neutral position.
   3. Inspection and replacement of all main and arcing contacts (moveable and stationary) shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors.
4. A UL listed manual operating handle shall be provided for maintenance purposes. The handle shall permit the operator to stop the contacts at any point throughout the entire travel including points of contact make and break.

5. ATS shall be 4-pole Phase-A, Phase-B, Phase-C plus switched neutrals, with fully rated neutral transfer contacts which momentarily (100 milliseconds, maximum) interconnect the neutrals of the sources during the transfer/retransfer operation. The neutrals shall remain interconnected through the main contacts until the phase contacts close on the alternate source. Phase and neutral contacts shall be driven by one single main operator.

2.02 CONTROL PANEL

A. General

A separately mounted logic panel with solid state sensing and timing functions shall provide the following operational characteristics:

1. Time delay on momentary dips in normal source (adjustable 0.5-6.0 seconds), set at 1.0 seconds.

2. Time delay on transfer to emergency for controlled loading of generator (0-5 minutes adjustable 0 to 300 seconds). Set at 0 seconds for each ATS supplying Building Code mandated emergency electrical loads. Set at 15-second sequential additional incremental intervals for each additional ATS supplying electrical loads that are not mandated for emergency standby power source by Building Code regulations.

3. Time delay on retransfer to normal after restoration of normal source (adjustable 0-30 minutes), set at 15 minutes.

4. Selector switch to manually bypass time delay on retransfers.

5. Time delay on engine shutdown (engine cool down) after retransfer to normal (adjustable 0-15 minutes), set at 5 minutes.

6. Close differential voltage sensing of all normal source phases (adjustable pick-up 85-100 percent of nominal and drop out 75-98 percent of pick-up), set at 85 percent drop out and 95 percent pickup.

7. Independent voltage (adjustable 85-100 percent pick-up) and frequency (adjustable 90-100 percent pick-up) sensing of the emergency source to prevent premature transfer, set at 90 percent voltage and 95 percent frequency.

8. Test switch for both test with load and test without load (momentary type).

9. Gold plated 10-ampere engine-starting contacts (1-N.C. and 1-N.O.) rated 120 volt AC or D.C.

10. Visual annunciators to indicate ATS connection position (white on normal, yellow on emergency, red for common trouble.

11. Auxiliary contacts each D.P.D.T. (one relay to operate on normal "N" and one relay to operate on emergency “E”) rated 10 ampere 480 VAC.

12. An in-phase monitor shall be provided to control transfer/retransfer operation between live sources so that closure on the alternate source will occur only when the two sources are approaching synchronism and at the instant when the two sources are within plus/minus 60 electrical degrees, max. The monitor shall function over a frequency difference range of plus/minus 2Hz minimum, with a maximum total transfer operating time of 1/6 of a second (10Hz in the event of abnormal frequency difference (in excess of plus/minus 2Hz) and/or failure of the load-carrying source, the monitor shall be automatically bypassed. The monitor shall not require inter-wiring with generator controls nor active control of generator.
13. All time delay and sensing functions shall be readily field adjustable over the ranges indicated and operate without drift over minus 4 degrees Fahrenheit to 158 degrees Fahrenheit. The logic panel shall be provided with a protective cover and isolation plug in wiring harness between control panel and main transfer panel.

14. Automatic engine generator exerciser to provide adjustable 30-minutes to 60-minutes duration generator start-run and stop sequence, one time per week or one time every 2-weeks. Exercising sequence shall be field selectable with or without load connection and with or without load bank connection. The exerciser shall provide automatic (activate-deactivate) separate control of the engine generator load bank when a load bank is provided with the engine generator system. Note: Where more than one ATS is provided as part of Contract Work, only the master ATS shall be furnished with automatic engine generator exerciser feature.

15. Visual annunciators shall indicate availability of normal and emergency power sources and automatic transfer switch position. A prominent and detailed instruction plate shall be furnished.


17. Provide ground fault sensing and indication for each ATS. Shall automatically detect a ground fault condition occurring on electrical circuits connecting to the ATS. Provide audiovisual alarm notification that there is an emergency system ground fault condition. The alarm notification shall occur both local at each ATS and remotely, at the engine generator annunciator panel. The ground fault system shall not cause an interrupt of the operation of the emergency system.

B. Automatic Monitoring, Management and Load Controls

1. Where more than one (1) Automatic Transfer Switch (ATS) is included in the Contract Scope of Work, and/or where one (1) or more “closed” transition operation ATS is required, provide each ATS with microprocessor based, software controlled, microprocessor controller Programmable Logic Controller (PLC). The respective engine generator(s) shall each also be provided with software Programmable Logic Controllers (PLC). The PLC units and operating software shall be compatible/interoperable with all of the other PLC and software units connected at engine generators, annunciators and ATS equipment.

2. The PLC shall provide monitoring and visual display of engine generator and ATS analog and digital operating parameters including output voltage, output frequency and output demand load.

3. Load automatic control, add-and-shed
   a. In the event of an engine generator overload, the PLC shall automatically disconnect (Load-Shed) respective ATS load from emergency generator source, causing the overload condition.
   b. The PLC shall also automatically control sequence-staged loading (Load-Add) using ATS connection to the engine generator source during emergency generator system initial start-run sequence.
   c. The ATS load control process shall prioritize load “shedding” and load “adding” by ATS load type priorities connected to the respective ATS. Shall provide software adjustable time delay for each load “shed” and load “add” priority level.
   d. Priority #1 emergency loads shall be setup as the highest priority for load continuity supply for load-add. Priority #1 loads shall be setup as the last
load-shed priority. Similar setup logic for load priorities #2, #3, and #4 in sequential descending order of priorities for emergency load add-and-shed functions.

4. The ATS supplying building units Life-Safety and Building Code mandated emergency loads (i.e., life safety exit egress lighting, fire alarm, etc.) shall have the highest priority #1 and #2 respectively, to remain connected and for "first" connected (load-add) and "last" disconnected (load-shed) to the engine generator. Loads connected to other ATS units that are not mandated by building codes (i.e., non-life safety loads, refrigerators, UPS, computers, air conditioning, equipment, etc.) shall have the lower priorities #3 and #4 to remain connected and/or disconnected to the engine generator. The PLC load "shed" and load "add" priorities and time delays shall be software programmable.

5. The PLC shall provide visual/audio alarm annunciation of the overload condition(s), engine generator system status/alarms each ATS load connection status and load priority start, at each engine generator location, respective engine generator remote annunciator panel and at the respective ATS.

6. The PLC shall communicate the ATS load shed and load add command controls to the respective PLC equipment in each ATS unit, and assign each ATS with a separate individual load shed and load add priority.

7. The PLC shall provide selective load “lockout” with manual reset upon shed or time delay automatic load restore of each ATS after a load shed event has occurred, software programmable at the PLC.

8. Provide the PLC equipment in each engine generator, in each engine generator remote annunciators, in each Automatic Transfer Switches (ATS) and at the building main fire alarm control panel. Provide PLC common digital/multiplex communications protocols and operating software, to ensure correct, error-free interoperability among all the PLC units and related equipment.

9. The PLC color display screen with LCD based “touch screen” function, shall display operating status and alarms of each engine generator, and each ATS unit. 10-inches (nominal) diagonal or larger LCD screen size. PLC non-volatile memory storage shall store in memory a minimum of 30-days display information, plus the operating software program controls. Interface port for plug-in connection of portable laptop computer interface to provide uploading to the PLC software programs and downloading system-operating information from the laptop computer.

10. Each PLC shall be rated for operation in the same ambient environments and vibration conditions as the engine generator and respective ATS units.

11. ATS with “closed transition operating mode.

a. The PLC shall provide monitoring, operational control and status information display of the ATS/Engine Generator “closed” transition and “open” transition systems.

b. Provide an additional PLC at main electrical service entrance disconnect to monitor and communicate the P.T. and C.T. electric power and current directional flow information, plus utility source voltage and frequency information back to the ATS/generator control system.

2.03 ATS INTERLOCK AND COMMUNICATION

A. General

1. The ATS equipment and system shall provide communications with each building’s system, in addition to the engine generator. The emergency power
electrical system shall communicate when the ATS is supplying emergency source electrical power or normal source electrical power.

2. Provide communication “gateway” protocol for ATS communications compatibility with each building system.

B. Building Fire Alarm System
1. Building Fire Alarm System, the ATS system shall communicate to the fire alarm system the emergency electrical system status; ready to operate status; running power fail status; trouble and fail-to-run or inoperative status; exercise testing-mode status; over load shed status.

C. Building Automation System – BAS
1. Building Fire Alarm System, the ATS system shall communicate to the BAS the emergency electrical system status; normal ready to operate; running normal power fail; trouble and fail-to-run or inoperative; exercise testing-mode; overload-shed.

D. Building Elevator Interlock
1. Provide transfer switch auxiliary contacts D.P.D.T. rated 480-volt AC 10 amps, for Elevator Interlock. The Elevator Interlock shall signal each elevator controller when a normal source power failure has occurred and the transfer switch has transferred to the emergency source (the elevator interlock shall not operate during automatic generator exercising).
2. The interlock shall signal the elevator control system to operate only one elevator at a time with sequential automatic return to safe-ground level and lock-out. Typical when elevator is operating on the emergency power system.
3. Fire Fighter’s override; the elevator control system shall provide automatic manual transfer between each elevator in the building elevator system, to allow each elevator to operate sequentially on emergency power, one elevator at a time.

2.04 ELECTRICAL AND MECHANICAL PERFORMANCE

A. General
The system shall comply with UL Std. #1008 and NEMA Standard. ICS 2-447. In addition, the switch shall meet or exceed the following requirements and be verified by Certified Independent Laboratory Test data:
1. Temperature Rise: Measurements shall be made after the overload and endurance test.
2. Dielectric: Tested after the withstand test at 1960 VAC r.m.s. minimum.

B. Short circuit fault
1. UL listed to the magnitude of short circuit fault current available ampere RMS symmetrical at the switch terminals plus safety-factor, shall be coordinated with respective line side protective devices.
2. Automatic Transfer Switch and related assemblies shall be fully rated for the withstand, interrupt, and close/latch available short circuit fault current, plus an additional 25-percent safety-factor, but not less than indicated on the Drawings plus safety-factor.
3. Alternative short-circuit fault “series-rating” withstand and interrupt methods with upstream and down-stream circuit protection systems are not acceptable.
4. The Automatic Transfer Switch equipment system short circuit fault current rating duration shall selectively coordinate with the up-stream and down-stream circuit protection devices time/current trip characteristics, as determined by the short-circuit fault report submitted by the Contractor.
   a. UL “Umbrella-Rating” for 3Hz duration short circuit fault withstand, closing and opening.
   b. UL “Umbrella-Rating” for 30Hz short circuit fault duration withstand, closing and opening.

2.05 HOUSING ENCLOSURE

A. General
   1. The automatic transfer switch and bypass/isolation switch system shall be supplied in a common NEMA 1 enclosure with a barrier between the compartments. Rust inhibitor prime undercoat with Manufacturer's standard color finish final coat of paint.
   2. The complete system shall be factory assembled, wired and tested prior to shipment.

B. Connections
   1. All line voltage power interconnections shall be silver-plated copper bus bar.
   2. Incoming line and load terminations shall be provided for top, bottom and side entry. Rear access to the transfer switch assembly shall not be required. Entire automatic switch assembly shall be constructed for front accessible only.

C. Weatherproof Outdoor Equipment
   1. Equipment indicated as Weather Proof (W.P.) or outdoors shall be enclosed in a NEMA 3R, non-walk-in, and tamper resistant construction. Provide full height hinged doors with provisions for padlocking the doors in the closed position. Install all ATS operator controls and annunciators on the front cover of ATS located securely behind the NEMA-3R ATS front access door. Do not install ATS operator controls and annunciators in the NEMA—3R-access door.
   2. Provide a nominal 300-watt sealed, resistance type, anti-condensation heater in each equipment section. Heaters shall be controlled automatically by Thermostats and Humidistats. A circuit breaker shall be provided to supply ATS “utility” source buss voltage to the heaters, all prewired by the Manufacturer to fused terminals.
   3. Finish shall be electrostatically applied finish paint over iron oxide rust inhibitor primer. Finish color shall be Manufacturer’s standard color, olive green Munsel #7GY3.29/1.5. The bottom side and bottom 6 inches of floor standing equipment shall be coated with 4-mil minimum thickness rust inhibitor undercoating over finish paint, on all interior surfaces. Finish withstand test without face corrosion or blistering:
      b. Humidity withstands – 750-hours ASTM D2247.
   4. Exposed hardware and hinges shall be Stainless Steel type 302 or 304, tamper resistant.

PART 3 - EXECUTION

3.01 GENERAL

A. The Manufacturer shall certify that the complete unit meets or exceeds the seismic requirements of the California Administrative Code Titles 21 and 24.
B. Certification: The Manufacturer shall provide a notarized letter certifying compliance with all the requirements of this Specification. The Certification shall identify, by serial number(s), the equipment involved.

3.02 TEST AND COMMISSIONING (ADDITIONAL REQUIREMENTS)

A. SETTINGS
1. Set and calibrate field-adjustable intervals, timing settings, load-shed, load-add and delays, and engine exerciser.
2. Check remote communications connects, protocols, interfaces and controls with remote related building systems.
3. A Factory-Authorized Service Technician shall inspect components, assemblies, and equipment installation, including connections, and to assist in testing.

B. Testing
1. Following completion of automatic transfer switch and generator installation and after making proper adjustments and settings, site tests shall be performed in accordance with Manufacturer’s written instructions to demonstrate that each automatic transfer switch functions satisfactory and as specified.
2. Advise Owner’s Representative of the site testing 10-days prior to the scheduled date. Provide Certified Field Test Reports three (3) copies within 14-days following successful completion of the site tests to the Owner’s Representative. Test reports shall describe adjustments and settings made and site tests performed.
3. Operational tests shall include the following:
   a. Insulation resistance shall be tested, both phase-to-phase and phase-to-ground.
   b. Inspect for physical damage, proper installation connection, and integrity of barriers, covers, and safety features.
   c. Verify that manual transfer operation.
   d. Perform manual transfer operation.
4. After energizing circuits, demonstrate the interlocking sequence and operational function for each automatic transfer switch.
   a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
   b. Simulate loss phase-to-ground voltage for each phase of normal.
   c. Verify time-delay settings.
   d. Verify pickup and dropout voltages by data readout and inspection of control settings.
   e. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, re-transfer time delay on restoration of normal power, and engine cool-down and shut-down.
5. Coordinate with testing of ground and fault protective devices for power delivery from both sources.
   a. Verify grounding connections and locations and ratings of sensors.
   b. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
   c. Power failure of normal source shall be simulated by opening upstream protective device. This test shall be performed a minimum of five (5) times.
d. Power failure of emergency source with normal source available shall be simulated by opening upstream protective device for emergency source. This test shall be performed a minimum of five (5) times.

e. Low phase-to-ground voltage shall be simulated for each phase of normal source.

f. Operation and settings shall be verified for specified automatic transfer switch operational feature, such as override time delay, transfer time delay, return time delay, engine shutdown time delay, exerciser, auxiliary contacts, and supplemental features.

g. Manual and automatic transfer and bypass isolation functions shall be verified.

6. If any defects or deficiencies are detected, correct the defects and repeat the test until all test-pass is achieved.

3.03 ELECTRIC POWER AND CONTROL CIRCUITS (ADDITIONAL REQUIREMENTS)

A. General

1. Provide NEC Class-1, Division-1 explosion-proof conduit fittings and seals on each conduit entering or exiting the engine generator location from the ATS.

2. Terminal blocks with barriered terminals shall be provided for all control wiring terminator points. Control wiring shall be run in horizontal and vertical, isolated, internal metal wireways and shall be carried across hinges in laced bundles. Wire terminators shall be crimp-on type spade terminal

3. Secondary control wiring shall be a minimum of 14 AWG stranded copper type SIS 600-volt insulation.

4. Control circuits shall have circuit number tags at each termination or break in the wire to match circuit numbers on terminal strips and control wiring diagrams.

5. Provide quantity and AWG conductor size/type capacity, circuit conductor “lug” connection landings, compatible with connections shown on the Drawings.

B. Additional Conduit Homeruns

1. Provide the following minimum quantity and size conduit and wire, to connect each ATS controls, generators, monitoring, and annunciators, shall also comply with ATS and Engine Generator Manufacturer’s recommendations. Install the conduit and wire from each ATS to the respective engine generator, monitoring and control equipment and locations. Refer to Drawings for additional requirements. Install conduit underground and/or concealed in building structure at all locations.

a. 1.25-inch conduit 5#10 plus 1#10 ground and 12#14 from each ATS to engine generator, for engine automatic stop-start controls, overload shed and add, engine exercising, engine generator “emergency-stop”, control and monitoring.

b. ATS line voltage feeder circuits for generator source, normal source and load feeders.

c. 1.0-inch conduit 4#10 to each elevator equipment /machine room controller unit – elevator interlock.

d. 0.75-inch conduit 8#14 to fire alarm control panel for fire alarm system monitoring and control of ATS.

e. 1.0-inch conduit 8#12 to HVAC – BAS building automation system master control transponder.

f. Two (2) 1.5-inch conduits to the generator, with engine generator control circuits for momentary parallel-synchronized operation of the engine.
generator with the Electric Utility Company incoming electric service. Circuit conductor quantity and type as recommended by Manufacturer.

END OF SECTION
120715/223015
SECTION 26 3215

STANDBY POWER

PART 1 – GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
   2. General provisions and requirements for electrical work.

B. Engine Generator
   1. Furnish and install emergency continuous standby diesel (USA-grade #2 ULSD-CARB) fuel engine driven generator with all accessories and other appurtenant work and materials required for a complete operational installation.
      a. The fuel provided shall comply with; be listed by; and shall be approved by, the California Air Resources Board (CARB Fuel Specifications and Test Methods).
   2. The standby power system shall include an electric generating set rated to deliver 150kW, 187.5kVA at 0.8 power factor. Engine not less than 1500Bhp minimum, V-16 cylinders at 1800RPM.
   3. Unit rating shall not be based on the peak output curve of the prime mover. Unit rating shall be based on the continuous standby rating at the altitude above sea level of the engine generator installation site. Performance engine curves shall be submitted.
   4. The engine generator output voltage shall be 480/277 volts, 3 phase, 4 wire, 60Hz AC.
   5. The engine generator set shall be built, tested and shipped by the Manufacturer of the unit so there is one source of supply and responsibility. As manufactured by Cummins; or Kohler; or Caterpillar.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. General
   1. The Factory Authorized Distributor supplying the equipment shall have full service and parts available on a 24-hour basis located within 200 miles of the Project Site. Instruct the involved CONTRACTORS on the proper method of installing the engine generator unit and related equipment.
   2. Make Shop Drawings to scale, showing overall dimensions and other dimensions required for proper installation of equipment and external connections. Identify clearly each item on Drawings to show piece of equipment it represents. Indicate corrosion resisting treatment and finish.
   3. Shop Drawings shall include complete Floor Plan layout of room and/or area show install location of all equipment and indicate equipment layout, conduits, junction boxes, etc., complete with dimensions and clearances for review of the OWNER’S Representative.
4. Diagrams shall be both schematic and elementary point-to-point using standard symbols and with components arranged in logical sequence, so that system operation can be checked easily. Where special symbols are used or where function of components is not obvious, include suitable legend or functional guide. Number all terminals for external wiring connections on diagrams. A composite control wiring diagram shall be provided showing the integrated control and load connections of the following:
   a. Engine generator and control panel.
   b. Engine generator remote annunciator panel.
   c. Automatic transfer switch.
   d. Battery charger.
   e. Special interlocks noted on Drawings.
   f. Fuel system.
   g. Load testing system.
   h. Connect to control and monitoring systems.

5. Submit prototype, independent test lab, certified test reports for engine generator unit of identical size, type and construction showing conformance with performance requirements outlined in the Contract Documents. Plus the following additional tests:
   a. Maximum power level.
   b. Maximum motor starting capacity.
   c. Fuel consumption.
   d. Engine/alternator cooling air flow (heat rejection).
   e. Transient response and steady state governing.
   f. Alternator temperature rise.
   g. Single step load pickup.
   h. Harmonic analysis and voltage wave form.
   i. Three phase short circuit test for mechanical electrical strength.

B. Pollution Emissions
   1. The engine generator shall comply with the air pollution controls and pollution emission limits regulations of the Authorities Having Jurisdiction (AHJ), including but not limited to the following: A Manufacturer’s “Certified Equipment Permit” shall be provided showing the proposed equipment AHJ approval permits.
      a. Environmental Protection Agency (USEPA) – Local Region Having Jurisdiction.
   3. State of California:
      a. California Environmental Quality Act – CEQA.
      b. California Environmental Protection Agency (CALEPA) and California Air Resource Board (CARB).
      c. California Air Quality Management District (AQMD) District Office Having Local Jurisdiction at the Project Site location.
      d. Additional Local and City/County Pollution Control District Authorities Having Jurisdiction.
   4. The emission pollutants tests and reports shall include but not be limited to the following:
      a. Reactive organic gases – (ROG)
      b. Nitrogen oxides – $\text{NO}_x$
      c. Carbon monoxide – (CO)
      d. Particulate matter – (PM)
      e. Sulfur oxides – $\text{SO}_x$
f. Non Methane Hydrocarbons – NMHC

g. Non Methane Organic Gas – NMOG

h. Total Organic Compounds – TOC

i. Carbon Dioxide – CO\textsubscript{2}

j. Fuel storage containment, fuel leak detection and leak monitoring system.

5. Pollution emissions and Particulate Matter (PM):
   a. The engine generator pollution emissions and particulate emissions shall not exceed AHJ requirements.
   b. In no case shall particulate emissions exceed the following: The engine combustion air exhaust (discharge) emissions shall not exceed particulate matter (PM) emissions of 0.01 grams/Bhp-HR (engine brake horsepower each hour) at all engine generator load factors.

6. The engine generator Manufacturer shall prepare pollution emissions reports for the proposed engine generator. The reports shall be in the format and include the documentation required by the AHJ for emissions regulations. The engine generator operational pollution emissions and controls shall comply with the requirements and regulations of the AHJ for the intended engine generator use. If the engine generator requires the addition of emission controls and/or abatement controls to comply with AHJ requirements, provide said controls as part of the Contract Document requirements.

7. Apply for and obtain in the name of the CONTRACTOR and the OWNER respectively the Permits to construct and Permits to operate the engine generator system as a Building Code mandated Emergency Stand-by Power System. Provide four (4) copies of each permit application for review by the OWNER’S Representative prior to submittal to AHJ. Obtain the AHJ approval of the permits, along with a written description of any additional actions the OWNER must accomplish. Submit all documents to the OWNER’S Representative.
   a. The design intention hours of engine operation (engine running) are less than 199 hours in a 12-consecutive month period of time, to supply Building Code mandated emergency electrical power. The actual operating (running) time of the engine generator will be determined by uncontrollable and unpredictable conditions, such as; acts of God; equipment failures; Utility Company outages; rolling blackouts, etc. The design intent estimated engine operating time includes an estimated 30-hours of programmable time for testing (exercising) maintenance of the engine generator system.
   b. The following is a partial list of “non-code” mandated electric loads that will be connected to the standby engine generator system:
      - UPS equipment
      - Refrigerator/freezer motor load equipment
      - Radio frequency transmitter
      - Intrusion detection/security alarm
      - Time-of-day master clock system
      - PBX telephone, intercom, paging equipment
      - HVAC air conditioning
      - Other loads as shown in the Contract Documents

C. Quality Control
   1. General
      The equipment shall be listed, labeled and approved for the application shown in the Contract Documents, as Building Code mandated, emergency electrical power supply equipment, complying with the most recent versions of the
requirements of the following Applicable Standards. The following standards shall become requirements of and are included in the Contract Documents:

2. Underwriters Laboratory – UL
   a. UL – 142, Steel Aboveground Tanks for Flammable and Combustible Liquids.
   b. UL - 2085, Fire Rated (vaulted) aboveground tanks for Flammable and Combustible Liquids. Fuel Tanks.
   c. UL – 508, Industrial Control Equipment.

   b. NFPA – 37, Stationary Combustion Engines and Gas Turbines.
   c. NFPA – 70, National Electrical Code.

4. National Electrical Manufacturer’s Association – NEMA
   a. NEMA – MG1.1, Electric Motors and Generators

5. American National Standards Institute – ANSI
   a. ANSI – 43, Recommended practice for Testing Insulation Resistance of Rotating Machinery

6. Institute of Electrical and Electronic Engineers – IEEE
   a. IEEE – 446 Recommended Practice for Emergency and Standby Power Systems

7. National Electrical Contractors Association – NECA; National Electrical Installation Standards – NEIS.
   a. NECA – EGSA404, NEIS – Recommended Practice for Installing Generator Sets.


D. Operating Manuals
   1. Provide in acceptable form, three (3) bound copies of Operating Manuals for electrical equipment.
   2. Provide catalog cuts, functional description of operation, wiring diagrams, operating and maintenance instructions, parts lists and other data useful and necessary for complete Maintenance and Operation of equipment.
   3. Deliver operating manuals to the OWNER’S Representative.

E. Special Considerations
   1. Manufacturer shall have printed literature and brochures on the complete unit describing the standard series specified.
   2. Critical Speeds: Each complete engine-generator unit shall be free of critical speeds of either a major or minor order that will endanger the satisfactory operation of the unit or cause undue vibration in any part of the plant equipment or structure. Satisfactory operation will be considered endangered if torsional vibration stresses exceed 5,000 psi within 10-percent above or below rated engine speed. Copies of a summary of computations of critical speeds shall be submitted.
   3. All openings for fuel lines, air intake/discharge, engine exhaust, conduits etc. shall be temporarily capped or plugged prior to shipment.
F. SHORT CIRCUIT, COORDINATION AND ARC-FLASH (ADDITIONAL REQUIREMENTS)

1. Perform and submit Engineered Settings for each equipment location, fuse and adjustable circuit breaker device, showing the correct time and current settings to provide the coordination within the limits of the specified equipment, per the latest applicable standards of IEEE and ANSI. Provide electrical system short circuit fault analysis, both 3-phase line-to-line and 1-phase line-to-ground calculations as part of the Coordination Analysis recommendations. Provide Electric ARC-FLASH calculations as part of the Coordination Analysis recommendations.

2. The information shall be submitted in both tabular form and on time current log-log graph paper, with an Engineering Narrative. Written narrative describing data, assumptions, analysis of results and prioritized recommendations, six (6) copies.

3. The goal is to minimize an unexpected but necessary electrical system outage and personnel exposure to the smallest extent possible within the fault occurrence location, using the specified Contract Equipment. Shall comply with, but not limited to:
   b. IEEE-399, Recommended Practice for Industrial and Commercial Power System Analysis.
   d. CEC/NEC

G. Seismic Earthquake and Wind Loading Withstand, Testing and Certification (ADDITIONAL REQUIREMENTS)

1. The complete engine generator assembly; including attached fuel storage and supply systems, cooling systems, exhaust system, housings/enclosures, accessories, supports/anchors etc., shall be designed, manufactured and tested for wind loading and earthquake seismic withstand at the installation location.

2. Shall withstand, survive and maintain continuous non-interrupted operation (running) during the seismic event occurrences. Continued normal operation after the wind event and seismic event occurrences have abated.

3. Shall include demonstrations of successful start-and-run test after completion of seismic event shake-table simulation.

4. Provide three (3) dimensional finite element analysis demonstrating anchorage and operational withstand of wind loading as follows:
   a. 100MPH-West Coast States USA and Hawaii.
   b. 150MPH-East Coast States USA, Gulf Coast States USA and Alaska States.
   c. 90MPH-all other USA locations.

5. Acceptance test seismic qualification of proposed engine generator shall employ triple axis shake-table simulation of the Required Response Spectrum (RRS) seismic event motion, certified and approved by the AHJ.

6. All unit fluids shall be at full-capacity during the seismic test.

7. Seismic test shall be performed by a third party independent test laboratory. Wind Analysis and Seismic Testing and Reports shall be certified, signed and “stamped” by PE Professional Engineer licensed and in good standing in the State, Civil Engineer or Structural Engineer.
PART 2 - PRODUCTS

2.01 ENGINE

A. General
1. The engine shall be diesel drive, two or four cycle, water cooled type with unit mounted radiator cooling, turbo-charged, operating speed of 1800 RPM. Engine speed shall be governed by an electronic governor with electrical activator, as manufactured by Barber Colman; Woodward Governor Company.
2. A unit mounted, 24 volt, D.C. 30-ampere battery charging alternator and solid state regulator shall be provided.
3. Engine shall be rated for continuous standby duty.
4. The engine lubrication system shall be pressure type with engine driven lubrication oil pump and replaceable oil filter element, full flow oil filter. Breather pipe suitable for adding engine-lubricating oil while the engine is running shall be provided. Provide lubricating oil per Manufacturers recommendations.
5. The engine throttle control system shall provide a minimum discrete engine speed adjustment sensitivity of 0.15Hz, measured at the generator output under all loading conditions.
6. Engine Governor:
   a. The Engine Generator shall be furnished with digital electronic Isochronous Engine Governor and Generator Voltage Regulator.
   b. The Engine Governor shall provide measurement of the engine operating temperature, automatically adjust the engine governing gains as a fraction of the engine temperature to prevent unstable governor operation due to temperature.
   c. The engine generator output frequency control shall incorporate output frequency adjustable transient slew-rate, to prevent engine generator instability resulting from "pulsing" emergency loads.
7. The engine generator set package shall comply with the manufacturing requirements and test requirements of UL-2200.
8. Provide modifications for remote control operation from the ATS. Generator speed, frequency, power factor and load sharing shall be controlled from the ATS. The engine generator shall be modified for parallel and synchronized operation with the electric Utility Company incoming electric service. Provide additional engine generator controls required by the ATS Manufacturer, to ensure correct and safe operation of the engine generator parallel and synchronized operation with the Utility Company. The engine generator interconnection additional protection shall comply with:
   a. IEEE-1547, 1547.1, 1547.2 and 1547.3 including pending draft standards.
   b. Serving electric utility company requirements.
   c. State of California Rule #21 recommendations and requirements.

B. Engine Horsepower
1. The engine horsepower output shall be sized to provide sufficient capacity to operate all specified engine generator accessories and still maintain the electrical output and performance characteristics specified for the engine generator unit. The engine horsepower rating shall be increased to compensate for the following factors at the installation location. Submit calculations showing allowances for each condition:
   a. Installation altitude above sea level and specified ambient air temperatures.
b. Engine driven radiator cooling fan.
c. Cooling air positive and negative back pressure increases caused by radiators, radiator mounted load banks, generator housing, sound attenuation baffles, air louvers and cooling air intake/discharge air ducts.
d. Engine driven fuel pumps.
e. Engine driven coolant pumps.
f. Engine driven battery charger.
g. Generator coupling/transmission gearing losses.
h. Engine driven lubrication pumps.
i. Engine combustion exhaust mufflers and engine exhaust system piping.
j. Engine combustion air intake filters and intake air silencers.
k. Engine driven super chargers and turbo chargers.
l. Engine fuel source/type derating factors.
m. Engine combustion exhaust emission controls, with back-pressure monitoring and reporting system.

C. Engine Controls
1. Oil pressure, and temperature gauges.
2. Water temperature and pressure gauges.
3. Battery charge alternator rate ammeter.
4. Solid state, plug-in module monitor system including visible low water temperature alarm, individual fault lights, alarm terminals and engine shutdown with manual reset for over crank, over speed, high water temperature, low fuel, high oil temperature and low oil pressure. Low oil pressure, high water temperature and low fuel shall provide pre-alarm prior to engine shutdown. Over speed shall provide both positive air and fuel supply shut-off at approximately 110-percent of operating RPM.
5. Solid state plug-in type cycle “cranking” start control. After three (3) failed cranking attempts of approximately 75 seconds each, the crank/rest cycles will be terminated, with alarm and manual reset.

2.02 ALTERNATOR (GENERATOR)

A. General
1. The line voltage alternator shall be a revolving field, broad range, 4-pole, brushless, designed for minimum reactance, low voltage waveform distortion and maximum efficiency. The rotor amortisseur windings shall improve the AC waveform, reduce field heating with single phase or unbalanced loads and act as a stabilizer for paralleling. The rotor shall be dynamically balanced, connected and aligned to the engine by a semi-flexible disc coupling.
2. The three phase alternator shall be twelve lead reconnectable. The insulation shall be NEMA MG1-1.65. Temperature rise 80 degrees centigrade per NEMA MG1-22.40. Insulation shall be vacuum impregnated for improved protection and cooling.
3. The exciter shall be brushless, three phase, full wave rectified, with silicon diodes mounted on common rotor shaft and sized for electric induction maximum motor starting capacity.
4. The voltage regulator shall be digital type solid state, including silicon controlled rectifiers with three phase-controlled sensing circuits. The system shall feature automatic voltage reduction if the load demand exceeds the engine capacity, to eliminate engine stalling due to an occasional engine misfire or temporary overload such as motor starting and shall prevent overheating or blowing of fuses of the load circuit, due to saturation of magnetic
components, when the voltage remains constant at reduced frequency. The voltage reference shall be a temperature compensated Zener Diode. The voltage regulator shall eliminate voltage regulator incorrect operation caused by voltage distortion resulting from non-linear emergency loads.

5. The winding “pitch” of each generator shall be matched and shall be the same for each generator. The engine “governor”, generator “voltage regulator” and generator “exciter” shall all be the same Manufacturer and type for each engine generator.

6. Anti-condensation heater in the generator line voltage alternator with automatic “on-off” control shall prevent condensation from occurring inside the alternator. 120/208 volt 60Hz operation, single or 3-phase as indicated on the Drawings. Provide automatic cut-off when engine is running and automatic thermostat control.

B. Harmonic Load compensation
1. The engine generator alternator system, generator windings, voltage regulator and exciter shall be compensated for "SCR" type loads on the output side, with 50 percent 3rd, 5th, 7th and 9th harmonic voltage and current content in the connected loads.

2. SCR emergency type loads include Variable Speed Motor Drives (VFD); uninterruptible power supplies (UPS), computer/data processing equipment, lighting electronic dimming equipment, audio/video equipment, etc.

C. Generator Controls
2. Output load voltmeter, true RMS.
3. Output load ammeter, true RMS.
4. Output load power factor meters, for both negative and positive power factors.
5. Combination voltmeter-ammeter selector switch for phase-to-phase and phase-to-neutral meter input.
6. Analog meters shall be not less than 4-inches in size. Digital meter digits shall be not less than 0.25-inch high. Meter accuracy ± 1-percent.
7. Elapsed running time meter, 0-99999 hour’s minimum, non-resettable.
8. Output load frequency meter (true relative to engine speed).
9. Output load voltage manual adjusting rheostat, plus or minus 5-percent rated output voltage and voltage regulator.
10. Startup cranking controls.
11. Solid state digital electronic protection devices with adjustable settings for; loss of excitation; output overvoltage protection; under/over frequency; generator winding differential overcurrent protection; reverse VAR (loss of field) protection to prevent pole-slippage and mechanical impact damage because of out-of-phase paralleling action with the utility source or other engine generators.
12. Generator control panel illumination, with on-off manual switch illumination control.
13. Output load circuit breaker mounted in Nema I enclosure on the side of the generator control panel. A signal light shall be provided to indicate breaker is in the "off" or tripped position. Circuit breaker shall be mounted on vibration isolators. Circuit breaker shall be rated for “service entrance” use. Circuit breaker shall be 100 percent continuous load rated. The circuit breaker shall be sized at not less than 115-percent of the generator rated electric load output and voltage. The output load circuit breakers shall be provided with adjustable trip settings as follows:
a. Instantaneous pickup.
b. Long time pickup and longtime delay.
c. Provide ground fault detection sensor on the generator main disconnect. The sensor shall provide audio/visual alarm indication in the event of a ground fault detection occurring in the electrical line voltage output connecting into the generator main disconnect. The ground fault condition shall also provide audio/visual alarm indication at the engine generator remote annunciator panel. The ground fault system shall not cause an interruption of the emergency system.

14. Three position control selector switch "Automatic-Off-Run" when the switch is in the "off" position a red pilot light shall activate with a nameplate "Generator is not operable" when light is on.
15. Remote stop-start connection terminals.
16. Reset pushbutton to reset automatic shutdown lockout circuits.
17. All controls shall be identified as to function with engraved nameplates or engraved control panel. Nameplates shall be fastened with bolts, nuts and lock washers.
18. Combination engine and generator control panel shall be shock mounted over the rear end of the alternator, and include switched panel lights, controls shall be solid state type.
19. Provide a factory prewired terminal panel in the engine generator control panel. The terminal panel shall provide individual “landing” and termination points for each control/annunciator circuit entering and exiting the engine generator location. Each termination point shall be vibration resistant, insulated, barriered, and identified with individual circuit numbers/names.
20. Exposed control and monitoring wiring shall be installed in liquid tight fuel, oil and fire resistant flexible raceways within the engine generator housing.
21. Engine generator emergency shutdown:
a. Provide "Emergency-Stop" manual control station switch to automatically stop-shutdown engine generators when the switch is activated.
b. Weather resistant; tamper resistant manual operation, double action (breakable glass) with auto-lockout on activation. Flush mounted or surface mounted +42-inches on wall to accommodate wall condition.
c. Provide alarm indication on generator control panel when switch is activated. Provide a switch at each entry door location into the engine generator enclosure/room; each main fire alarm control panel; and at each engine generator automatic transfer switch. Provide 5#10 – 1-inch conduit homerun to engine generator from each switch.
d. As manufactured by ASCO #124 series, Square-D or equal.

D. Automatic Load Controls, Engine Generator Controls and Monitoring-Programmable Logic Controller
1. Each engine generator shall be provided with microprocessor based, software controlled, engine generator management Programmable Logic Controller (PLC), rated specifically for engine generator monitoring and control. The respective remote annunciators and ATS units shall each also be provided with compatible matching software for Programmable Logic Controllers (PLC) engine generator systems.
2. The PLC shall provide monitoring, control and visual display of engine generator analog and digital operating parameters including output voltage, output frequency and output demand load.
3. In the event of an engine generator overload, the PLC shall automatically disconnect (shed) respective ATS load causing the overload condition.
4. The ATS load control process shall prioritize load “shedding” and load “adding” by ATS load types connected to the respective ATS, and shall provide software adjustable time delay for each load “shed/add” priority level. The PLC shall provide individual independent load “shed” and load “add” priority for each ATS connected to the engine generator.

5. The ATS units supplying Building Code mandated emergency loads (i.e., life safety exit egress lighting, fire alarm, etc.) shall have the highest priority to remain connected to the engine generator. Loads connected to other ATS units that are not mandated by Building Codes (i.e., non-life safety loads – refrigerators, UPS, computers, air conditioning, telephone equipment, etc.) shall have the lower priorities to remain connected to the engine generator. The PLC load “shed/add” priorities shall be software programmable.

6. The PLC shall provide visual/audio alarm annunciation of the overload condition(s), engine generator system status/alarms and each ATS load connection status, at each engine generator location, respective engine generator remote annunciator panel and at the respective ATS.

7. The PLC shall communicate the ATS load “shed/add” command controls to the respective PLC equipment in each ATS unit, and assign each ATS with a separate individual load “shed/add” priority. Provide the PLC equipment in each engine generator, remote enunciators and Automatic Transfer Switches (ATS). Provide PLC common digital/multiplex communications protocols and operating software, to ensure correct, error-free interoperability among all the PLC units and related equipment.

8. The PLC shall provide selective load “lockout” with manual reset upon shed or time delay automatic load restore of each ATS after a load shed event has occurred, software programmable at the PLC.

9. The PLC color display screen with LCD based “touch screen” function shall display operating status and alarms of the engine generator, fuel system and each ATS unit. 10-inch diagonal or larger LCD screen size. PLC non-volatile memory storage shall store in memory a minimum of 30-days display information, plus the operating software program controls. Interface port for plug-in connection of portable laptop computer interface to provide uploading to the PLC software programs and downloading system operating information from the laptop computer.

10. Each PLC shall be rated for operation in the same ambient environments and vibration conditions as the engine generator.

**2.03 UNIT ENGINE AND GENERATOR COMBINED PERFORMANCE**

A. General

1. Frequency Regulation: Isochronous no-load to rated load.

2. Voltage Regulation: Steady state voltage regulation shall be within plus or minus 2-percent of rated voltage from no-load to full rated load.

3. Recovery to stable operation after application of full rated load shall occur within 5-seconds.

4. Steady State Operation: The frequency variation shall not exceed plus or minus 0.15Hz. Voltage variation shall not exceed plus or minus 1-percent of their mean value. The steady state operation shall be based on constant loads ranging from no load to full rated load.

5. Electromagnetic Interference Level Attenuation shall exceed requirements for generator connected loads including but not limited to: data processing equipment, Uninterruptible Power Supplies (UPS), standard AM and FM radio, CATV and commercial television, marine radio-telephone equipment. Tele-
phone influence factor shall be less than fifty (50) pursuant to NEMA MG1-22.43.

6. Waveform Deviation Factor shall be less than 0.06 line-to-line and line-to-neutral per NEMA MG1-22.42.

7. RMS Voltage Dip: The sustained RMS voltage dip shall be less than 18-percent of rated voltage when full 3 phase load and rated power factor is applied to the alternator.

8. Peak kVA: The available peak kVA shall be suitable for simultaneous electric motor starting as shown on the Contract Documents. Quantity and size of motors as indicated on the Drawings, shown connected to engine generator system. The generator shall sustain at least 90-percent of no load voltage for 10 seconds with 250-percent of rated load at zero power factor connected to its terminals. Submit test data.

2.04 ENGINE GENERATOR REMOTE ALARM ANNUNCIATOR PANEL

A. General
1. A remote mounted alarm annunciator panel in a NEMA 3R flush mounted enclosure with clear tamper resistant locking cover door, at each location shown on the Drawings, but in no case less than one (1) annunciator for each engine generator.

B. Annunciator Display
1. The annunciator shall include the following with appropriate sensors “sending” units installed in each engine generator, fuel system and ATS units.
   a. Generating: Generating power ready for load.
   b. Over crank: Electric plant failed to start.
   c. Low Oil Press: Low engine lube oil pressure.
   d. Hi Engine Temp: Pre-alarm and final excessive cooling water temperature.
   e. Low Engine Temp: Low engine cooling water jacket temperature.
   f. Over speed: Excessive RPM of electric plant.
   g. Low Fuel: Pre-alarm and final low fuel supply.
   h. Low Battery Voltage: Low starting battery voltage.
   i. Hi Battery Voltage: High starting battery voltage.
   j. Weak starting battery alarm.
   k. Overvoltage: Generator output over voltage.
   l. Fuel Spill: Each fuel storage unit rupture basin fuel spill detection.
   m. Low coolant: Engine low coolant level.
   n. Low oil level: Low engine lube oil level.
   o. PER engine emissions common alarm and status.
   p. Generator ground fault alarm.
   q. ATS alarms for each ATS.
      1) ATS: connected to normal utility source.
      2) ATS: connected to generator source.
         Engine generators supplying more than one Automatic Transfer Switch (ATS) shall include the following additional alarm annunciation for each individual ATS:
      3) ATS: generator overload shed.
   2. Audible alert:
      a. An audible signal will sound with the visual signals, except for conditions paragraph 1.a; 1.q.1 and 1.q.2 above. A switch will be incorporated to silence the audible alarm until the alarm condition is corrected. The
audible alarm shall then sound until the switch is repositioned to the "normal" position.

2.05 FUEL

A. Fuel Connections
   1. Engine mounted and piped dual parallel, in line “Baldwin” or “Dahl” fuel filters. Each fuel filter twin chamber, 3-stage combination fuel filter/water Separator. Provide valving for replacing individual filters while engine is running and valves for draining accumulated water from each filter.
   2. Flexible, bronze, fuel line connectors' minimum 24-inches in length for supply and return fuel line connections. Leak proof connectors type and size to match and be compatible with respective fuel lines and engine connectors.
   3. Main remote fuel storage tank system, fuel transfer pumping, and fuel line piping under related Contract Document Sections and Drawings.

B. Maximum Permitted Engine Fuel Flow
   1. The full rated fuel consumption for the engine generator shall not exceed the following:
      a. Maximum engine full load fuel consumption shall not exceed “(insert gallons)” gallons per hour.
      b. Maximum engine fuel flow rate shall not exceed: (engine full load fuel consumption) plus (excess fuel flow for engine components cooling) “(insert gallons)” gallons per hour.

2.06 COOLING

A. Liquid Cooling
   1. The engine shall have an engine driven centrifugal type water circulating pump with bypass, for circulating thermostat controlled water through the engine cooling system.
   2. 50-percent water and 50-percent permanent solution anti-freeze protection.

B. Radiator
   1. Radiator Cooling: A unit-mounted radiator and piping, with pusher type fan shall be provided for full load continuous standby operation in an ambient 24 hour temperature of 110 degrees Fahrenheit and including the “load-bank” cooling airflow requirement. Provide a fan shroud and protective guard. Radiator coolant drain petcock and pressure relief filler cap.
   2. Radiator shall be provided with metal duct flanges for connection of flexible discharge air duct.
   3. Provide, flexible metal, rust resistant, watertight, discharge air duct. The air duct shall connect airtight from the radiator/radiator mount loadbank duct flanges to the respective wall louver air discharge opening located to the front direction of the radiator. Flair the air duct to direct all radiator/loadbank cooling discharge air through louvers and to match the size of the radiator/loadbank configuration to the larger size of the wall louver configuration.
   4. The pusher radiator fan shall be sized to provide proper cooling air flow to overcome the static back pressure of the supply and exhaust cooling air ducts, radiator, plus the radiator mounted resistance “load-banks”, plus the discharge air ducts and louvers associated with the engine generator installation. Submit back pressure air flow calculations for review.
C. Water Jacket Heater
   1. Water jacket engine electric resistance preheater shall provide positive water circulation, thermostatically controlled to operate within range of 100 degrees to 120 degrees Fahrenheit. In an ambient temperature of zero degrees centigrade, 120/208 volt 60Hz AC, single or three phase, as indicated on Drawings. Provide automatic power cut-off contactor/relay when engine is running and to cycle the operation of the heaters. Provide shut-off bypass valves on heaters at both the inlet and outlet sides, readily accessible. As manufactured by "Kim-Hotstart".
      a. 11 feet from a property line.
      b. 4 feet from an exterior wall or roof.
      c. 11 feet from windows, building openings, air outlets and air intakes for the building.

2.07 ACCESSORIES

A. Batteries:
   1. Starting batteries shall be lead acid type. Batteries shall provide sufficient capacity to provide the equivalent of three (3) 75-second duration engine cranking operations with a 60 second rest period between cranking operations at 77 degrees F. with a cold engine and final battery voltage of 1.75 volts per cell at 77 degrees Fahrenheit. Specific gravity of fully charged battery shall not exceed 1.220 at 77 degrees Fahrenheit. Batteries shall be equipped with removable cell caps utilizing catalytic conversion of hydrogen battery gases. Provide insulated stranded copper conductors to connect batteries to generator electric starting motors(s), sized to insure a full load voltage drop of not more than 5-percent when starting the engine.
   2. Battery Box: Battery box shall be rated outdoor weatherproof. Acid resistant fiberglass battery box with hinged, padlocking cover. Electrically insulated seismic earthquake restraints and anchors. Install batteries in battery box. Install battery box on floor directly adjacent to engine generator for indoor locations. Install battery box inside engine generator housing for outdoor locations.
   3. Battery Charger: Completely solid state. DC output shall be voltage regulated and current limited so as not to require a cranking disconnect relay. The charger shall include: full wave output, silicon semiconductors, automatic boost (equalize) mode, surge suppression, individual potentiometer adjustments for boost and float voltage, DC output voltmeter and ammeter, AC and DC fuse, input and output terminals, DC output completely isolated from AC input, and shall completely recharge full discharged batteries within a 12 hour period. Input voltage shall be 208-volt, as indicated on the Drawings. NEMA 3R for outdoor locations and NEMA 1 enclosure for indoor locations.
   4. Weak Battery Alarm: Monitor the engine starting battery voltage under start-up load, while the engine is cranking in the start-mode. If the starting battery voltage drops for too long a time period, (as recommended by Battery Manufacturer) a “weak-battery” audible warning shall sound, along with annunciator visual alarm indication.

B. Engine Exhaust Silencer
   1. Super-critical grade exhaust silencer with companion flanges, rain-cap, and seamless stainless steel flexible exhaust tubing, 18-inch minimum length.
   2. Provide approximately 8-inch length of rigid schedule 40 black iron pipe between the exhaust manifold and the flexible tubing. Sweep elbows a
minimum radius of three times the exhaust pipe diameter shall be used for exhaust pipe bends.

3. Provide safety, continuous heat guards on all engine exhaust piping, manifolds and silencers located below 10 feet above finish grade.

4. Provide automatic gravity operated “rain-cap” on discharge, to prevent entry of rain and vermin. Horizontal or vertical exhaust discharge, for compatibility with install location.

5. Provide drain “petcock” at the low point of each exhaust stack to allow condensate gravity drain of engine exhaust system.

C. Engine Exhaust Emissions and Particulate Emissions (PER) Reduction

1. The PER shall be a self-contained, passive, self-regenerating, continuously self-cleaning (regenerating) particulate filter, with internal precious metal catalysts in conjunction with the particulate filters. Connect the PER “in-line” with engine combustion air exhaust discharge system. PER high temperature 304 stainless steel housing, supports and fittings. The PER system, supports, and housing shall withstand and operate correctly with the engine exhaust flow output, pressures, physical characteristics and thermal conditions of the engine exhaust system. The PER shall be specially designed and manufactured for stationary, internal combustion engine operation and for 2-stroke or 4-stroke engines as applicable.

2. The PER shall actively reduce environmentally harmful products of ENGINE combustion present in the engine combustion air exhaust. The PER shall not cause an increase in any other engine exhaust toxic contaminants:
   a. Diesel particulates reduction (without increasing NO$_2$ content) not less than………………85-percent reduction
   b. Carbon Monoxide (CO) not less than …………………70-percent reduction
   c. Total Hydro Carbons (THC) not less than……………70-percent reduction

3. The PER shall be Tested, Approved and Certified to comply with Federal - EPA, State and Local Air Quantity Management Districts and applicable AHJ, by the Engine Generator Manufacturer, for safe correct operation of the proposed engine/PER combination and by the PER Manufacturer for AHJ compliance and engine compatibility. The PER shall be listed and approved by and with each AHJ.

4. A microprocessor - based, data logger and alarm, with data logger and sensors installed to Record PER temperature and engine exhaust back pressure, shall detect if engine combustion exhaust back pressure and/or PER operating temperatures comply with and/or exceeds engine and PER Manufacturer’s recommendations. The alarm status shall also be reported on the engine Generator Remote Annunciator Panel (EGAP) and the engine generator internal control panel.

5. Provide a permanent sign on the engine generator fuel input port and each related fuel storage tank, minimum $\frac{3}{4}$-inch high block letters: “Warning this engine is equipped with an engine exhaust particulate combination filter/catalyzer. Diesel fuel for this unit shall be Ultra Low Sulfer Diesel fuel (ULSD), maximum of 15-PPM sulfur content or less, as measured by weight. The fuel shall be CARB Tested and Certified. Damage to the equipment and failure to operate may occur if the correct ULSD/CARB fuel is not used!”

6. PER systems requiring the addition of additives to the engine postproduction fuel supply are not acceptable.
7. Standby Emergency Unit Operation with Emissions Particulate PER Filter
   a. Standby Engine Generator Load Factor with PER Particulate PER filter. The particulate emissions shall not exceed AHJ requirements, but in no case shall particulate emissions exceed the following:
   b. The engine combustion air exhaust (discharge) shall not exceed particulate emissions of 0.01 grams/Bhp-HR (engine brake horse power each hour) at all engine generator load factors.

D. Enclosure and Mounting
   1. Spring type, vibration/seismic isolators, with a (1) one-gravity lateral (horizontal) acceleration withstand rating seismic earthquake restraints. The install location of the engine generator shall be included in selecting the correct isolators, for example the seismic forces on the roof of a building are substantially greater then seismic forces at ground level.
   2. Radiator, engine and alternator shall be mounted on a twin steel "I" beam base. Base shall be suitable for lifting, hoisting, or skidding of the entire unit into installation position.
   3. The engine generator shall be completely housed in a NEMA 3R outdoor rated weather-protective metal enclosure NEMA 1, indoor rated protective metal enclosure. The generator housing shall be attached to and mounted on the same skid steel frame "I" beam base as the engine generator. Provide at least four (4) hinged, removable side access doors and rear hinged control panel access doors. Provide locking hasps on all access doors. Engine exhaust silencer shall be side inlet type, mounted on top of housing and terminate with rain cap. Engine exhaust transitioning through housing shall be provided with a suitable rain shield to prevent water from entering the housing.
   4. Engine generator unit and housing shall have a Manufacturer's standard weather protective finish paint color, applied over a rust inhibitor prime coat on all exposed and concealed surfaces.

E. Engine Combustion Air
   1. Engine combustion air intake silencers to limit the air intake noise to less than the engine exhaust silencer noise level.
   2. Replaceable, dry element, heavy duty, intake combustion air filters.

2.08 LIQUID FUEL TANK (SKID BASE MOUNTED BELOW THE ENGINE/GENERATOR)

A. General
   1. The fuel day tank for each generator shall be of the self-contained skid base mount type. Tanks shall be completely housed within the generator enclosure. Tank shall be welded metal construction. The fuel tank shall structurally support the weight and provide the anchorage for the complete engine generator assembly, plus a 150-percent safety factor.
   2. Tank finish and color to match generator finish and color. Interior of fuel tank shall be epoxy coated. The exterior bottom of the tank shall be provided with additional layer of anti-rust coating.
   3. The fuel tank holding capacity shall provide a minimum of twenty-four (plus 10-percent additional reserve) hours of continuous full load engine generator operation. Approximately 10-percent of fuel shall remain in tank to prevent fuel fouling and loss of fuel suction priming. Provide fuel filler neck with locking removable cap. The filler shall extend outside the engine generator enclosure.
4. The maximum height addition to the engine generator unit caused by the skid base mount tank shall not exceed 15-inches. The fuel tank footprint shall not extend beyond the engine generator/radiator footprint.

5. Tank shall be provided with two (2) fuel level detection switches and floats, low level engine shut down (set at approximately 10-percent fuel remaining to prevent fuel fouling of engine) and low level pre-alarm (set at 90-minutes remaining fuel) prior to shut down. Provide fuel level float activated "sight" gage. Provide threaded connection points on the tank for auxiliary fuel pump/filter “polish” system.

6. Fuel tank assembly anchoring and attachment shall be designed for earthquake seismic zone 4 with the tank full of fuel, and with the engine generator installed on the tank. The engine generator spring/vibration seismic isolators shall be provided between the engine generator “I Beams” and top of fuel tank.

7. Provided threaded removable insert plugs in all fuel tank line connections.

8. Fuel tank shall have a sump area at the bottom of the tank to collect water and sediment, with “drain-valve” to allow gravity draining of sump-fuel sediment.

B. Rupture Fuel Containment
1. Tank unit shall have rupture basin (double wall construction) with accidental spillage detection alarm contacts. Rupture basin capacity shall be sized at a minimum of 115-percent of fuel tank capacity. Rupture basin shall have 0.5-inch pet lock valve at the bottom of the basin to drain contents into portable container. Basin shall be enclosed to prevent collection of dust, debris and water.

2.09 LOAD BANKS

A. General
1. Each engine generator set shall have a resistive load bank, which shall operate connected to the generator electric output only under exercising function of the engine generator. The total kW rating of the load resistors shall be not less than 50 percent of the full load output kW rating of the generator to which it is connected, but in no case less than required by Engine Generator Manufacturer to maintain the Unit Manufacturer’s warranty.

2. Load bank shall be housed in a NEMA 3R weather protective enclosure, mounted integrally to the engine on the front of the radiator, and cooled by the airflow across the radiator. Provide air duct metal flanges on the inlet and exhaust sides of the load bank. The load bank housing shall be rust inhibited galvanized steel after fabrication, with Manufacturer’s standard finish color finish paint. The load bank’s load chamber shall have the physical dimensions coordinated with the radiator’s duct flange. The radiator fan’s cooling capacity (airflow) and engine standby rating horsepower shall be increased as necessary to prevent excessive static back pressure build up caused by the load bank.

3. The load bank resistors shall be mounted in field removable trays for servicing capability.

4. Resistors shall be constructed of high temperature alloy capable of continuous operation at 1920° Fahrenheit with a melting point of 2750° Fahrenheit and designed to operate at an average of 750° Fahrenheit. The resistors shall be assembled in a three phase array with the phase-to-phase resistor current balanced within 2-percent and an overall kW tolerance within 5-percent of its nominal rating.
5. A circuit breaker and load bank connection circuits shall be provided in the engine generator supplying the load bank. The circuit breaker shall be sized at 125-percent of the full load current of the load bank. Provide fuse protection for each individual load bank section.

6. Provide automatic electric contactors as required to activate load bank in the exercising mode. Provide all control interlocks with the automatic transfer switch as required to provide the following functions: load bank on-line.
   a. ATS exercising timer starts generator and brings load bank on-line.
   b. Exercising function operates for pre-selected period of time with load bank connected at 100-percent of load bank capacity.
   c. At end of exercise period, and prior to the engine "cool down" run out, the load bank shall be automatically taken off-line.
   d. If utility power outage occurs during the exercise period, the load bank shall immediately be de-energized (under any operating mode) before the emergency load automatic transfer switches change position; generator shall continue to run during the disconnect of the load bank.
   e. Provide a load bank “on-off-automatic” selector switch. The switch shall control the operational function of the load bank. The “on” position shall by-pass automatic operation and connect the load bank to the engine generator only when the generator is “running” at stabilized voltage output and rated RPM. The “on” switch position shall not override the automatic disconnect of the load bank in the event of an “emergency power” generator operation mode. The “off” position shall by-pass automatic operation, disconnect the load bank and prevent automatic operation of the load bank.
   f. Provide red (load bank connected) and green (load bank disconnected) indicating lights with “push-to test” for each load bank step load.
   g. Load bank system shall be as manufactured by Load Technology, Inc., La Mirada, California; AVTRON; Simplex or equal.

2.10 DIESEL FUEL AUTOMATIC MAINTENANCE (DFAM)

A. General
   1. Automatic, self-contained fuel maintenance system to remove particulates, microbial growths and water contamination in each engine distillate fuel storage system. The multistage filter system shall operate in a parallel pipe connection arrangement with the engine main fuel supply system.
   2. Provide fuel chemical treatment, anti-microbial dispersant and preservative fuel additives to the fuel storage system.
   3. As manufactured by Fuel Technologies Inc. (http://www.fueltechinc.com); ALGAEX-STS Series (http://www.algae-x.com).

B. Components
   1. Fuel filter pump:
      a. 120 volt 60Hz AC self-priming, electric motor driven fuel pump(s), directing the fuel through multi-stage particulate removal filtering and water removal separators, transporting fuel to and from the fuel storage tank.
      b. Pump fuel lift capacity not less than 1.4 gallons per minute at 15-foot head suction lift.
      c. Spurgear, iron casing, Viton sealed, pressure relieve valve, pump construction.
2. Piping connections:
   a. Piping connections for “dirty” fuel suction supply from the engine generator fuel tank sump. Filtered fuel return to the engine generator fuel storage tank fuel return directly to main storage tank bypassing day-tank within 6-inches of the bottom of the tank at the opposite end from the fuel sump.
   b. Provide ball valves on the filter fuel supply and return fuel pipelines, for system isolation and maintenance.
   c. Provide “foot-valve” in the fuel storage tank filter supply line pipe to keep the filter system primed.
   d. Provide one-way flow “check-valve” on the filter return line pipe to prevent fuel back-flow and siphoning.
   e. Thread connection black iron supply and suction pipes, sizes as recommended by filter Manufacturer, but not less than 1-inch diameter. Flexible line, final connectors to the fuel tank, to isolate vibrations between equipment.

3. Particulate filters
   a. Particulate filters, removable for filter cleaning and replacement. The filters shall remove and trap particulates in the fuel, 2 microns in size and larger, and flow forced through the filters by the filter pumps.
   b. Suction sensors to detect when filters are 75 percent or more obstructed with trapped particulates and requires servicing/cleaning.

4. Fuel water separator
   a. Trap and remove not less than 90-percent of the water contaminating the fuel, flow forced through the water trap by the filter pumps.
   b. “See-through” water trap bowel, with water level sensor probe, to indicate when the trap bowel is 75-percent or more full with removed water and requires servicing/cleaning.
   c. Trap bowel “spin” on and off removable for servicing and cleaning.

C. Controls
   1. Digital electronic controls for the automatic on-off control, monitoring and trouble alarms reporting of the DFAM system.
   2. Alarms shall monitor and annunciate and be reported on the engine generator remote annunciator panel as follows:
      a. High suction (fuel filter clogged).
      b. High water level in fuel water separator trap bowel.
      c. Fuel leak in the DFAM cabinet.
      a. Operations timer selection and programming.
      b. Alarm indicators and alarm reset.
      c. Suction gauge.
      d. Manual override stop-start control.

D. Cabinet
   1. Self-contained Metal Cabinet Manufacturer’s standard finish and color, to contain all of the DFAM components.
   2. Tamper-resistant NEMA-4X.
      a. Install DFAM cabinet inside the engine generator housing for outdoor locations.
      b. Install the DFAM cabinet for generators with “base mounted” fuel storage tank at engine generator on floor support brackets/pipe for indoor generator room locations. Engine generators with freestanding day-tank fuel storage; install the DFAM cabinet at the respective fuel day-tank
location on floor support brackets/pipe. Mounting height to prevent fuel siphoning.

c. Provide fuel pipes, power and control conduit/wire connections.
d. Complete the installation of chemical fuel treatment additive to the fuel storage tank after all engine generator testing and acceptance is completed.

PART 3 – EXECUTION

3.01 ENGINE-GENERATOR TESTS

A. General
1. Before delivery to the site, the engine generator assembled unit shall be given a preliminary operation and load test. The test shall be performed by an approved independent Testing Laboratory. The tests shall include full load test with a load bank of adequate capacity and shall assure performance of all specified function to the satisfaction of the OWNER’S Representative. Upon completion of the preliminary tests, the unit, complete with equipment, shall be delivered and installed at site. Provide four (4) copies of complete test records. A copy shall be framed and mounted in the unit by the CONTRACTOR. All shop load tests shall be run at 80-percent lagging power factor.

2. Upon completion of the installation work, including the electrical connections, and grounding of equipment and neutral, the CONTRACTOR shall provide all necessary facilities, fuel, instruments and equipment, including full capacity load bank required for the load tests, and arrange for final test runs. Field tests to be run at unity power factor with CONTRACTOR provided unity power factor load bank and fuel.
   a. Generator shall start and pick up full load at normal voltage and frequency within eight seconds, from a cold start (no prerunning within the previous 12 hours prior to the test).
   b. Load test at 0, ¼, ½, ¾ full load and 105-percent overload until readings are constant for 10 minutes duration for each.
   c. Four (4) 2-hour duration 100-percent continuous full load test conducted consecutively with the above test.

3. Readings required during all tests shall be taken on recently calibrated laboratory instruments as well as those on the equipment and shall include not more than 15-minute intervals during the test period including initial start and at final conclusion prior to shutting down for the following:
   a. Output frequency.
   b. Output voltage.
   c. Load current.
   d. Load watts and volt-ampere
   e. Ambient temperature.
   f. Engine, coolant temperature.
   g. Radiator and engine exhaust air temperatures.
   h. Generator frame temperature at hottest spot.
   i. Engine lubricating oil pressure and temperature.
   j. Frequency and voltage tests shall include a record of response time recovery from load changes.
   k. All adjustments, replacement of unsatisfactory equipment, and retesting shall be made by the CONTRACTOR’S at the CONTRACTOR’S own expense.
4. Before acceptance of the equipment, the CONTRACTOR shall instruct the OWNER’S Maintenance Personnel in the Operation and Maintenance of this equipment. Four (4) complete written instructions manuals, operating schedules, parts, lists, blueprints, wiring diagrams, maintenance and repair manuals, Engine and Generator Specifications including actual performance curves shall be submitted to the OWNER’S Representative before final approval.

5. Perform tests as specified and as requested by the OWNER’S Representative to prove installation is in accordance with Contract requirements. Perform tests in presence of the OWNER’S Representative, and furnish all test equipment, facilities, and Technical Personnel required to perform tests.

6. Provide full fuel tank fuel supply, prior to transferring acceptance of the engine generator after completion of tests.

B. Commissioning (Additional Requirements)

1. Setup, testing, startup, and commissioning shall be performed by Factory Technician(s) trained, certified and authorized by the Equipment Manufacturer. Final commissioning shall be performed after installation and connections are complete.

2. Simulate normal source power failure by opening (turn-off) building main service disconnect and verify connections and operation of each electrical system device connected to the engine generator system on both normal power source and emergency power sources. Simulated test time duration for operating connected on the emergency systems shall be not less than 120 continuous minutes without failure or anomalies in the system operation.

3. Record and document electrical demand load and sequence of operations on the engine generator system with all connected loads operating, including but not limited to:
   a. Fire alarms
   b. Egress/exit lighting
   c. Doors
   d. Auto-loading and overload shedding controls
   e. Fire sprinkler pumps.
   f. Elevators.

4. Provide system programming and setup of all control sequences and related equipment including but not limited to:
   a. Automatic Transfer Switches (ATS)
   b. Lighting control system
   c. Fire alarm
   d. (HVAC)
   e. Fuel transfer/storage
   f. Elevators.
   g. Other non-code mandated electrical loads.

5. Test all control system functions after the installation and connections are complete and the system has been energized. Verify each control sequence of operation and each device to be controlled are each operating correctly.

6. Record and document each device setup and program setting.

7. Submit written report (6 copies) to OWNER’S Representative certifying commissioning has been performed; all respective systems are operating correctly and document all software setup and each device settings.
3.02 GENERATOR INSTALLATION

A. General
   1. The engine-generator shall be mounted on Seismic Zone-4 rated spring isolators and anchor bolts having telescopic top and bottom housing with vertical stabilizers to resist lateral and vertical forces. Constructed of shatterproof ductile iron per ASTM-A-536 grade G5-45-12, type RJ from California Dynamic Corporation or equal.
   2. Engine generator furnished with a “Skid-Base” fuel tank. The seismic spring anchors shall attached between the fuel tank and engine generator skid-base “I” Beams. The seismic spring anchors shall isolate engine generator vibration from the “skid-base” fuel tank. The skid-base fuel tank shall be anchored to concrete slab for one gravity lateral acceleration seismic earthquake restraint.
   3. Generator engine shall have a crankcase drain pipe that is at least 8-inches from the floor, equipped with a readily accessible positive locking shut-off valve. All units shall have a removable full-length metal drip pan under the engine.
   4. Provide expansion type or cast in place type anchor bolts to anchor generator to equipment slab. Installation shall comply with Seismic requirements of California Code of Regulations Title 21 and Title 24.
   5. Diesel engine fuel shall be Ultra Low Sulfur content (ULSD); CARB tested and certified diesel fuel. Sulfur content shall not exceed 15 Parts Per Million (PPM) content.
   6. Complete all electrical connections, control connectors plumbing and mechanical connections.

3.03 CONTINUOUS MAINTENANCE SERVICE AND PREVENTATIVE MAINTENANCE

A. The Generator Factory Trained Service Personnel shall perform two (2) Field Inspections and Service Maintenance Visits, 4-hours duration each visit excluding travel time, at 6 and 12-calendar months after the engine generator installation connections and testing is complete. The Manufacturer’s standard recommended maintenance procedures shall be performed as part of the Contract requirements. A certified and registered letter outlining and describing the maintenance visit work has been completed shall be sent to the OWNER’S Representative after each visit.

B. The Supplier shall provide documentation of maintaining local 24-hour parts and Factory-Trained Service Personnel within a 200-mile radius of the Project Site with the Shop Drawing submittal.

3.04 ELECTRIC POWER AND CONTROL CIRCUITS

A. General
   1. Provide NEC Class-1, Division-1 explosion-proof conduit fittings and seals on each conduit entering or exiting the engine generator location.
   2. Provide quantity and AWG conductor size/type capacity, circuit conductor “lug” connection landings, compatible with connections shown on the Drawings’.
   3. The final conduit/raceway connections to any part of the engine generator from any “fixed” location entrance to the engine generator shall be made with liquid-tight flexible raceway. The raceway shall be UL label and approved for use in the atmosphere environment at the engine generator, shall be oil and fuel resistant.
B. Additional Conduit Homeruns

1. Provide the following minimum quantity and size conduit and wire, to connect each emergency generator, controls and annunciators. Install the conduit and wire from each engine generator to the respective monitoring and control equipment. Refer to Drawings for additional requirements. Install conduit underground and/or concealed in building structure at all locations.

   a. 1.25-inch conduit - 3#10 and 8#14 to each automatic transfer switch. Engine stop-start controls, overload shedding, engine exercising control, and monitoring.

   b. 1.5-inch conduit - 18#14 and 3#10 to remote engine generator annunciator panel.

   c. 2.5-inch conduit - 4#1 and 1#6 ground, feeder from each engine generator CPP panelboard to the remotely located emergency control power panel/switchboard source, 208/120 volt (life safety branch). Provide a subfeed 70 ampere 3-pole circuit breaker (100 ampere 3-pole for generator units exceeding 200kW) in the remote panel/switchboard and connect to the CPP feeder. Refer to Drawings for additional requirements.

   d. 1.5-inch and 1-inch conduits - 4#4 and 7#14 respectively to engine generator engine fuel transfer pump control system, fuel storage system, fuel leak detection system and the engine generator CPP panelboard.

   e. Two (2) 1-inch conduits 4#10 and 7#14 respectively to engine generator engine fuel “day tank” control system and leak detection system.

   f. Branch circuit conduit/wire for CPP panelboard connections to generator lighting, receptacles, engine block heaters, alternator anti-condensation heater, fuel day tank pumps, battery charger, etc.

   g. Generator load output feeder circuits.

   h. 1.25-inch conduit with 8#10 to main fire alarm control panel, generator “run-fail-ready” monitoring and emergency “run-stop” bypass controls from the fire alarm control panel location.

   i. 1-inch conduit with 5#10 to each respective engine generator emergency shutdown control station.

   j. 1-inch conduit with 6#10 to each elevator controller, for initiation of emergency power, elevator-recall function.

   k. Two (2) 1.5-inch conduit to each automatic transfer switch, with engine generator control circuits for momentary parallel synchronized operation of the engine generator with the electric Utility Company incoming electric service. Circuit conductor quantity and type as recommended by Manufacturer.

B. Control Power Panel

1. Provide a tamper resistant Control Power branch Circuit Panelboard (CPP) installed at each engine generator. Panel shall be in a NEMA-4x enclosure. Panel rating shall be 100 ampere bus 208/120 volt, 60Hz AC, three phase, 4 wire. The panel shall contain a 70 ampere, 3-pole 100 ampere, 3-pole for generator units exceeding 200kW main circuit breaker; (6) six 20 ampere single pole branch circuit breakers; (3) three 15 ampere single pole branch circuit breakers; one (1) 30 ampere 3 pole branch circuit breakers; and two (2) - 50 ampere, 3-pole branch circuit breakers for the engine block heaters. Provide control power branch circuit conduit and wire connections from CPP to respective engine generator components, including but not limited to; the engine starting battery charger; engine block heaters; fuel monitors and transfer pumps; engine lighting and power systems. The CPP-panel shall be surface mounted on or inside the engine generator, unless indicated otherwise.
on the Drawings. CCP Mounting height shall not be less than +24-inches above finish grade to panel bottom, or exceed +78 inches above grade to panel top.

2. Provide two (2) 120 volt 20 ampere duplex convenience weatherproof receptacles adjacent to the CPP panel installed in a surface mounted cast metal outlet box. Connect to CPP 20 ampere branch circuit breaker, with 0.5-inch liquid-tight flexible metal conduit with 3#12.

3. Provide sealed and gasketed vapor-proof nonmetallic housing lighting fixtures inside the generator enclosure. Each lighting fixture shall contain two (2) 9 watt or one (1) 13 watt compact fluorescent lamps with internal solid state low temperature electronic lamp ballasts. Provide not less than the following quantity of lighting fixtures, spaced equally within the housing. Connect to CPP panel 15 ampere branch circuit breaker, with 0.5-inch 3#12 liquid tight flexible metal conduit. Provide one (1) S.P.S.T. “on-off” vandal proof lighting control switch in cast metal outlet box.
   a. 200kW and smaller engine generator, quantity of four (4) lighting fixtures.
   b. Over 200kW engine generator, quantity of eight (8) lighting fixtures.
SECTION 26 5000
LIGHTING FIXTURES

PART 1 - GENERAL

1.01 SCOPE

A. Work Included:
   All labor, materials, appliances, tools, equipment necessary for and incidental to
   performing all operations in connection with furnishing, delivery and installation of
   the work of this Section, complete, as shown on the Drawings and/or specified
   herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other Specification Sections and Drawings for related work
      required to be included as work under Division 26.
   2. General provisions and requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. General
   1. Submit certification letter from Manufacturers of Lamps and Ballasts and
      Power/Driver Supplies, (or alternately, Manufacturer's published catalog data)
      stating/showing the specific lamp, ballast, or power/driver supply combination
      comply with Manufacturer recommendation and approval for the combined use,
      shown on the Drawings.
   2. Provide complete Manufacturers catalog data information for each light fixture
      (luminaire), ballast, power/driver supplies, lamps, materials, auxiliary
      equipment/devices, finishes and photometrics.

B. Performance Certification
   1. Submit Manufacturer's Certified Test Report data showing compliance with
      Contract Document.
   2. Submit Manufacturer's letter of certification for each fixture type, confirming the
      proposed combination of specific lamp, ballast, power/driver supply and
      auxiliary components for each light fixture (luminaire) type will function together
      correctly and perform in compliance with the requirements of the Contract
      Documents as follows:
      "The proposed drivers, (where, applicable), lamp sockets and fixture have been
      tested as an assembly. The proposed fixture products assemblies are certified
      by the Manufacturer to function within the required temperature, lumen output,
      electrical characteristics and operational life described in the Contract
      documents".

C. Light Fixture Samples
   1. If requested by the DISTRICT’S Representative, provide a sample of each
      fixture proposed as a substitution for a specified fixture. Sample fixture shall be
      complete with specified lamps, 3-wire grounding "SO" cord and plug for 120-
      volt 60Hz, AC plug-in operation. Sample fixtures shall be delivered to the
      DISTRICT’S Representative’s Office for review, the samples shall be picked up
      within 10-working days after review comments have been received; any
      samples left beyond this time will be discarded by the DISTRICT’S
      Representative. Decision of DISTRICT’S Representative regarding
      acceptability of any lighting fixture is final.
1.03 QUALITY ASSURANCE (ADDITIONAL REQUIREMENTS)

A. Work and Materials shall be in full accordance with the latest rules and regulations as follows. The following publications shall be included in the Contract Document requirements. If a conflict occurs between the following publications and any other part of the Contract Documents, the requirements describing the more restrictive provisions shall become the applicable Contract definition:

1. UL – Underwriters’ Laboratory:
   a. UL – 8750 and 1598C: Light Emitting Diode – LED Equipment for use in Lighting Products and Replacements

2. NEMA – National Electrical Manufactures Association:
   a. NEMA – LE4: Recessed Luminaries Ceiling Compatibility
   b. NEMA – SSL #1, #3 and #6: Electronic Drivers for LED; LED and Incandescent Lamp Replacement
   c. NEMA – LSD #44, #45, #49 and #51: SSL - Solid State Lighting

3. United States Federal Government:
   a. FCC – Part 18: EMI and RFI emissions limitations.
   b. EPA: Energy conservation publications and waste disposal regulations.

4. ETL and C.B.M. certified and approved.

5. Electrical installation standards, National Electrical Contractors’ Association:
   a. NEIS/NECA and IESNA – 500: Recommended Practice for Installing Indoor Commercial Lighting Systems.
   b. NEIS/NECA and IESNA – 501: Recommended Practice for Installing Exterior Lighting Systems
   c. NEIS/NECA and IESNA - 502: Recommended Practice for Installing Industrial Lighting Systems.

6. Illuminating Engineering Society – IES (IESNA):
   a. IES – LM41: Photometric and Reporting.
   b. IES – 587: Transient Surge Protection.
   d. IES – LM80: Testing for Lifetime of LED.

7. ANSI-American National Standards Institute:
   a. ANSI – C81
   b. ANSI – C82
   c. ANSI – C62.41: Transient Withstand
   d. ANSI – C78: Lamps


PART 2 - PRODUCTS

2.01 GENERAL

A. Complete Fixture
   1. Provide light fixtures complete including lamps, drivers, housings, ceiling and wall trim "rings" for each ceiling type, mounting and adapter support brackets, diffusers/lenses and outlet boxes.
   2. Include an allowance of $300.00 to provide a light fixture for each lighting fixture outlet shown on Drawings without a fixture type designation.

B. Specific Fixture Requirements and Fixture Schedule Information
   1. The catalog numbers included in the description of the various types of lighting fixtures shall be considered to establish the type or class of the fixture with a particular Manufacturer only. The fixture length, number of lamps and lamp
types, component materials, accessories, mounting type, ceiling, wall and install adapters, operation voltage, and all other components required to fulfill the total description of the fixture based on all Drawing information, branch Circuits, Voltages, Specification information, and shall be included in the Contract Requirements regardless of whether or not the catalog number specifically includes these components.

2. Lighting fixtures shall be the types as indicated in Fixture Schedule on the Drawings and as described in the Specifications.

3. All fixtures of the same fixture type shall be the same Manufacturer and of identical finish and appearance, unless indicated otherwise on Drawings.

C. Manufacturer Certification of Operation

1. Lamps and lamp ballasts and power supplies (drivers) shall be recommended and certified by the respective Manufacturer(s), to be "matched" to operate correctly together, within the published characteristics, for efficacy, lamp starting, operating life hours, lumen output, power factor, power input, operating line ampere, sound intensity, and temperature.

2.02 POWER SUPPLIES (DRIVER-POWER SUPPLIES FOR LED-SOLID STATE LAMPS)

A. General

1. All ballast, power supplies, lighting fixtures assemblies and components shall be ANSI, ETL approved C.B.M. Certified and UL labeled.

2. Ballasts shall comply with FCC Part 18 Class-A and NEMA limits as to EMI or RFI and not interferes with normal operation of electrical or electronic data processing equipment.

3. Open circuit voltage, starting voltage, crest voltage and lamp-operating voltage shall comply with requirements of the respective Manufacturer of the installed lamps.

4. Lamp ballasts, power supplies and transformers shall be for use with the specific lamps provided as part of the Contract.

5. Shall be suitable for use with automatic occupancy motion sensing type switching "on-off" control systems, with multiple "on-off" cycles per hour, on a 24-hours a day basis. Operation shall be without loss of performance in operating characteristics described in the Contract Documents.

6. Fusing
   a. Shall be independently fused on the incoming line side within the fixture compartment.
   b. Alternately the Ballast Manufacturer may install the equipment fuse inside the ballast/power supply.
   c. Provide a label next to ballast cover reading: "Ballast (Power Supply) is fused, check fuse prior to relamping". Provide an additional quantity of 10% spare fuses and deliver to DISTRICT’S Representative.

7. Ballast sound rating Class-A or better. Where sound-rating classification is not published, the ballast sound rating shall be the best of product manufactured. Ballasts, which are judged by the DISTRICT’S Representative to be excessively noisy, shall be removed and replaced at the CONTRACTOR’S expense with low noise ballasts.

8. Electronic solid-state ballasts and power supplies shall be the product of Manufacturer that has been producing electronic ballasts/power supplies for a minimum of five (5) consecutive years prior to the date of the Contract.

9. Shall be designed and supplied to operate on the incoming line voltage system circuits to which the respective light fixtures are connected.
10. Shall not contain any PCB (polychlorinated biphenyl).
11. Power factor shall be not less than 0.90, starting and operating. The input starting transient line input ampere should never exceed lamp normal operating ampere by more than 10%.
12. Ballast and power supply disconnect:
   a. Lighting Fixture Manufacturer factory installed and prewired inside each light fixture, for lamp-ballast or lamp-driver power supply.
   b. Shall comply with UL-2459 and CEC/NEC. Shall disconnect (load-break) energized or de-energized ballast/driver from respective line voltage circuit and dimming circuit. UL-94V-0 flame retardant.
   c. Hot pluggable, multi-pole, insulated connectors, with strain relief and finger-safe squeeze-to-release latching function.
   d. Suitable for available voltage and ampere dimming and non-dimming lamp-ballasts and lamp-power supplies.
13. Ballast and power supplies as manufactured by General Electric, Advance, Philips, Universal, Sylvania/Osram or equal.

2.03 LIGHT FIXTURES (LUMINAIRES)

A. General
1. Lighting fixtures shall have all parts, ballasts, sockets, support attachments, trim flanges and fittings necessary to complete and properly install the fixture at the indicated installation locations. All fixtures shall be provided with lamps of size and type specified.
2. Ceiling and/or wall surface mounted lighting fixtures shall not have any exposed chase nipples or conduit knockouts visible to view within fixture housing. Lighting fixtures mounted in continuous rows shall have chase nipples or conduit knockouts between lighting fixture housing, but shall not have visible chase nipples/conduit knockouts on the visible ends of the continuous row of lighting fixtures.
3. Where fixture color is indicated to be selected by the ARCHITECT and/or DISTRICT’S Representative, provide two (2) color chip samples for each color for review.
4. Recessed fixtures with attached junction box shall be provided with a junction box permanently attached to the plaster ring so that the junction box is accessible through the fixture opening when the fixture is removed. Connection between fixture and pull box shall be flexible metal conduit with not less than 16 AWG "AF" or "CF" type fixture rated copper wires, high temperature wire insulation for not less than 600 volts AC. The flexible conduit shall be sufficient length, so that when the fixture is removed, the pullbox is readily accessible.
5. Recessed fixtures shall be Underwriters’ Laboratory approved for recessed installation with plaster frame and attached pull box. Lamp enclosure, reflectors and finish wiring shall not be installed until plastering is completed. Exposed finish trim shall not be installed until finish painting of the adjacent surface is completed.
6. The fixture shall bear Underwriters’ Laboratory label of approval for the wattage and installation indicated.
7. Light fixtures installed outdoors, in damp or wet locations shall be UL labeled for said location as "damp-location" and "wet-location" for the respective installation location.
8. Fixtures in contact with thermal/building insulation shall be UL listed and rated for direct contact installation in thermal insulation systems.
9. Lamp auxiliary support brackets shall be heat-resistant, non-dielectric. Alternatively, metal auxiliary lamp support brackets shall be electrically isolated from the fixture, to prevent glass decomposition.

10. Lighting fixtures installed in masonry and/or concrete construction. The fixture housing shall be rated for "concrete-pour" installation location.

11. Provide a permanent label inside each light fixture stating the following relamping information. Not less than 0.125-inch high black alphanumeric characters on white background.

"Replacement lamp(s) installed in this light fixture must comply with the following criteria:

*: CRI  *: Lamp Watts
*: CCT-K  *: Lamp Lumens

Only lamp rated * type lamp ballast shall be installed in this fixture."

*Insert the value required for the specific lamp required by the Contract Documents for each light fixture.

B. Lens and Diffusers

1. Acrylic plastic or Plexiglas for the light fixture diffusers or fixture lenses shall be 100% virgin material.

2. Thickness of not less than 0.125-inch, as measured at the "THINIST" portion on the diffuser or lens. However, thickness shall be increased to sufficient construction and camber to prevent the lens and diffusers from having any noticeable sag over the entire normal life of the installation.

3. Diffusers shall be formed from cast sheet by a vacuum and/or pressure technique.

4. Lighting fixtures containing lamps with dichroic reflectors and light fixtures with non-dichroic lens/diffuser shall be rated for high temperature lamp operations resulting from lamp heat redirected (reflected) back into the fixture.

2.04 SOLID STATE LIGHTING (SSL), LIGHT EMITTING DIODES (LED) LAMPS, POWER SUPPLIES, AND LIGHT FIXTURES (ADDITIONAL REQUIREMENTS)

A. General

1. Solid State LED light source (lamps), related control equipment (driver-power supply), and luminaire (light fixture) optics for light output distribution.

2. Shall comply with the US-DOE Energy Star Program for SSL-LED. Submit documentation with Shop Drawings.


4. SSL chromaticity shall comply with latest revision NEMA and ANSI – C78.377. Submit documentation with Shop Drawings.

5. Submit with Shop Drawings two (2) samples of each light fixture type employing SSL, with prewired 120 volt, 60Hz AC “SO” cord and plug-in cap.

B. LED Lamps

1. Lamp lumen output and overall efficiency shall be based on the LED lamps installed in specified fixture and ambient operating temperature.

2. Lamp Color Rendition Index (CRI) shall equal or exceed CRI – 80, unless noted otherwise on Drawings.

3. Lamp color output shall be 4000-degree K (± 100K), unless noted otherwise on Drawings.

4. CRI and lamp color temperature shall be same for all light fixtures of the same fixture type.
C. LED Power Supply (driver)
   1. Combination of power supply and SSL – lamp shall be tested and certified by
      respective Manufacturers for performance and proper operation.
   2. Provide dimming type driver where indicated on Drawings. Driver and dimming
      equipment shall be Tested and Certified by respective Manufacturers for
      performance and proper operation.

D. Self-Contained LED Lamp and Driver, Integral “Screw-Base” and/or “Pin-Connect”,
   replacement assembly for incandescent lamps.
   1. Shall be dimmable. Dimmer and lamp shall be certified by respective
      Manufacturers for compatible correct operation with each other.
   2. Optical system and operating temperature thermal performance shall be
      compatible with light fixture.

2.05 EMERGENCY BALLAST LIGHTING AND EMERGENCY DRIVER LIGHTING

A. General
   1. Self-contained emergency ballast and power supply (driver) containing
      batteries, battery charger, solid-state electronic control and lamp/ballast/driver
      operation, contained within a metal case, red finish case color.
   2. UL–924, listed Emergency Lighting and Power Equipment, for installation
      inside and/or attached to lighting fixtures.
   3. The emergency battery supply unit(s) shall be provided inside each respective
      emergency light fixture by the Fixture Manufacturer.
   4. Normal operating temperature range from 0-degrees Centigrade up to
      operating ambient temperature inside respective lighting fixture, but not less
      than 50-degrees Centigrade.
   5. Provide a permanent label inside each emergency light fixture stating as
      follows, not less than 0.125-inch high black alphanumeric characters on a white
      background:
      "Warning – this fixture provides more than one electric power source.
      Disconnect both normal and emergency sources including battery sources prior
      to opening fixture. Written permanent records documenting regular (every 30
      days) emergency lighting function testing results shall be kept on file by the
      DISTRICT."
   6. UL and Manufacturer rated to supply the lamp and ballast/driver (power-supply)
      combination occurring in the respective light fixture, both dimming-type and
      non-dimming type light fixtures.
   7. As manufactured by Bodine Inc. or IOTA-Engineering Inc.

B. Operation
   1. Emergency mode
      When external AC electrical power fails, the emergency unit shall immediately
      and automatically switch to emergency mode. Maintain emergency lamp(s)
      illumination, while operating from the internal battery/electronics during the
      power failure for not less than 90-minutes continuous duration.
   2. Normal Mode
      When AC electrical power is restored, automatically switch lamp(s) operation to
      external AC operation and begin battery-charging mode.
3. Battery Recharge Mode
The battery charger shall automatically fully recharge discharged batteries in less than 24-hours, and prevent overcharging of the batteries, while maintaining a "float-charge" on the batteries.

4. The emergency battery unit shall operate not less than two (2) lamps in multi-lamp light fixtures and one (1) lamp in single lamp light fixtures. When operating in emergency mode and battery power, the lamp lumen output of each lamp shall be not less than 40% of the lamp normal full lumen output rating of the lamp operation on normal power. The lamp-lumen output shall be 100% of the lamp normal full lumen output rating when operating in normal mode.

5. The emergency ballast shall provide cold-strike start and hot-restrike operation of the fixture lamp(s).

6. Periodic automatic, internal self-test, simulating normal power loss and actual operation of emergency lamps on internal battery power. Auto self-test shall occur not more than 30-day intervals. Audible and visual trouble alarm display, with manual alarm reset/silence, for problems identified by autotest functions.

C. Electrical Characteristics
1. Emergency equipment shall operate on the same input AC voltage as the normally "hot" branch circuit supplying the respective light fixture. Maximum line input load shall not exceed 15% more than normal fixture electrical load.

2. The emergency equipment shall be compatible for correct operation with the specific lamp/ballast/driver combination contained in the respective light fixture.

3. The emergency equipment shall be compatible with switched (on-off), non-switched (continuously on) and dimmer controlled lighting fixtures/circuits.

D. Components
1. Sealed nickel cadmium batteries, maintenance-free, rated for continuous operation in high ambient temperature, with 7 to 10 year operational life expectancy.

2. When standing on the floor below the fixture the emergency ballast test/monitor control panel shall be visible and readily accessible when the fixture is installed. The control panel shall provide:
   a. Charging indicator visual annunciator to display the charger and battery status.
   b. Momentary test switch/pushbutton to manually simulate power failure test.

PART 3 - EXECUTION

3.01 LIGHT FIXTURE INSTALLATION

A. General
1. The CONTRACTOR shall verify actual ceiling and wall construction types as defined on the Architectural Drawings and furnish all lighting fixtures with the correct mounting devices, trim rings, brackets whether or not such variations are indicated by fixture catalog number. The CONTRACTOR shall verify depth of all recessed lighting fixtures with Architectural Drawings prior to ordering fixtures. Any discrepancies that would cause recessed lighting fixtures not to fit into ceiling shall be reported to the DISTRICT’S Representative prior to release of order to the Supplier of the fixtures.
2. On acoustical tile ceilings, fixture outlets shall be accurately located in the center, at the intersection of the four (4) corners or at the center of the joints of two (2) tiles.

3. The CONTRACTOR shall aim the exterior adjustable lighting fixtures after dark in the presence of, and at a time convenient to the DISTRICT'S Representative.

4. Fixtures shall be ordered and furnished to operate correctly on the branch circuit voltage connected to the respective fixture as shown on the Site Plan and Floor Plan Electrical Drawings. The voltages shown on the fixture schedule are for generic fixture information only.

5. Install and connect lighting fixtures to the circuits and control sequences indicated on the Drawings and to comply with respective Manufacturer's instructions/recommendations.

6. Lighting fixtures in building interstitial spaces, in mechanical plumbing and electrical spaces/rooms, are shown in their approximate locations. Do not install lighting outlets or light fixtures until the mechanical, plumbing and electrical equipment/pipes/ductwork are installed; then adjust and install lighting in revised clear (non-interfering) locations to provide best even-illumination. Coordinate the locations with all other trades prior to lighting installation.

B. Lighting Fixtures Installed in Ceiling Support Grids - Suspended Lay-in "T-bar" and Concealed Spline Ceilings.

1. Provide two (2) seismic clips at opposite ends of each recessed light fixture, the clip shall connect to the ceiling grid main runners and the light fixture. The light fixture with seismic clips and ceiling grid runner connections shall resist a horizontal seismic force equal to the total weight of the light fixture assembly.

2. Each light fixture weighing 40-pounds or less and where the respective ceiling grid system is "heavy duty" type, shall be suspended directly from the ceiling grid or shall be suspended independent of the ceiling grid support system as approved by the AHJ. Each light fixture weighing more than 40-pounds or where the ceiling grid system is not a "heavy duty" type shall be supported independent of the ceiling grid and independent of ceiling grid support system.

3. Each light fixture supported independent of the ceiling grid system shall be supported with a minimum of four taut independent support wires, one wire at each fixture corner.

4. Each light fixture supported directly from the ceiling grid or ceiling grid support system shall be additionally connected with a minimum of two (2) independent slack safety support wires. One (1) wire at each opposite diagonal fixture corner. Each 3-feet by 3-feet and larger light fixture shall be supported in the same manner, except provide a minimum of four (4) independent slack safety wires, one at each fixture corner.

5. Light fixtures surface mounted to a suspended ceiling shall be installed with a 1½-inch steel – "C" channel which spans across and above a minimum of two (2) parallel main ceiling grid "runners" and concealed above the ceiling. Each channel or angle member shall be provided with a minimum of two (2) threaded studs for attaching to the fixture housing through the lay-in ceiling tile. Two (2) steel "C" channel members shall be installed for each 4-feet (or smaller) fixture. Install the channels within 6-inches of each end of the light fixture to span a minimum of two (2) ceiling grid parallel main runners. Provide two (2) seismic clips connecting the ceiling grid main runners to each steel – "C" channel. Provide a not less than two (2) taut independent support wires connecting to
C. Fixture Supports

1. The support wires for light fixture support shall be 12-gauge steel (minimum). The wires including their building and light fixture attachments shall provide support capacity of not less than four (4) times the weight of the light fixture assembly. Provide additional light fixture support wires and building anchors to meet these requirements, as part of the Contract. The support wires shall be anchored to the building structural elements above the ceiling.

2. Pendant mounting fixtures shall be supplied with swivel hangers. Fixtures shall swing in any direction a minimum of 45 degrees of gravity, position. Fixtures shall have special stem lengths to give the mounting height indicated on the Drawings. Stem to be single continuous piece without coupling, and to be finished the same color as the canopy and the fixture, unless otherwise noted. The CONTRACTOR shall check all lock nuts and set screws to rigidly secure the swivel socket to the stem, and the stem to the outlet box. Fixtures shall be plumb and vertical. Where obstructions occur restricting 45-degrees free-swing of fixtures, the fixtures shall be "guy" wired to prevent fixtures from striking obstructions. The DISTRICT’S Representative shall approve method of guying. Swinging fixtures shall have an additional safety hanger cable attached to the structure and the fixture at each support, with the capacity of supporting four (4) times the vertical weight of the light fixture assembly.

3. Suspended fixtures weighing in excess of 40-pounds shall be supported independently of the fixture outlet box. Provide "air craft" (minimum 12 gauge) steel hanger cable for suspended fixtures route cable concealed or in pendant where possible. Each cable attachments shall support four times the weight of the fixture assembly. Securely attach the cable to the building structure.

4. Surface mounted fixtures installed on drywall or plaster ceilings and weighing less than 40-pounds may be supported from outlet box. Provide structural supports above drywall or plaster ceilings for installation of fixtures weighing more than 40-pounds and secure fixture to structural supports. The use of toggle bolts is prohibited.

C. Recessed Lighting Fixtures - Fire Rated Building Surfaces

1. Lighting fixtures recessed in ceiling or wall which has a fire resistive rating of 1-hour or more shall be enclosed in a fully enclosed backbox (except over fixture lens/diffuser). The material used to fabricate the "enclosed backbox" shall have a fire rating equal to that of the respective ceiling or wall.

2. The space from the fixture to the box enclosure shall be a minimum of 3-inches.

3. The backbox shall be concealed behind the fire rated ceiling and wall finish surface. The light fixture shall be provided with lamp ballast rated for (normal light output) operation in a "high" ambient temperature.

3.02 LENS AND DIFFUSERS

Lens, diffusers, internal reflectors shall be completely cleaned of all dust, dirt and fingerprints after the installation of the light fixtures and lamps, and after all trades have completed work and prior to occupancy of the facility by the DISTRICT.
3.03 COMMISSIONING LIGHTING FIXTURES (ADDITIONAL REQUIREMENTS)

A. General
   1. Verify correct lighting control configurations and operation in each room.
   2. Simulate normal source power failure by "opening" (turn off) building main service disconnect and verify connections and operation of each emergency lighting fixture.
   3. Confirm "EXIT" sign directional arrows are visible in each "EXIT" sign.
   4. Verify light fixture support-hangers, ceiling grid clips and seismic restraints comply with the Contract Documents.
   5. Remove protective shipping/installation shields on fixtures. Verify fixtures and lamps are clean and free of construction debris. Clean light fixtures found to be contaminated or dirty.
   6. Setup, program, and function test lighting control systems to perform each of the indicated control functions, area/room zones and sequences.
   7. Provide "aiming", directional adjustment of light fixtures, both indoor and outdoor. Aiming shall comply with Manufacturer's aiming diagrams, and as directed by District's Representative.

B. Sample Spot-Check in each room the following lighting fixture information:
   1. Lamp type and performance data.
   2. Ballast type and performance data.
   3. Combined lamp/ballast certification of performance and compatibility by respective Manufacturer.
   4. Verify instructional signage is placed inside each lighting fixture in compliance with Contract Documents.

END OF SECTION
120715/223015
SECTION 26 0536
CABLE TRAY FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
   2. General provisions and requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Submit Product Data Sheets for all cable trays, all related components, and NEMA VE1.

B. Submit Cable Tray Support Details.

C. Provide Reproducible Floor Plan Shop Drawings, with the same scale as the Contract Floor Plan Drawings. The Drawings shall show the proposed Cable Tray Layout Plan views. An elevation view shall be provided at each riser or change in horizontal elevation in the cable tray. The Shop Drawing Plans shall show all building elements, expansion/seismic joints, air ducts, piping and components that cross the path of the cable tray, along with separation of the cable tray from the crossing components.

PART 2 - PRODUCTS

2.01 CABLE TRAY

A. Material and installation shall comply with NEMA - "VE1" latest edition, Cable Tray Systems', N.E.C., California Title 24 and Title 8. As manufactured by Globe Tray, Chalfant, P-W Industries or equal.

B. Cable tray shall include two (2) longitudinal side rails, ladder type, with transverse 6 inches rung spacing welded to side rails. Rungs shall have a minimum cable-bearing surface of 0.75-inches. Rungs shall not extend below bottom of side rails. Splice plates shall be locking bolt type to connect tray sections together without decreased tray strength. Provide expansion/deflection fitting at each building seismic and expansion joint crossing.

C. Trays shall be steel or aluminum. Steel trays shall be hot dip galvanized after fabrication ASTM A 123 with ANSI type 304 and 316 stainless steel hardware. Aluminum trays shall be extruded from 6063-T6-aluminum alloy with 5052-H32-aluminum alloy hardware.
D. The complete cable tray system and supports shall be designed for the following minimum uniformly distributed working load but not less than indicated on the Drawings, with a 1.5 minimum safety factor, when supported as a single span. In addition, the cable tray shall support 200 pounds concentrated at span midpoint without permanent distortion.
   1. Cable tray wider than 12-inches or deeper than 6 inches, live loading 200 pounds per linear foot.
   2. Cable tray 12-inches or less in width and 6 inches or less in depth live loading 100 pounds per linear foot.

E. Provide ladder type "elbows", "tees", horizontal "crosses", expansion connectors, reducer sections, connectors, straight sections, curved sections, fittings, supports, hangers, blind ends, risers and accessories to provide a complete installation of the cable tray shown on the Drawings. Provide trapeze brackets and individual threaded hanger suspension rods in any combination required to support the cable tray system. Provide all materials and labor necessary for a complete installation.

F. Cable tray runs shall be minimum 6-inches deep by 12-inches wide, but not less than indicated on Drawings. Dimensions are outside dimensions of the cable tray rails.

G. Similar cable tray parts and hardware shall be interchangeable with each other. The cable tray system shall be free of sharp edges, burrs or projections that can damage cable insulation.

PART 3 - EXECUTION

3.01 CABLE TRAY

A. Cable trays shall be seismically anchored and supported to the building structure to prevent horizontal or lateral movement with 1.0-gravity acceleration, including specified live load conductor capacity, complying with State of California Seismic Codes. Support hangers from the building structure shall provide a 2.0 weight carrying safety factory including specified live cable weight. Cable tray hangers shall be provided with a spacing to insure the maximum cable tray deflection with the specified live cable loading does not exceed 0.75-inches between supports and hangers. In no case shall cable tray support or hanger spacing be greater than 12-feet on center.

B. Punching or drilling of structural side members shall not be performed except for splice plate bolt-holes.

C. Provide expansion adapters where cable trays cross a building expansion joint, and to comply with Tray Manufacturer's recommendation for the cable tray thermal expansion requirements.

D. All cable trays including non-connected tray sections shall be made electrically continuous. Provide grounding jumpers minimum equivalent to #8AWG, where required to provide continuity.

E. Grounding for cable trays shall comply with Article 318-6 of NEC.
F. Provide curved "radius" cable trays at each "horizontal" or "vertical" change in direction of the cable tray. Provide "tee" and "crosses" at each intersection of cable trays. Provide "blind ends" at the end of each cable tray "run".

G. Provide removable fire blocking "bag style" at cable tray penetrations of fire barriers.

END OF SECTION
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PART 1 - GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other Specifications Sections and Drawings for related work required to be included as work under Division 26.
   2. General provisions and requirements for electrical work.

B. Provide Electronic Network Systems Infrastructure for the following systems:
   1. Computer Data Networks
   2. Telephone and Intercom Voice Communications
   3. Other special systems described in the Contract documents.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Drawings Submittals
   1. Drawings shall be submitted on reproducible sepias and Autocad® Version 2.2 (or later revision) data files on CD/DVD-ROM disk, WINDOWS®-XP or Version-7 or Version-8 format.
   2. Submit redrawn Building Floor Plan for each building area, same scale as the Contract Drawing.
   3. Plans shall show walls, doors, windows, furniture, infrastructure, outlets and network systems equipment locations. Show point-to-point interconnecting cables, pathways, conduit, conduit sizes, circuit types, along with circuit identification names, numbers and quantities between all components.
   4. Provide scaled Elevation Drawings of each equipment rack, terminal blocks, terminal backboard and terminal room/closet showing location and arrangement of each equipment component, outlet and cable training provisions, with estimated weight of each complete assembly.
   5. Submit block wiring diagrams showing major system components, outlets, equipment racks, terminal blocks, signal loss with interconnecting circuit conductors, splices, portable patch cords and connectors. Riser type diagram shall be provided if the building has more than one floor level, with information shown on riser diagram corresponding for each respective floor.

B. Submit Manufacturer's standard catalog data for each component. The submittal shall be arranged in the order of the Specification and shall list the Specification paragraph number, the name, the proposed model and Manufacturer for each item as well as a reference indicating the specific piece of data which can be easily located in the brochure. The Manufacturer's data sheets shall be marked to indicate the specific item being proposed in cases where the sheet covers several types or sizes of items. The data sheet shall completely describe the proposed item. Where modification to the equipment is necessary to meet the operational requirements of the Contract Documents, the brochure shall include complete Mechanical and
Electrical Shop Drawings, detailing the modification. The brochure shall include a listing of the outlet rough-in requirements for every device and equipment item. The applicable symbol which illustrates that rough-in item on the job plans shall be drawn on the proposal, opposite the description of the rough-in to facilitate locating the data by Field Personnel. Submit elevation and dimensional information.

C. Performance Calculation:
1. Provide engineered calculations showing the Passive Cable System Signal Attenuation losses of the proposed installed system. The intent is not to require calculations for every system segment, port and outlet. The intent is to require engineered calculations for proposed typical worst case port to port; head end to farthest distance outlet and patch port to outlet signal attenuations.
2. Provide calculations for a minimum of 50 complete channel/circuit paths. The calculations shall include attenuation insertion losses for each system component including individually itemized cable-fiber/wire; outlet, termination, connector, electronic component (if any), coupler and patch cord along the entire path from the head end equipment to the end use outlet.
3. The calculations shall serve as the basis for verifying the system performance with the system testing specified in the Contract Documents.

D. Provide proposed nameplate and outlet identification/color coding system. Indicate proposed identification naming sequence and methods, itemized for review.

E. Submit Manufacturer Certified Test Reports showing test documentation for the proposed material that the material meets or exceeds the performance standards defined in the Contract Documents. The testing and results shall reflect worst case performance based on a minimum of ten samples. Tests shall be certified by a Nationally Recognized Independent Test Lab (i.e., ETL, UL, etc.). The Manufacturer shall certify in writing the material has been manufactured and tested to comply with the requirements defined in the Contract Documents.

F. Submit three (3) samples of each of the following, fully assembled with 24-inches of cable type connected:
1. Copper wire outlet and connector, with each type of specified inserts.
2. Copper cables and patch cords, each type.
3. Fiber optic cables and patch cord each type.
4. Mechanical splice - fiber optic.
5. Fusion splice - fiber optic.
6. Fiber optic outlet and connector each type.
7. Fiber optic cable connector each type of termination, with interconnection coupler.
8. Patch panel each type.
9. Coverplate each type.

1.03 APPLICABLE STANDARDS

A. Individual component Production/Manufacturer Testing and Labeling.
1. The equipment shall be UL listed, labeled, and approved for the application shown in the Contract Documents.
2. ETL (USA) each network systems infrastructure component. Third party testing, documentation and certification for performance compliance of each component with the UL, ANSI, TIA and EIA Applicable Standards specified in the Contract Documents.
B. The complete system material, equipment, testing, installation, workmanship and installed performance shall comply with the mandatory requirements and the guideline/recommendation requirements of the following latest published version, supplements, latest revision including addendums and TSB. Both the mandatory and advisory criteria shall be included as requirements of the Contract Documents:

1. TIA-526 Optical Power and loss measurements – multimode and single mode fiber.
2. ANSI/TIA/EIA-568C Commercial Building Telecommunications Standards.
3. ANSI/TIA/EIA-569B – Commercial Building Standards for Telecommunications Pathways.
5. ANSI/TIA/EIA-598B Optical Fiber Cabling Color-Coding.
7. ANSI/TIA/EIA-607 Commercial Buildings Grounding and Bonding Requirements for Telecommunications.
9. ISO/IEC 11801
10. National Electrical Code (NEC) and California Electrical Code (CEC) including Articles 770 and 800 with ETL verified testing and local code jurisdictions.
11. NECA/NEIS, National Electrical Contractors Association, National Electrical Installation Standards:
   a. 301 – Standard for Installation and Testing for Fiber Optic.
   b. 568-Standard for Installing Building Telecommunications Bonding and Grounding.
   c. 607-Telecommunications
12. Manufacturer’s recommendations for the respective equipment.

C. Network Performance

1. The entire completed Electronic Network Systems Infrastructure shall be tested and provide electronic data/network and telephone/voice multi-channel communications latest revisions, standards and addendums for the following protocols:
   a. IEEE 802.3/ETHERNET latest revisions.
2. Twisted pairs copper wire (100 meter path length unless indicated otherwise)
   a. 10Mbps 10Base-T, 100Mbps 100Base-Tx;
   b. 1000Mbps (1Gbps) 1000 Base-Tx;
   c. 10,000 Mbps (10Gbps) 10Gb Base-Tx.
   d. IEEE-802.3 for Power Over Ethernet (POE) and Power Over Ethernet-Plus (POE Plus).
3. Fiber optic, 550 meter communications pathway distance, OM4 standard multimode and OS2 single-mode.
   a. 10Mbps 10Base-F1, 100Mbps 100Base-FX,
   b. 1000Mbps 1000Base-Lx-Sx
   c. 10,000 Mbps (10Gbps) for fiber optics
   d. Single Mode path length performance increase requirement to 3000 meters.
4. IEEE 802.5/TOKEN RING.
5. APPLETALK (Phone-net).
6. FDDI - Distributed data interface on fiber or copper wire, 100Mbps.
7. 100VG – Any LAN
8. TIA/EIA serial and Bi-directional RS-232 and RS-485, including Star-Hub repeaters.
9. ANSI - TPPMD 55Mbps, 155Mbps and 622Mbps Asynchronous Transfer Mode - ATM.

D. The Complete Telephone/Voice Infrastructure System shall be suitable for the telephone/voice analog and digital communications and VOIP protocols. The system shall be compatible with the telephone/voice equipment installed as part of the Contract.

F. Installation of All Infrastructure Equipment, Devices, Splices, Terminations, Cables, Outlets, etc. shall comply with Manufacturer's recommendations.

1.04 EQUIPMENT QUALIFICATIONS

A. Equipment
   1. The Supplier of the equipment shall be the Factory Authorized Distributor and service facility for the brands of equipment and material provided.
   2. Network systems infrastructure equipment and materials shall all be the product of one of the individual same Manufacturers as follows. Typical unless specifically described otherwise:
      Belden – 10GX Series; or CommScope-Systimax X10D Series;
      or AMP/Tyco – NetConnect Series;
      or Ortronics/Legrand – NetClear Series;
      or Siemon – ConvergeIT Series.

B. Installation Certification
   1. Work and material for cables, cable terminations, outlets and related components for infrastructure systems shall be performed by Certified Installers. The Installer shall be certified by the respective Product Manufacturers.
   2. The Manufacturers of the indicated work and material, shall provide an Installer education/training and certification program for the supplied products.
   3. The Installers performing the Contract Work for the indicated products, shall have attended and successfully completed each of the respective Manufacturer's installation training education programs for the specified products.
   4. Submit six (6) copies of the Manufacturer's Certifications for each installer performing the work. The submittal shall be approved by the OWNER'S Representative prior to initiating any related Contract Work.
   5. Contract material installed and work performed by Installers not complying with these requirements shall be removed. Removal of work and material not in compliance with these requirements shall done at the CONTRACTOR'S expense, without any additional cost to the Contract and without any additional Contract completion due date extensions. New material and work required to replace the non-complying removed work and material shall be provided at the CONTRACTOR'S expense, without any additional cost to the Contract and without any additional Contract completion due date extensions.

C. Extended Material and Performance Warranties
   1. In addition to the warranty requirements described elsewhere in the Contract Documents, provide the following extended material and performance warranties. The warranty period shall be for not less than 15-years from the Contract Notice of Completion.
2. Warranty scope includes materials and performance for network cables and terminations, network workstation plug-in outlets, and patch panel plug-in outlets, cable splices and connectors.
3. Repair or replace the defective material with new material at the Project premise, to comply with the performance standards outlined in the Contract Documents during the warranty period.
4. Submit seven (7) copies of proposed warranty statements, with Shop Drawing submittals.

1.05 ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Terminology</th>
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<tbody>
<tr>
<td>ACR</td>
<td>Attenuation to Cross Talk.</td>
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<tr>
<td>AHJ</td>
<td>Authority Having Jurisdiction.</td>
</tr>
<tr>
<td>Backbone</td>
<td>Circuit interconnections between MDF and IDF patch panel locations.</td>
</tr>
<tr>
<td>dB</td>
<td>Decibel.</td>
</tr>
<tr>
<td>dBm</td>
<td>Decibel referenced to a milli watt.</td>
</tr>
<tr>
<td>Demarc</td>
<td>Demarcation location where operational control change occurs or ownership change occurs.</td>
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<tr>
<td>ft.</td>
<td>Feet.</td>
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<tr>
<td>GHz</td>
<td>Gigahertz.</td>
</tr>
<tr>
<td>Gbps</td>
<td>Gigabits per second.</td>
</tr>
<tr>
<td>Horizontal Connection,</td>
<td>Circuit interconnections between and/or individual workstation outlet</td>
</tr>
<tr>
<td>Horizontal</td>
<td>location to respective IDF or MDF equipment rack patch panel.</td>
</tr>
<tr>
<td>IDF</td>
<td>Intermediate Distribution Frame (horizontal or vertical cross connect) for an individual building area/ floor.</td>
</tr>
<tr>
<td>km</td>
<td>Kilometer-lkm.</td>
</tr>
<tr>
<td>kPSI</td>
<td>1000 pounds per square inch.</td>
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<tr>
<td>m</td>
<td>Meter = 39.37 inches.</td>
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<tr>
<td>Mbps</td>
<td>Megabits per second.</td>
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<tr>
<td>MDF</td>
<td>Main Distribution Frame (central/main cross connect) for multi-building site or for a single individual building.</td>
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<tr>
<td>MHz</td>
<td>Megahertz.</td>
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<tr>
<td>MIC</td>
<td>Micrometer</td>
</tr>
<tr>
<td>mm</td>
<td>Millimeter = 10⁻³ meter.</td>
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<tr>
<td>NEXT</td>
<td>Near end cross talk.</td>
</tr>
<tr>
<td>nm</td>
<td>Nanometer = 10⁻⁹ meter.</td>
</tr>
<tr>
<td>pF</td>
<td>Picofarad = 10⁻¹² farad.</td>
</tr>
<tr>
<td>Provide</td>
<td>Furnish, install and connect.</td>
</tr>
<tr>
<td>RTDE</td>
<td>Equipment rack mount fiber optic termination distribution enclosure, with fiber optic patch panel.</td>
</tr>
<tr>
<td>RMSE</td>
<td>Equipment rack mount fiber optic enclosure, splice only (without patch panel).</td>
</tr>
<tr>
<td>STP</td>
<td>Shielded individual twisted pairs copper wire.</td>
</tr>
<tr>
<td>ScTP</td>
<td>Shield Screened Twisted Pairs copper wire.</td>
</tr>
</tbody>
</table>
1.06 MATERIALS AND METHODS

A. Material and Labor not complying with the Contract Documents shall be removed by the CONTRACTOR from the Project Site. Material and labor complying the Contract Documents shall be provided.

B. All the cost to remove deficient work and material, provide work and material complying with the Contract Documents and the direct, indirect, incidental damages and Contract delays resulting from complying with these requirements shall be the sole responsibility of the CONTRACTOR and shall be included in the bid price.

C. System Performance Requirements

1. The work, performance and type of materials provided as part of the Contract shall comply with the following ANSI/TIA/EIA-568C and related standards for all Electronics Network Systems Infrastructure work and materials described in the specifications and shown the Drawings:
   a. Computer/data network systems: Category-6A
   b. Telephone/intercom voice systems: Category-6A
   c. Broadband transmission radio frequency for television, digital or analog cable television, digital satellite system, broadcast quality Coaxial-RG6 (QUAD SHIELDING).
   d. Trunking-cable, analog circuits copper wire twisted pairs: Category-5E.

2. The Electronic Network Systems Infrastructure system shall be based on “star-topology”; for MDF to IDF backbone connections and workstation outlet to MDF/IDF horizontal connections.

PART 2 - PRODUCTS

2.01 FIBER OPTICS CABLES

A. General

1. Operating temperature range - 20 degrees centigrade through +60 degrees centigrade. Cables shall be flame retarding.

2. Electronic network systems infrastructure cables that are not installed inside conduit raceways. Electronic network systems infrastructure cables that are installed in concealed spaces including plenums and non-plenums; access.
floors, ceiling spaces, walls, floor, etc., and/or installed without continuous raceways. The cable insulation and jacket shall be listed and labeled “Limited Combustible Cable” (LC or LCC) and shall comply with the latest published revision of all of the following additional requirements.

a. Limited combustible “FHC-25/50” per UL-2424.

b. NEC/CEC/CMP, additional listing/labeling where the install location is an environmental air plenum, fiber optic “FHC-25/50-CMP and/or OFNP/OFCP”.

c. NFPA-90A; ceiling cavity plenums, wall cavity spaces and raised floor cavity plenums, limited-combustible.

d. NFPA-5000; defines combustible material including wire and cable.

e. NFPA-75 computer rooms and electronic equipment room.

f. NFPA-13; spaces containing “limited combustible loading”.

3. Cables shall qualify as 100% recyclable materials disposal, RoHS regulation complaint.

4. All fibers in a multi-fiber cable shall be fully operational within the performance characteristics specified prior to and after the cable is installed. The use of spare fibers in the cable to compensate for defective fibers is not permitted. Defective cables shall be removed and replaced with fully functional cables at no additional cost to the Contract.

5. Cables shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with specified requirements. ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.

6. Each fiber shall be individually identified with factory color-coding or factory imprinted label. The outer cable jacket shall be imprinted with date, Manufacturer's model and catalog number, along with Agency listing identification.

7. Fiber optic cable shall be a product of the same Manufacturer, including portable patch cables.

8. Cables installed in raceways or conduits below grade, through in-grade manholes or pullboxes shall be rated for installation in water/wet locations.

9. Provide overall outer jacket enclosing all fibers inside jacket. Cables containing less than seven (7) fiber strands shall be provided with a color coded outer jacket (red or orange).

10. Multimode (62.5/125)

a. Fiber optic cables optical fibers, (62.5/125) graded index multimode optical glass fibers, 62.5 micron fiber core and 125 micron fiber cladding, 0.275 numerical aperture. Optical fibers shall be 100 kpsi proof tested, with maximum 0.7 micron flaw size for dual operation at 850nm and 1300nm wave lengths.

b. Minimum bandwidth:
   @ 850nm - wave length 160MHz per km length
   @ 1300nm - wave length 500MHz per km length

c. Maximum attenuation:
   @ 850nm-wave length 3.4 dB @ 1km length
   @ 1300nm-wave length 1.0 dB @ 1km length

d. Laser-optimized "OM2" optical multi-mode standards.

11. Multimode (50/125)

a. 50/125 fiber optic cables optical fibers, graded index multimode optical glass fibers, 50.0-micron fiber core and 125-micron fiber cladding, 0.2 numerical aperture. Optical fibers shall be 100 kPSI proof tested, with maximum 0.7 micron flaw size for dual operation at 850nm and 1300nm wave lengths.
b. Minimum bandwidth:
   @ 850nm-wave length 3500Mhz per km length
   @ 1300nm-wave length 500Mhz per km length

c. Maximum attenuation:
   @ 850nm-wave length 3.0db @ 1km length
   @ 1300nm-wave length 1.0db @ 1km length

d. Laser-optimized "OM4" optical multi-mode standards.

12. Single mode:
   a. Fiber optic cables optical fibers, (8.3/125) single mode optical glass fibers, 8.3-micron core fiber and 125-micron fiber cladding, 0.11 numerical aperture. Optical fibers shall be 100-kPSI proof tested, with maximum 0.7-micron flaw size. For operation at 1310nm and 1550nm wave lengths.
   b. Maximum attenuation:
      @ 1310nm- wave length 0.5 dB @ 1km length
      @ 1550nm- wave length 0.4 dB @ 1km length

c. Maximum dispersion
   @ 1310nm- wave length 2.8 ps/nm km length
   @ 1550nm- wave length 18.0 ps/nm km length

d. Laser-optimized "OS1"/"OS2" optical single mode standards.

B. Loose Tube Gel-filled Cables
   1. Multiple, loose tube buffer tubes, gel-filled. Each buffer tube shall contain the same quantity of optical fibers, but not more than twelve (12) optical fibers in each buffer tube.
   2. Buffer tubes shall be cabled around a central dielectric strength member. The central strength member shall be centered along the length of the cable.
   3. Aramid yarn, non-optical, strength fibers shall extend continuously along the length of the cable.
   4. The cable interstitial spaces shall be flooded to inhibit water migration, with non-flammable water blocking gel.
   5. Each optical fiber shall be individually UV cured acrylate coated, 250-micron diameter coating over fiber cladding.
   6. A seamless black polyethylene outer layer jacket shall envelope the entire cable.
   7. The cable shall be fungus resistant, UV resistant, and moisture resistant for installation indoors with or without an enclosed raceway and outdoors in underground enclosed raceway/conduit and manholes/pullboxes continuously flooded with water.

C. Indoor/Outdoor Cables
   1. The cable shall be fungus resistant, UV resistant, moisture resistant for installation indoors with or without an enclosed raceway and outdoors in underground enclosed raceway/conduit and manholes/pullboxes continuously flooded with water, and in conduits exposed to the sun.
   2. Each optical fiber shall be primary coated with 500 micron uniform acrylate tight buffered and with elastomeric uniform 900-micron diameter tight buffered, secondary coating. Aramid yarn strength member elements shall be tensioned and symmetrically and uniformly distributed around the fibers, along the length of the cable.
   3. An overall cable jacket uniformly extruded directly around and mechanically interlocked with the optical fibers/strength members. The extruded jacket shall form internal helical cusped ridges that interlock with the optical fibers and
strength members. The interlocking jacket shall not allow cable fibers to move axially within the cable jacket.

4. Cables containing more than twenty-four (24) optical fibers shall be constructed with sub-cable fiber bundles. Each sub-cable bundle shall contain equal quantities of optical fibers, with a separate PVC jacket around each sub-cable. Sub-cable and sub-cable jacket construction shall match the overall cable requirements and jacket requirements.

5. The cable shall be UL listed and comply with NEC and NFPA requirements for each installation location shown in the Contract Documents. ETL tested and certified to comply with or exceed specified requirements.
   a. NEC – OFNR (Vertical Riser Type Locations) OFNP (UL FHC-25/50 LC Plenum Type Locations and locations where not continuously enclosed inside conduits for entire cable length).
   b. NEC – OFNG (Where continuously enclosed inside conduits for entire cable length).

D. Tight Buffered Cables
   1. Each optical fiber shall be coated, 900-micron diameter uniform coating, with uniform tight buffering over the coating, uniform dielectric strength member surrounding the buffering coating and an overall jacket around each optical fiber assembly.
   2. Individual multiple optical fiber assemblies shall be symmetrically arranged around a central dielectric strength member. The central strength member shall be centered along the length of the cable.
   3. A dielectric strength member shall surround the fiber assemblies.
   4. An outer dielectric jacket shall envelope the entire cable.
   5. The cable shall be UL listed and comply with NEC and NFPA requirements for each installation location shown in the Contract Documents. ETL tested and certified to comply with or exceed specified requirements.
      a. NEC - OFNP (UL FHC-25/50 LC Plenum type locations and locations where not continuously enclosed inside conduits for entire cable length).

2.02 COPPER WIRE CABLES (TWISTED PAIRS)

A. General
   1. Conductors shall be copper wire, individually insulated and color coded, with multiple conductors arrange in twisted pairs.
   2. An overall non-conductive jacket shall encase the copper wires and any shielding (where shielding is specified) shall also be encased by the jacket.
   3. Cables shall be UL listed, complying with NEC National Electrical Code, National Fire Protection Agency and NFPA requirements for each installation location shown. ETL tested and certified to comply with or exceed specified requirements.
      a. NEC – MPP/CMP, FHC-25/50 (Plenum type locations and locations where not continuously enclosed inside conduit).
      b. NEC – MPR/CMR (Vertical riser type locations).
      c. ANSI/TIA/EIA-568C; including related standards, amendments and TSB.
   4. Electronic network systems infrastructure cables that are not installed inside conduit raceways. Electronic network systems infrastructure cables that are installed in concealed spaces including plenums and non-plenums; access floors, ceiling spaces, walls, floor, etc., and/or installed without continuous raceways. The cable insulation and jacket shall be listed and labeled "limited
combustible cable” (LC or LCC) and shall comply with the latest published revision of all of the following additional requirements.

a. Limited combustible “FHC-25/50” per UL-2424.
b. NEC/CEC;CMP, additional listing/labeling where the install location is an environmental air plenum, copper wire “FHC-25/50-CMP”.
c. NFPA-90A; ceiling cavity plenums, wall cavity spaces and raised floor cavity plenums, limited-combustible.
d. NFPA-5000; defines combustible material including wire and cable.
e. NFPA-75 computer rooms and electronic equipment room.
f. NFPA-13; spaces containing “limited combustible loading”.

5. Cables shall qualify as 100% recyclable materials disposal, RoHS regulations complaint.

6. Cables installed in air plenums, air-handling spaces and cables installed without raceway or conduit shall also be UL listed and labeled for installation in air plenums.

7. Cables installed in raceways or in conduits below grade, or through in-grade manholes and pullboxes, shall be rated for installation in water/wet locations.

8. The outer cable jacket shall be imprinted with date, Manufacturer’s model and catalog number and Agency (AHJ) listing identification.

9. Copper wire Electronic Network Systems Infrastructure cable shall be a product of the same Manufacturer, including portable patch cables.

10. The outer jacket of cables with less than nine (9) pair of conductors shall be color-coded. The jacket color shall be different for each system type; multimedia; telephone/voice; computer/data network; and fiber cable jackets.

11. 300-volt RMS insulation material for each data conductor shall be the same material; shall be the same electrical characteristics and shall be the same dielectric constant, for all data conductors contained within the respective common cable jacket, along the entire installed length of the cable. Data cables employing differing insulation materials for individual data conductors contained within a common cable jacket are not acceptable and shall not be provided.

12. Propagation and “Skew” Rate

a. Skew rate (nominal velocity of propagation delay) between any twisted pair in a combination of four (4) twisted pair conductors grouped in the same cable, shall not exceed 35-nano seconds between any wire pair contained in the conductor group, and as required by the cable Category rating, over a cable length of 328-feet (100 meters), for all frequencies up to the cable maximum frequency rating.

b. Nominal velocity of propagation, exceeding 70% of the speed of light.

13. Large capacity feeder cables and trunking-cables

a. Copper wire cables with more than twenty-four (24) twisted pairs of conductors shall be constructed with twenty-five (25) pair binder groups of conductors. The cable binder groups shall be enclosed in colored binders and assembled to form a single cable. The twisted pair/binder groups shall be enclosed with multi-layer dielectric protective sheaths underneath a cable jacket enclosing the entire cable assembly. A corrugated metal 100% shield shall be provided under the cable jacket enclosing all conductors.

b. Cables shall be wet location rated and listed for installation in conduit, where the conduit is in a wet environment and/or high-temperature environment, including:
   · Underground conduit.
   · Inside manholes and pull boxes.
Outdoor conduit exposed to weather and/or sunlight.

c. ANSI/TIA/EIA Category rating of cable assembly shall be Category-5E, trunking-cable.

B. Category-5E Computer/Data Enhanced Cables – UTP
1. Category-5E cables shall be tested and shall pass ANSI/TIA/EIA test recommendations for Category-5E.
2. Operational characteristics:
   a. Wire size
   b. Quantity of twisted pairs
   c. Impedance
   d. Maximum Signal Attenuation
      Per 300 feet (100 meters)
      20dB @ 10MHz
      25dB @ 16MHz
      28dB @ 20MHz
      32dB @ 25MHz
      36dB @ 31.25MHz
      52dB @ 62.5MHz
      67dB @ 100MHz
   e. Mutual Maximum Capacitance of Any Pair
   f. Worst Pair "NEXT" Loss Per/328-feet (100 meters)

C. Category-6A Computer/Data Enhanced Cables – [ScTP] [UTP]
1. Category-6A cables shall be tested and shall pass the ANSI/TIA/EIA test recommendations for Category-6A.
2. Operation Characteristics:
   a. Wire size
   b. Quantity of twisted pairs
   c. Impedance
   d. Maximum Signal Attenuation
      Per 328-feet (100 meters)
      62dB @ 1Mhz
      53dB @ 4Mhz
      48dB @ 8Mhz
      47dB @ 10
      44dB @ 16Mhz
      42dB @ 20Mhz
      41dB @ 25Mhz
      40dB @ 31.25Mhz
      35dB @ 62.5Mhz
      32dB @ 100Mhz
10.5dB @ 31.25Mhz  
15.0dB @ 62.5Mhz  
19.1dB @ 100Mhz  
27.6dB @ 200Mhz  
31.1dB @ 250Mhz  
34.3dB @ 300Mhz  
40.1dB @ 400Mhz  
45.3dB @ 500Mhz  
e. Mutual Maximum Capacitance of Any Pair  4.4nF/100m  
f. Worst Pair "NEXT" Loss Per/328-feet (100 meters)  
   67.0dB @ 1Mhz  
   67.0dB @ 4Mhz  
   67.0dB @ 10Mhz  
   67.0dB @ 16Mhz  
   67.0dB @ 20Mhz  
   67.0dB @ 31.25Mhz  
   65.6dB @ 62.5Mhz  
   42.3dB @ 100Mhz  
   58.0dB @ 200Mhz  
   56.5dB @ 250Mhz  
   55.3dB @ 300Mhz  
   53.5dB @ 400Mhz  
   52.0dB @ 500Mhz  
3. ScTP, all the wires in the cable shall be enclosed in a common, 100% metallic foil shield with copper "drain" wire, shield and drain wire located under the cable jacket.  

2.03 COPPER WIRE CABLES (COAXIAL)  

A. General  
   1. An overall non-conductive jacket shall encase the copper wires and shielding.  
   2. Cables shall be UL listed, complying with NEC National Electrical Code, National Fire Protection Agency and NFPA requirements for each installation location shown. ETL tested and certified to comply with or exceed specified requirements. In addition to the UL listing requirements for Copper wire Cables twisted pair, coaxial cable shall additionally be UL listed and labeled for each install location.  
      a. NEC - CATVP (Plenum type locations and locations where not continuously enclosed inside conduit).  
      b. NEC - CATVR (Vertical riser type locations).  
      c. NEC - CATV (Locations where continuously enclosed inside conduit).  
      d. ANSI/TIA/EIA-568C; including related standards, amendments and TSB.  
   3. Electronic network systems infrastructure cables that are not installed inside conduit raceways. Electronic network systems infrastructure cables that are installed in concealed spaces including plenums and non-plenums; access floors, ceiling spaces, walls, floor, etc., and/or installed without continuous raceways. The cable insulation and jacket shall be listed and labeled “Limited Combustible Cable” (LC or LCC) and shall comply with the latest published revision of all of the following additional requirements.  
      a. Limited combustible “FHC-25/50” per UL-2424.  
      b. NEC/CEC; CMP, additional listing/labeling where the install location is an environmental air plenum, “FHC-25/50-CMP”.  

ELECTRONIC NETWORK SYSTEMS INFRASTRUCTURE  
27 2000 - 12
c. NFPA-90A; ceiling cavity plenums, wall cavity spaces and raised floor cavity plenums, limited-combustible.
d. NFPA-5000; defines combustible material including wire and cable.
e. NFPA-75 computer rooms and electronic equipment room.
f. NFPA-13; spaces containing “limited combustible loading”.

4. Cables shall qualify as 100% recyclable materials disposal, RoHS regulation complaint.

5. The outer cable jacket shall be imprinted with date, Manufacturer’s model and catalog number and agency (AHJ) listing identification.

6. Cables installed in air plenums, air-handling spaces and cables installed without raceway or conduit shall be UL listed and labeled for installation in air plenums.

7. Cables installed in raceways or conduits below grade, through in-grade manholes and pullboxes shall be rated for installation in water/wet locations.

8. Copper wire Electronic Network Systems Infrastructure cable shall be product of the same Manufacturer, including portable patch cables.

B. RG6 Coaxial Cables
1. ANSI/TIA/EIA-568C cables. RG-6, Quad-Shield cables, shall be tested and shall pass ANSI/TIA/EIA test recommendations for the cable type. Rated for both analog and digital RF signal circuits.

2. Operational characteristics:
   a. Single center conductor size 18AWG stranded or solid bare copper.
   b. Velocity of propagation not less than 82%.
   c. Impedance 75-OHM.
   d. Maximum signal attenuation per 100-feet.
      - Baseband Video: 0.26dB @ 1MHz
      - Upstream Digital Cable: 0.76dB @ 10MHz
      - TV ch. 2: 1.46dB @ 50MHz
      - FM Radio: 2.05dB @ 100MHz
      - TV Ch. 12: 2.83dB @ 200MHz
      - CATV Ch. 54: 4.05dB @ 400MHz
      - CATV Ch. 109: 5.60dB @ 700MHz
      - CATV Ch. 142: 6.23dB @ 900MHz
      - DBS: 6.59dB @ 1000MHz
      - DBS: 7.50dB @ 1200MHz
      - DBS: 8.04dB @ 1450MHz
      - PCS Cell Phones: 8.50dB @ 1800MHz
      - Wireless Cable: 9.00dB @ 2200MHz
      - High Frequency: 13.7dB @ 3000-4500MHz
   e. Capacitance 16.2 pf/feet
   f. ASTM-D4566, 5 thru 4500MHz Return Loss Headroom (RLH) not less than 20dB.
   g. 100% sweep tested 5MHz thru 4500MHz

3. Four (4), alternating layers of metal foil shielding and brass braiding shielding, 100% metallic shielding below the jacket and symmetrically enclosing the individual layers of dielectric insulation surrounding the center conductors.

2.04 FIBER OPTIC FIBER SPLICES

A. General
1. Fiber optic cable splices shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed specified...
requirements, ANSI/TIA/EIA–568C including related Standards, Amendments and TSB.
2. Fiber optic splices shall be the product of the same Manufacturer.

B. Mechanical Splice
1. Mechanically splice each fiber with a splice suitable for use with the type of fiber optic fibers. Re-enterable and reusable splice. Splice shall be recommended as compatible with the optical fibers by the Manufacturer. Splice shall not require the use of adhesives. Splice shall provide integral strain relief.
2. Performance requirements after installation:
   a. Operating temperature range minus 20-degrees centigrade through plus 60-degrees centigrade.
   b. Loss variation over temperature range, 0.05dB or less at specified wave lengths.
   c. Insertion loss, 0.3dB or less at specified cable wave lengths.
   d. Reflection (return loss), -40dB at specified cable wavelengths.

C. Fusion Splicing
1. Fusion splicing shall be performed with equipment providing the following features:
   a. Cleaving and cleaning optical fiber.
   b. Integral splice optimization verification system with local injection and detection.
   c. Projection screen optics and fiber core alignment system.
   d. Fiber cleaning/stripping.
   e. Cleaning fiber ends and fusing of fiber together with an electric arc.
2. Fusion splice insertion loss as measured at the completion of the splice shall be less than 0.1dB at specified cable wave lengths.

2.05 FIBER OPTIC FIBER CONNECTORS AND INTERCONNECTION COUPLERS

A. General
1. The connectors and interconnection couplers shall be compatible, maintain the same performance Category rating and be compatible with the corresponding fiber optic cable type attached to the connectors.
2. Fiber optic cable connectors and interconnection couplers shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed specified requirements. Connectors and couplers shall comply with ANSI/TIA/EIA-568C, related standards, amendments, TSB, and TIA/EIA-Fiber Optic Connector Intermateability Standard (FOCIS) documentation.
3. Fiber optic connectors and couplers shall be the product of the same Manufacturer.
4. Shall be UL listed and comply with UL94V-0.
5. Color code connectors for fiber optic cables to match the respective fiber optic strand/jacket color.

B. Fiber Optic Fiber Connectors
1. LC – Small Form Factor (SFF) termination connector
   a. Ceramic oxide 1.25mm ferrule. Mechanical durability not less than five hundred (500) mating cycles. Insertion loss of mated connector shall be less than 0.3dB at specified wavelengths.
b. Strain relief boot, long boot type unless indicated otherwise, short or angled boot type to match the connector installation application. Provide duct cover cap for each connector.
c. Locking type to automatically align mating fibers in the fiber cable and prevent accidental rotation and pullout.

2. ST type bayonet termination connector
   a. Ceramic aluminum oxide 2.5mm ferrule, multi-cure ultra violet or heat cured epoxy bonded, for multimode or single mode to match cable fiber. Insertion loss of each mated connector shall be less than 0.3dB at specified wavelengths.
b. Strain relief boot, long boot type unless indicated otherwise, short or angled boot type to match the connector installation application. Provide duct cover cap for each connector.
c. Locking type, to automatically align fiber cable and prevent accidental pullout.

3. SC – Square/Subscriber termination connector
   a. Ceramic oxide 2.5mm ferrule. Insertion loss of mated connectors shall be less than 0.3dB at specified wavelength.
b. Strain relief boot, long boot type unless indicated otherwise, short or angled boot type to match connector installation application. Provide dust cover cap for each connector.
c. Push-pull snap and lock type to automatically align mating fibers in the fiber cable and prevent accidental rotation and pullout.

4. "FSD" fixed shroud duplex type termination connector

C. FIBER OPTIC FIBER INTERCONNECTION COUPLERS
   1. Interconnection couplers shall be “like-to-like” compatible, and shall provide "plug-in" coupling of two fiber optic cable connectors terminated with fiber optic fibers front-to-rear "in-line" together. The coupler shall provide interlocking, automatic optical self-alignment of two mating fiber optic connectors.
   2. The centerline to centerline spacing of the interconnection couplers shall allow removal and insertion of portable patch cords, fiber cable connectors for both "single" and "duplex" type fiber adapter connectors without interfering with adjacent connectors.
   3. Patch panel mounted interconnections couplers shall be factory pre-mounted to a modular nominal 0.09-inch thick metal panel, couplers aligned and anchored on the plate.
      a. The metal panel shall be predrilled for standard EIA mounting in high-density 19-inch wide metal patch panel frames.
   4. Interconnection couplers in workstation outlets shall be installed in outlet boxes with cover plates.
   5. Provide removable dust caps for the front side of each coupler.

2.06 COPPER WIRE OUTLET CONNECTORS

A. General
   1. Connectors shall comply with FCC part-68 Subpart F for gold plating.
   2. Connectors shall be UL listed and shall comply with UL94V-0.
   3. Provide a removable blank dust cover for each plug-in outlet insert. The dust cover shall protect the insert from contamination until a workstation or patch cord is "plugged" into the outlet.
4. Copper wire outlet connectors shall be color coded to distinguish telephone/voice separately from computer/data. The outlet cover plate shall be engraved to identify telephone/voice, computer/data and other infrastructure outlets separately.

5. Copper wire outlet connectors shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed specified requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.

6. Copper wire outlet connectors shall be the product of the same Manufacturer.

B. Universal Outlet Connector (for twisted pair Copper Wire Premise/Workstation Wiring and copper wire patch panels).

1. General
   a. Connections for twisted pairs copper conductors shall provide a universal outlet connector between the building premise copper wire, and plug-in workstation locations. Patch panel/equipment plug-in connectors. The connector components shall assemble with "snap-in" spring loaded retainers to prevent dislocation during insertion or removal of external plug-in devices.
   b. The contacts shall be gold plated with a 250 insertion/withdrawal cycle rating.
   c. Unless specifically noted otherwise the universal outlet connector shall comply with ANSI/TIA/EIA-568C; related Standards, Amendments and TSB.
   d. Operational characteristics shall match or exceed and shall be compatible with the respective twisted pair’s cable.
   e. A metal ground shield with EMI/RFI metal ground clip shall be provided where shielded cable is connected to the universal outlet connector for each universal outlet connector assembly.
   f. Each universal outlet connector shall consist of three major components.
      1) Universal edge connector assembly.
      2) Plug-in adapter inserts.
      3) Connector housing.
   g. Provide snap-in blank removable insert covers for connector installed without plug-in adapter inserts.

2. Universal edge connector:
   a. Insulated assembly shall connect to the premise copper wire. The connectors shall be multiple plug type connector contacts, one contact (total of eight (8) contacts) for each individual premise wire connection interconnected to the individual wire terminations.
   b. Connector shall provide insertion of individual insulated copper wire, gas tight, 110-style punch down/displacement termination, for 22-26 AWG insulated premise wire.
   c. The edge connector assembly shall provide termination of eight (8) separate wire conductors, twisted or untwisted pairs, solid or stranded, shielded or unshielded, with color codes and numbered identification of each contact. Integral cable/conductor strain relief to prevent pullout of terminated premise wire conductors.

3. Plug-in adapter inserts:
   a. Plug-in adapter inserts shall be internally factory connected to the universal edge connector assembly to adapt the universal connector to the specific outlet type configuration (i.e. "RJ" style computer/data, telephone/voice, (multimedia) modular jacks, etc.).
b. Inserts shall be certified for shielded or unshielded wire, to match premise wire type connected to the universal edge connector.

c. Inserts shall provide correct pin-to-pin connections, electrical and mechanical matching characteristics for the specific equipment connected to the respective outlet.

d. Inserts for different infrastructures shall be color coded with different colors from each other, for system identifications.

e. Plug-in adapter insert type:

1) Computer/data network systems:
   a) ANSI/TIA/EIA-568C, female modular jack 8-position/contact "RJ-45" style.

2) Telephone/intercom voice systems:

3) Multimedia audio/video tv (baseband only):
   a) ANSI/TIA/EIA-568C female modular jack 8-position/contact RJ-45 style.
   b) Each multimedia audio/video outlet location provides a Balun to match the circuit impedance of the premise wiring to the multimedia outlet signal type.

4) Intrusion detection/access control systems:
   a) ANSI/TIA/EIA-568C female modular jack 8-position/contact RJ-45 style.
   b) Each intrusion detection system outlet location provides a Balun to match the circuit impedance of the premise wiring to the intrusion system outlet signal type.

4. Connector housing:
   a. Connector housing shall contain the universal edge connector assembly and the plug-in adapter inserts in a rigid assembly. Connector housing shall provide integral cable strain relief for the premise wiring connection.
   b. The connector housing shall mount to a metal panel, metal device cover plate or plastic device cover plate with spring loaded snap-in retainers. Nominal depth of connector housing behind the mounting panel and/or device cover plate shall not exceed 1.625-inch including premise wiring termination depth requirements.

C. Coaxial Cable Connectors

1. General
   a. BNC type connectors, for coaxial cable premise/workstation wiring and coaxial cable patch panel equipment.
   b. Unless noted otherwise, the BNC connectors shall comply with ANSI/TIA/EIA-568C and related standards, addendums and TSB.
   c. Brass body and male contact. Beryllium copper or bronze female contact. Bayonet coupling with threaded or cam-locking mating connection.

2. Operational characteristics shall match or exceed and shall be compatible with the respective coaxial cable. 75-OHM, operational frequency range 0-4500MHz.

2.07 FIBER OPTIC FIBER DISTRIBUTION ENCLOSURES

A. General

1. Fiber optic fiber distribution enclosures shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed
specified requirements, ANSI/TIA/EIA–568C including related Standards, Amendments and TSB.

2. Fiber optic fiber distribution enclosures shall be the product of the same Manufacturer.

B. Equipment Rack Mount Fiber Optic Termination Distribution Enclosure - RTDE

1. The RTDE enclosure shall mount in an EIA standard 19-inch wide enclosed or open frame equipment rack assembly. The RTDE enclosure shall be metal, painted finish, Manufacturers standard color.

2. The RTDE shall provide the following self-contained functions internal to the RTDE assembly.
   a. Fiber cable termination.
   b. Fiber cable "pig-tail" splicing.
   c. Fiber cable patch panel.
   d. Fiber cable management, training and strain relief.
   e. Individual fiber and patching port identification numbers, color-coding of incoming trunk and out-going distribution fiber ports.
   f. Plug-in fiber optic interconnection couplers for port to port patching with portable fiber optic patch cords.

3. Fiber splice drawers:
   a. Horizontal sliding metal drawers adjustable to approximately 30-degree angle when fully open, and removable for easy access. Each drawer shall contain two (2) fiber optic splice trays with tray holders.
   b. Drawers shall stack vertically one above the other in the RTDE and allow sufficient slack in all fiber cables for removal of the drawer and splice trays.
   c. Provide one sliding drawer and two splice tray assemblies for each group (twenty-four (24) individual fibers or fewer fibers per group) of fiber optic fibers terminated in the equipment rack, but in no case provide not fewer than two (2) sliding drawers with splice tray assemblies in each RTDE.

4. Fiber cable patch panel
   a. Metal panel shall provide a patch port for each fiber consisting of metal panel mounted fiber optic interconnection couplers for each fiber optic fiber indicated to be terminated at the RTDE.
   b. The fiber optic fiber interconnection coupler shall be provided to match and be compatible with the fiber cable connectors. Quantity shall match quantity of terminated fibers, unless indicated otherwise on the equipment rack schedules.
   c. Nominal panel thickness 0.09 inches.
   d. Provide a minimum of sixteen (16) unused spaces for additional couplers in the patch panel.

5. Nominal height of the RTDE shall not be exceeded, as follows:

<table>
<thead>
<tr>
<th>Quantity of Patch Ports</th>
<th>Quantity of Splice Drawers</th>
<th>Nominal Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>2</td>
<td>11-inches</td>
</tr>
<tr>
<td>48</td>
<td>2</td>
<td>11-inches</td>
</tr>
<tr>
<td>72</td>
<td>3</td>
<td>14-inches</td>
</tr>
<tr>
<td>144</td>
<td>6</td>
<td>28-inches</td>
</tr>
</tbody>
</table>
C. Equipment Rack Mount Fiber Optic, Splice only (for use only where fiber patch panel is not required) enclosure - RMSE
   1. The RMSE enclosure shall mount in an EIA standard 19 inch wide enclosed or open frame rack assembly. The enclosure shall be metal, painted finish, Manufacturer's standard color.
   2. The RMSE shall provide the following self-contained functions internal to the RMSE assembly:
      a. Fiber cable splicing for "thru splicing" of fiber optic cables where the cables do not terminate in the equipment rack.
      b. Fiber cable management, training and strain relief.
   3. Fiber splice drawers
      a. Horizontal sliding metal drawers adjustable to approximately 30-degree angle when fully open and removable for easy access. Each drawer shall contain two (2) fiber optic splice trays with splice tray holders.
      b. Drawers shall stack vertically one above the other in the RMSE and allow sufficient slack in all fiber cables for removal of the drawers and splice trays.
      c. Provide one (1) sliding drawer and two (2) fiber optic splice tray assemblies for each group (twenty-four (24) individual fibers or fewer fibers per group) for fibers optic fiber routed through but not terminated in the equipment rack, but in any condition provide not fewer than two (2) sliding drawers with splice tray assemblies in each RMSE.
   4. Nominal height of the RMSE shall not be exceeded, as follows:

<table>
<thead>
<tr>
<th>Quantity of Thru Splices</th>
<th>Quantity of Splice Drawers</th>
<th>Nominal Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>2</td>
<td>4-inches</td>
</tr>
<tr>
<td>48</td>
<td>2</td>
<td>4-inches</td>
</tr>
<tr>
<td>72</td>
<td>4</td>
<td>8-inches</td>
</tr>
<tr>
<td>96</td>
<td>4</td>
<td>8-inches</td>
</tr>
</tbody>
</table>

2.08 COPPER WIRE PATCH PANELS

A. General
   1. Copper wire patch panels shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed specified requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.
   2. Copper wire patch panels shall be the product of the same Manufacturer.

B. Equipment Rack Mounted Patch Panel
   1. Standard EIA 19-inch wide metal panel, Manufacturers standard color. Prepunched for copper wire outlet connectors. Panel shall mount on a EIA standard 19 inch wide enclosed or open frame equipment rack assembly. Nominal twenty-four (24) copper wire outlet connectors in a horizontal row, quantity of rows as required for total quantity of connectors. Provide not less than two spare empty rows for future copper wire outlet connectors.
   2. The patch panel shall provide the following self-contained functions.
      a. Copper wire cable termination including conductor/ shield termination and strain relief.
      b. Plug-in copper wire outlet connectors for port to port patching with copper wire portable patch cords.
3. Patch panel height shall be based on the quantity of copper wire outlet connectors described plus the specified space for future outlets and shall not exceed the following dimension height:

<table>
<thead>
<tr>
<th>Outlet Quantity</th>
<th>Nominal Patch Panel Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-24</td>
<td>3.5 inches</td>
</tr>
<tr>
<td>25-48</td>
<td>7 inches</td>
</tr>
<tr>
<td>49-72</td>
<td>10.5 inches</td>
</tr>
<tr>
<td>73-96</td>
<td>14 inches</td>
</tr>
</tbody>
</table>

4. Horizontally mounted, cable support metal bracket shall be provided for each twenty-four (24) outlet/connector groupings. The brackets shall be bolted to the equipment rack located at the backside of the patch panel; the brackets shall support and provide strain relief for each incoming copper wire cable connecting to the patch panel.

5. The copper wire connector installed in the patch panel shall be the same configuration, Manufacturer and type as the corresponding copper wire connector provided in the remote workstation outlet locations connecting to the respective patch panel outlet, unless indicated otherwise.

6. Each multimedia, audio/video/TV multimedia and intrusion detection/access control outlet. Provide a Balun, to match the circuit impedance of the premise wiring and to the outlet signal type.

2.09 TELEPHONE/VOICE TERMINAL BLOCKS

A. General

1. Terminal blocks Type 110, shall consist of wiring blocks, connecting blocks, direct wire/patch cord cross connection and designation strips. Arrange in unitized, modular, vertical mounting sections, for telephone/voice.

2. Completely 100% front accessible for cross connections, terminating conductors, training, and fanning of cables. Rear access for any reason shall not be permitted.

3. Telephone/voice terminal blocks shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed specified requirements. Telephone terminal blocks and connections performance shall comply with ANSI/TIA/ EIA-568C and related Standards, Addendums and TSB and shall comply with and be listed under UL 1863. Category rating shall match the cables connecting to the patch panel.

4. The telephone/voice terminal blocks shall provide cross connection of telephone/voice four (4) pair premise copper wiring from telephone/voice handset outlets to multiple copper wire telephone/voice feeder cables and external free standing telephone equipment.

5. Each full height vertical section terminal block assembly shall terminate a minimum of 900 pairs (including specified spares for future construction phases) of telephone/voice conductors, plus associated cross connection wiring and patch cords in a nominal 20-inches wide by 90-inches high space. Provide multiple vertical sections of terminal block assemblies adjacent to each other, total quantity as required for quantity of telephone/voice conductor pairs and telephone/voice feeder cable pairs shown on the Drawings and requirements, plus specified spares.

6. Each telephone/voice terminal block vertical section assembly shall provide 15% or 100 (whichever is the larger quantity) of spare unused conductor pair terminals for future telephone/voice connections.

7. Provide a common ground bus in each terminal block section with a minimum of six (6) ground conductor termination positions, #10AWG through #6AWG.
8. Terminal blocks shall be the product of the same Manufacturer.

B. Wiring Blocks
1. One piece molded, die-electric thermoplastic blocks. The wiring block shall support and secure all the components of the terminal block assembly, and provide cable/conductor training and organization.
2. Fire retardant complying with UL 94V-0.
3. Standoff type support legs for mounting to backboard with pre-drilled anchor holes.
5. Horizontal index strip rows, for termination of not less than twenty-five (25) conductor pairs on each row. Color coded and marked in groups of four pairs or five pairs to match connecting cables.
6. Removable retainers at the ends of each horizontal connecting block index strip row, shall support cross connect wires at corner turns.
7. Distribution rings shall retain cross connect wire horizontal routing between terminations.
8. A full width, horizontal trough between each 100 pair wiring block shall provide a path for patch cord training and retention.

C. Connecting Blocks
1. Connecting blocks shall provide gas tight conductor electrical connections with conductor insulation displacement punch down slots, for insertion onto the telephone/voice wiring block index strips.
2. Connecting blocks shall electrically connect one-to-one between each conductor terminated at the wiring block index strips, and each cross connect/patch cord conductor terminated/connected to the opposite front side of the connecting block.
3. Both sides of the connecting blocks shall terminate telephone/voice UTP 22-26AWG stranded or solid copper wire individually insulated conductors. The front side of the connecting blocks shall also provide "plug-in" connections for portable patch cords, 110 style "plug-in" connectors.
4. Connection blocks shall be 4-pair insulated copper conductor type.
5. Provide insulated, removable termination caps for each connector block.
6. Connector blocks shall be marked to indicate tip and ring conductors and to indicate polarization.

D. Designation Strips
1. Designation strips shall provide retention of interchangeable labels. The labels shall show circuit identification of each terminated conductor pair.
2. The designation strips shall mount on the center and outside positions of the wiring block.

E. Telephone/Voice Cross Connection
1. The cross circuit connection between incoming and outgoing feeder cables and telephone voice outlet wiring shall be provided in the terminal block assembly.
2. The cross connection wiring shall terminate incoming and outgoing circuit conductors between respective connecting blocks.
   a. Direct connect cross connection shall provide internally wired one-to-one conductor twisted pair cross connection. Provide cross connection of each 4-pair telephone/voice outlet cable to corresponding 4-pairs of the telephone/voice feeder cable and cross connection of feeder to feeder cables, as applicable.
b. Patch panel cross connect, 110 terminal connector style, plug-in. Provide [one, two, three] twisted pair, 110 connector type portable patch cords.

c. Prewired 50 pin-Amphenol connectors:
   1) Provide factory prewired fifty (50) pin Amphenol connectors for connection from telephone/voice terminal blocks to the telephone switch equipment and Telephone Utility Company outside telephone service lines.
   2) Provide fifty (50) pair ANSI/TIA/EIA-568C and related Standards, Addendums and TSB cables, connected to fifty (50) pin Amphenol connectors at one end (telephone equipment connection) and connected to the respective telephone/voice terminal wiring blocks at the other end.
   3) The 50 pin Amphenol connectors shall group together and be positioned at the top of the respective terminal block section near the ceiling.
   4) The pin-to-pin conductor assignments shall conform to the Telephone Switch Manufacturer's requirements.
   5) The Amphenol connector/cable assemblies shall connect to and extend the telephone/voice outlet premise wiring from telephone/voice terminal block to the telephone switch equipment. The Amphenol connector/cable assembly shall connect to and extend the Telephone Utility Company outside telephone service lines to the telephone switch equipment.

d. Prewired "RJ" style modular jacks
   1) Provide factory prewired eight (8) position/contact plug-in "RJ" style jacks for patch panel portable patch cord cross connects, located on the front side of the terminal blocks.
   2) The pin-to-pin conductor assignments shall conform to the Telephone Switch Manufacturer's requirements.

2.10 EQUIPMENT RACK

A. General
1. An equipment grounding bus, nominal 19-inches long, UL labeled as a ground terminal bus, shall be provided on each equipment rack. The ground bus shall be bolted to the rack main metal frame member with 1-inch standoff non-insulating bolts. Provide a minimum of ten drilled and taped bolt holes in the ground bus with ground lug bolts, for connection of equipment grounding conductors to the ground bus, size to accept ground conductors #14-#4AWG.
2. Vertically mounted, cable management metal rings (aluminum or stainless steel) shall be provided full height, continuously along the front and rear of each vertical rail of the equipment rack. The rings shall be bolted to the equipment rack. The rings shall train and dress portable patch cords connecting between outlet connectors located in the equipment rack or in adjacent equipment racks.
3. Provide horizontal cable management panels with multiple cable training rings on each panel (not less than five (5) rings for each panel). Management panels (for up to twenty-four (24) outlet grouping) nominal 19-inches wide by 1.75-inches high by 3-inches deep and/or (for up to forty-eight (48) outlet groupings) 3.5-inches high by 3 inches deep, for EIA rack installation. Rings shall provide horizontal routing and support by grouping portable patch cords connecting between patch ports in the same equipment rack or adjacent racks.
Patch cords shall be grouped and bundled with “Velcro” tie wraps and shall not overlap patch fields or rack mounted equipment. The cable management panels shall be installed on both the front and rear of the equipment racks, mounted both above and below horizontally between groups of patch ports as follows:

a. One cable management panel (front and rear of rack) for each group of forty-eight (48) or less copper wire outlets for patch ports.
b. One cable management panel (front and rear of rack) for each group of forty-eight (48) fiber optic outlet patch ports.

4. The entire rack assembly including any support arms shall comply with seismic earthquake requirements for install location structural standards.

a. The assembly shall provide support for the weight of the equipment installed on the rack, but in no case less than 500-pounds of equipment, plus the weight of the rack and connecting cables. A 2.0 time’s safety factor shall be included in the equipment rack assembly structural design.

5. Provide plug strip Transient Voltage Surge Suppressors with RF Suppressor (TVSS) and Power Distribution Units (PDU). Horizontal strip, mounted in each equipment rack. Each unit shall contain not less than six (6) “plug-in” on the rear of the TVSS and not less than two (2) plug-in on the front of the TVSS protected outlet plugs.

a. Provide two (2) TVSS/PDU units in each equipment rack, to supply “dual-corded” equipment.

6. Provide pre-drilled mounting holes the entire length of equipment vertical mounting frames, EIA-310D-19 inch (nominal) wide standard spacing for indicated equipment. Racks shall provide 17.75-inches (nominal) equipment horizontal mounting space between vertical rails.

7. Provide all floor standing equipment racks with wall bracket support arms extending from the stationary portion of the rack to adjacent wall. Provide "dual-rail arm" cable “runway tray”, horizontally from each equipment rack, to the wall directly behind the equipment rack

a. The tray shall extend from and bolt to the top of the equipment rack “fixed” top rail.
b. The tray side rail arms shall be a minimum of 6-inches deep, with "ladder" type rungs spanning horizontally between the side rail arms. The rail arms shall be parallel with each other. The rail-to-rail arm spacing shall be the same as the equipment rack width.
c. The rungs shall be spaced not more than 6-inches on center between the side rails, along the length of the side rail arms. The rungs shall have a minimum cable-bearing surface of not less than 0.75-inches, lengthwise along the tray.
d. The runway tray shall support a minimum of 200 pounds per linear foot live conductor/cable loading, with not more than 0.25-inches deflection at mid-span.
e. Provide a continuous horizontal support “C” channel along the wall behind the equipment racks and bolt the dual-rail arm cable runway tray to the channel at the wall. The channel elevation on the wall above the finish floor shall support the runway tray horizontally (± 0.2-inches), from the equipment rack to the wall.
f. Equipment racks shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed specified requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.
g. The wall mounted horizontal support channel shall be securely through bolt to wall structural member, a minimum of 16-inches on center. The horizontal support channel shall extend a minimum of 6-inches past each side of the runway tray. Support channels as manufactured by Unistrut-P1001C Series; or B-Line; or Kindorf.

8. Provide a copper ground – bus for equipment bonding, in each equipment rack.

9. Equipment racks shall be Manufacturer’s standard rust inhibitor primer. Manufacturer’s standard color finish paint over primer, unless noted otherwise.

B. Swing Gate Open Equipment Rack Style:

1. Combination wall and floor mounted rack frame nominal 78-inches of usable equipment vertical space for mounting equipment into the rack. The equipment mounting portion of the rack shall be a hinged gate frame assembly. The rack shall provide access to the rear of the installed equipment, the wall behind the rack assembly and wall mounted terminal blocks, when hinged open.

2. The gate assembly shall hinge open not less than 90 degrees from the closed (normal position) on a fixed frame combination floor/wall mounted support structure. A positive latching mechanism shall lock the gate in the fully open and fully closed positions. The rack construction shall allow opening the swing gate, with the installed equipment depth, without obstruction. The fixed stationary portion of the swing gate rack assembly shall be supported from both the fixed floor bracket and wall located behind the rack with adjustable length “dual rail arm” wall brackets. The arms shall provide field adjustment (approximately 24-inches) of the equipment rack spacing from the wall behind the rack. Provide a minimum of two (2) support arms for each swing gate equipment rack.

3. The rack assembly shall be constructed of extruded metal; aluminum gold irradiates finish, or hot dip galvanized steel. Bolted or welded assembly. Hardware shall be stainless steel.

4. Provide steel caster rolling wheel support on the bottom rail of the moveable swing gate frame. The wheel shall provide additional support, but not the main support, of the moving gate assembly and rack mounted equipment along the floor travel “outside arc” of the gate in the open or closed position. The vertical height of the wheel assembly shall be adjustable ±3 inches.

5. Swing gate equipment racks as manufactured by B-Line; or Saunders; or Hendry.

C. Floor Standing Equipment Rack Fully Metal Enclosed Style:

1. Floor mounted self-supporting rack, nominal 80-inches high by 24-inches deep, by 24-inches wide. Internal bolted or welded hot dip galvanized steel or gold irradiate finish aluminum, support frame. Metal enclosed with screw attached removable metal panels. Manufacturer’s standard finish color.

2. The front and rear of the rack shall be a full height hinged door, opening not less than 90 degrees from the closed position. The doors shall be readily removable with positive latching mechanism to lock to the doors in fully open or fully closed positions. Doors shall be pad-lockable. Rack shall provide a minimum of 4-inches of clear space between front door and internal mounting face for rack mounted equipment. Smoke/grey impact resistant, tamper resistant see-through windows in the doors, front and rear. Hardware shall be stainless steel.

3. Provide six (6) 120-volt 60Hz AC motor direct drive air ventilation, "muffin" style, nominal 4-inches square, exhaust air fans. Flush mount fans in the top of each equipment rack. The fans shall be low speed, low noise type with wire
guards to prevent accidental contact with the fan blades. The fan motor shall be high impedance, self-protecting type motors. Provide "SO" cord with plug caps to connect from the fans to the 120 volt plug-strip in the equipment rack.

4. Provide cooling air intake louver with a removable 19-inches wide air filter and air filter holder, mounted in the bottom of the rack front nominal 6-inches high.

5. Floor standing metal enclosed equipment racks as manufactured by Stantron; or BUD; or equal.

D. Fixed Position Floor Standing Open Frame Equipment Racks:
1. Floor mounted self-supporting rack, nominal 78-inches of usable mounting frame height for equipment.
2. Bolted or welded hot dip galvanized steel or gold irradiate finish aluminum support frame. Hardware shall be stainless steel.
3. Open frame rack construction, fixed, non-swing gate.
   a. “Two-post” style for equipment racks not designated as containing UPS equipment nor server equipment.
   b. “Four-post” style for equipment racks designated as containing UPS equipment and/or server equipment.
4. Open frame equipment racks as manufactured by B-Line; or Saunders; or Hendry.

E. Floor Standing Modular Frame Equipment Racks
1. Provide a modular frame equipment rack, bolt together modular rack system with all accessories for a completely assembled equipment rack unit. The rack system, when configured for specific equipment, shall support and organize network servers, keyboards, printers, tape drive units, RAID units, CRT's, UPS units, telephone switching equipment, desk top work spaces, etc.
2. Nominal overall dimensions 31-inches deep by 72-inches wide by 84-inches high. Left/right or right/left orientation as indicated on Drawings. Minimum weight capacity of the entire rack assembly shall be 1500 pounds.
3. Manufacturer's standard finish painting, crème white color for metal surfaces. Horizontal flat support surfaces shall be post-formed, laminate top finish, white color.
4. "8L-01/8L-02" vertical support upright assemblies; shall be slotted the full height to "hook-on", lock in and support adjustable height (in 1-inch increments), modular components, with integral floor support "feet". Open back frame - "LF31". Minimum of three (3) vertical support and open back frames in each complete assembly.
5. Provide vertical (on upright supports) and horizontal (on modular "hook-on" components) wire management raceways integral to the assembly.
6. Network server configuration - equipment rack unit:
   a. "LE28" computer tower "roll-out" horizontal floor shelf; nominal 47-inches wide by 24-inches deep. Shelf shall pull out on "ball-bearing" rails, with 23-inch extension for access to computers. Provide one (1) tower shelf for rack unit. Minimum weight capacity 750 pounds. Mount at floor.
   b. "LE25"-computer tower horizontal shelf with ±12 inch end panels and two (2) shelf support brackets; nominal 47-inches wide by 22-inches deep, fixed mounted. Provide one (1) tower shelf for rack unit. Minimum weight capacity 500 pounds. Mounting height ±30-inches.
   c. "LB32" horizontal work surface; nominal 24-inches wide by 27-inches deep. Provide one (1) work surface assembly for each rack unit. Minimum weight capacity 300 pounds. Install on left or right side of rack as shown on Drawings. mounting height ±28-inches.


d. LF10/LF11/W162 - General equipment shelf; nominal 72-inches wide by 15-inches high by 16.7 inches deep, with (2) two horizontal shelf surfaces, full width of rack, ± 10-inches nominal vertical height between shelves and five (5) vertical shelf dividers. Minimum weight capacity 300 pounds. Provide one (1) general equipment shelf assembly for each rack unit. Mount at top of rack.

e. "LA-09" - Keyboard platform. Retractable keyboard platform with auxiliary mouse pad and up-down 15 degree adjustable tilt and adjustable 360 degree swivel. Nominal 23-inches wide by 11 inches deep. Provide three (3) keyboard platforms for each rack unit. Install below, upper tower computer shelf and work surface.

F. Plug Strip Transient Voltage Surge Suppressor (TVSS).

1. General
   a. Self-contained unit combining plug-in receptacle strip and TVSS. Rated 20 ampere, nominal 120-volt +10%, 60Hz, AC, 2400 watts full continuous load. Internal 20 ampere resettable overload protection circuit breaker. Red illuminated on-off switch. 9-foot, 12AWG 3-conductor grounded, high abuse heavy duty jacketed AC, line cord with NEMA 5-20P cap.
   b. Multi-outlet receptacles, suitable for use with the following types of plug in loads; data processing equipment, audio/video equipment, test instruments, medical equipment, photo graphic equipment and “switching type” power supplies.
   c. Protected 120-volt outlets shall be NEMA 5-15R 15 ampere, or 20 ampere NEMA 5-20R AC 60Hz receptacles, as applicable for connected equipment loads. Provide not less than eight (8) protected outlet plugs on each unit. Each individual or group of two (2) receptacles (duplex) shall be connected to separate protected load isolated filter banks.
   d. Each duplex shall be isolated from the other output receptacles, minimum isolation of 25dB at 1MHz line to line, line to neutral, line to ground and neutral to ground.
   e. Non-blocking plug-in locations/orientation, for plug-in self-contained “power-brick”, equipment power supplies.
   f. As manufactured by Liebert; or TRIPP LITE.

2. Operation
   Self-contained RFI and EMF shielded housing with mounting slots for temporary mounting of the unit. Protected outlet receptacles shall supply over current protected and filtered, electrical line voltage power to the connected equipment. Line noise RFI and EMI interference filtering suppression, transient voltage surge and spike protection shall occur in all three modes of operation line to ground, line to neutral and neutral to ground rated as follows:
   a. 13,000 ampere, 210 joules (watt-seconds) peak withstands capacity.
   b. Transient response time less than 5-nano seconds.
   c. 140-volt AC RMS initiate spikes suppression 330 volt maximum let through.
   d. RFI and EMI Suppression-Provide spectrum analysis test dB attenuation reports showing RFI filtering over specified frequencies.
   e. Diagnostic indicator lights located on the TVSS housing shall provide alarm alert for each of the following conditions:
      1) Loss of AC power.
      2) Damage, malfunction in the TVSS suppression circuits.
      3) Improper AC electrical outlet wiring.
f. Standards Testing, Listing and Certification Compliance:
   1) IEEE 587 A and B compliance.
   2) UL 1449 transient voltage surge suppressers.
   3) UL 1363 temporary power taps.
   4) UL 1283 electromagnetic interference filters.

3. Rack Mounted TVSS
   a. TVSS units installed in equipment racks shall comply with all of the same performance requirements including as follows.
      1) EIA/TIA – Equipment rack horizontal mount style (19-inches or 24-inches as applicable).
      2) Minimum of two (2) front mounted outlets and not less than six (6) rear mounted outlets.
      3) Position in each equipment rack as directed by Owner's Representative.
      4) Provide two (2) TVSS units in each equipment rack, for “dual-corded” network equipment.

G. Power Distribution Unit (PDU)
   1. General
      a. Self-contained unit combining main circuit breaker, multiple plug-in individual circuit breaker branch protection load receptacles, PDU metering status monitoring and network communication. All PDU components self-contained in a NEMA-1 metal enclosure.
      c. Standards Testing
         1) UL 60950-1 Information Technology Equipment.
         2) CAN/CSA-C22.2 No.60950-1-03 Information Technology Equipment.
         3) FCC, Title 47, Part 15 Subpart B for Class B operation as defined by ANSI Standard C63.4.
         4) ROHS Complaint.
         5) ISTA Procedure 1A and 2A.
      d. Provide two (2) PDU units in each equipment rack, to supply two (2) TVSS units in each equipment rack.
      e. Shall be a product of the same Manufacturer as the TVSS unit. As manufactured by Liebert; or TRIPP LITE.
   2. System Description
      a. Remote monitoring and/or control capabilities for power distribution at each load/equipment rack level. For data/network equipment line voltage plug-in and TVSS line voltage plug-in electrical distribution.
      b. PDU shall meter and monitor electrical attributes of an individual Rack PDU, including real-time remote and local display of monitoring of aggregate and branch electrical parameters (status, thresholds, alarms) including voltage, ampere, and kW. Rack equipment PDU and Branch load monitoring and control.
      c. Self-contained metering and communications
         1) Local display ampere-meter demand load meter to monitor plug-in demand load and total PDU load.
         2) Digital Fast Ethernet LAN RJ-45 communications port for Ethernet SNMP and IP network monitoring of electrical status. Multi-user
site-wide software license, compatible with PC-computer and IP-
WEB HTTP protocols.
3) Provide network array-interface for connection of multiple PDU units
positioned in the same location.
d) Nine foot input power (heavy duty high abuse) cord with appropriate
conductors and input NEMA plug-in connection. Provide input overload
protection with Hydraulic-Magnetic main input circuit breaker. Provide
load output NEMA plug-in branch connection with overload circuit breaker
protection for each load receptacle.
e) Equipment rack mounting horizontal position form factor.
3. Electrical Power ratings shall be as follows and as additionally indicated on
Drawings. Refer to Drawings for twist-lock verses straight-blade
configurations.
a) Single main input circuit breaker 30 ampere, 208/120 volt 3-phase 5-wire
"WYE" grounded 60Hz AC.
b) Branch load circuit breakers with a single plug-in receptacles for each load
circuit breaker. Balance loads on each circuit phase.
1) Three (3), 20 ampere 1-pole circuit breaker and three (3) NEMA 5-
20R receptacles. Also provide matching caps.
2) One (1), 30 ampere 2-pole circuit breaker and one (1) NEMA 14-
30R receptacle. Also provide matching cap.
3) Additional circuits and receptacles as indicated on Drawings.
4. Provide heavy duty high abuse flexible copper wire 300-volt insolated 15-feet
long jacketed electrical cord. Connect from PDU to wall-outlet receptacle with
same electrical rating as PDU. Rated for PDU voltages and amperes.
5. PDU units installed in equipment racks shall comply with all of the same
performance requirements including:
a) EIA/TIA – equipment rack horizontal mount style (19-inches or 24-inches)
as applicable.
b) Position in each equipment rack as directed by OWNER’s Representative.
6. Provide two (2) Category-6A 4-pair UTP 15-foot long portable patch cable
connects, PDU to respective network patch panel port.

2.12 WALL MOUNT FIBER OPTIC CABLE INTERFACE CABINET (WMIC)

A. General
1. Metal (14 gauge) enclosure, with full height hinged metal door. Door shall be
pad-lockable. Nominal size 12-inches deep by 18-inches wide by 36-inches
high. Enclosure shall mount directly on the wall.
2. WMIC shall be UL listed, complying with National Electrical Code, ETL Tested
and Certified to comply with or exceed specified requirements, ANSI/TIA/EIA-
568C including related Standards, Amendments and TSB.
3. Interface cabinets shall be the product of the same Manufacturer.

B. The WMIC shall provide the following self-contained functions internal to the WMIC
enclosure.
1. Fiber cable splicing for "through splicing" of non-UL listed fiber optic cables,
where the cables do not terminate in the building.
2. Fiber cable management, training and strain relief.
3. Transition from non-UL flame spread listed fiber optic cable, to UL flame
spread listed fiber optic cables where the cables terminate in the building.
C. Cable routing rings shall organize optic fibers in a 360 degree loop inside the WMIC housing and provide cable strain relief.

D. Fiber Optic Splice Trays
1. Provide fiber optic cable splice trays.
2. Tray holders shall provide mounting and support for each splice tray.
3. Provide two (2) splice trays for each group (24 or less fibers per group) fiber optic fibers routed through the WMIC, but in no case provide not less than four splice trays in the WMIC.

2.13 UNIVERSAL SPLICE ENCLOSURES - USE

A. General
1. The universal splice enclosure shall provide splicing for multiple cables containing multiple, network copper wire conductors or fiber optic fibers.
2. The enclosure with the connecting cables installed shall be water tight, continuously submersible in up to 10-feet depth of water without leaking water into the enclosure interior.
3. The enclosure with splices shall be completely re-enterable to allow access to the interior splices, adding cables, and removing cables, without compromising the water tight integrity of the enclosure.
4. The universal splice enclosure assembly shall be UL listed.
5. The USE shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed specified requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.
6. USE shall be the product of the same Manufacturer.

B. Fiber Optic Splices
1. Provide fiber optic splice trays inside the USE. Each splice tray shall provide space for up to 12 splices in lieu of twenty-four (24) splices on the tray.
2. A splice tray holder shall rigidly anchor splice trays inside the USE, with sufficient slack cable, to allow individual removal of each splice tray.
3. Provide one splice tray for each twelve (12) fibers passing through the USE, but not less than eight (8) splice trays in the use enclosure.

C. Copper Wire Splices

2.14 SPLICE TRAY FIBER OPTIC FIBERS

A. General
1. Trays shall be suitable for installation in USE, WMIC, RMSE and RTDE enclosures.
2. The trays shall be the product of the same Manufacturer as the respective enclosures.
3. Splice trays shall be UL listed, complying with national Electrical Code, ETL tested and certified to comply with or exceed specified requirements, ANSI/ TIA/EIA-568C including related Standards, Amendments and TSB.

B. Splice Trays
1. A metal or non-metal splice tray shall provide space for up to twenty-four (24) splices of individual fiber cable single mode and multimode optical fibers. The trays shall provide individual splice holder inserts for each splice to adapt the tray for mechanical or fusion splices, with or without splice sleeves.
2. The tray shall incorporate integral fiber tie down clamps, fiber routing rings, provide strain relief and two full 360-degree fiber loops around the tray perimeter with sufficient slack fiber for removal of the tray for access and splicing of the fiber cable. The tray shall insure the minimum bending radius of the optical fibers is not violated.

3. Provide a removable clear plastic tray top cover for each tray, to protect and isolate the fibers.

2.15 WORK STATION OUTLETS

A. General
   1. Engrave outlet cover plates with the port number corresponding to the port number at the respective terminal block, patch panel, or head-end equipment.
   2. The outlet cover plates shall be factory prepunched and formed to accommodate the installed outlet connector with attachment screws.
   3. Workstation outlets shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed specified requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.
   4. Workstation outlets shall be the product of the same Manufacturer.

B. Computer/Data Workstation Copper wire Outlets
   1. The outlets shall be the same configuration and type as the corresponding connector provided in the copper wire patch panel outlet, unless noted otherwise.
   2. ANSI/TIA/EIA-568C, and related Standards, Addendums and TSB.
   3. The copper wire outlet connectors for twisted pair wire connections in computer workstation outlets shall be universal outlet connector RJ-45 type.

C. Telephone/Voice Handset Twisted Pair Wire Connection Work Station Outlets
   1. The copper wire outlet connectors provided in telephone/voice handset outlets, shall be universal outlet connector type, unless noted otherwise, ANSI/TIA/EIA-568C and related Standards, Addendums and TSB.
      a. RJ-45 type
      b. [RJ-11 type]

D. Fiber Optic Workstation Outlets
   1. The fiber optic outlet connectors workstation outlets shall be fiber optic fiber interconnection couplers, installed in universal outlet connectors. Provide one (1) coupler for each fiber connecting to the outlet, but in no case less than the following for each outlet and as shown on the Drawing:
      a. Computer workstation data network two (2) couplers and fiber connectors.
      b. Data network server - four (4) couplers and fiber connectors.
   2. The universal outlet connector housing and cover plates shall be the same as copper wire outlet connectors, except with adapters for fiber optic interconnection couplers, for the fiber optic fibers plug-in connectors.
   3. The centerline-to-centerline spacing of the inter-connection couplers shall provide for "plug-in" insertion of "single or duplex" fiber connectors.
   4. Color-code and identify the "in"-receiving and "out"-transmitting position for each interconnection coupler.

E. Outlet Boxes
   1. General for Low Voltage Outlets Requirements
      a. Shall be UL approved and labeled for Life-Safety Appliances.
      b. UL listed and label for low voltage CEC/NEC class-2 wiring and devices.
c. Shall be adjustable to fit into the wall/ceiling and attach into the wall/ceiling thickness at each install location.
d. Provide cable “Strain-Relief” attachment and “Sharp-Edge” protection for each outlet cable connections.

2. Wall mounted
   a. Flush or surface wall mounted outlet box and size as indicated on the Drawings, but in no case less than 4.69-inches by 4.69-inches by 2.125-inches deep.
   b. Two (2) gang wide extension ring for outlet box to extend outlet flush with finish surface, or as noted on the Drawings.
   c. Two (2) gang wide cover plate, or as noted on the Drawings.

3. Pedestal Mounted "Poke-Thru".
   a. Shall combine a computer/data and a telephone/voice copper wire universal outlet connector in a duplex outlet in the pedestal/poke-thru outlet.

4. Inside flush floor boxes and other locations where indicated in the Contract Documents.

5. Low Voltage Outlets in Fire rated walls and ceilings
   a. Provide metal outlets for low voltage devices installed (recessed into) in fire rated walls or fire rated ceilings.
   b. Provide metal outlet box enclosed type, for each outlet location. Provide UL labeled and listed “Fire-Wrap” complete coverage protection on the exterior of each outlet box. The combined outlet box and “Fire-Wrap” protection shall be equal or greater than the respective wall or ceiling fire-rating location.

6. Low Voltage Outlets in Non-Fire Rated walls and ceilings
   a. Outlets for low voltage devices installed (recessed into) walls or ceilings, only where the wall/ceiling is not fire-rated.
   b. Provide the following for each outlet location
      1) Metal outlet box, enclosed type. All locations where one (1) or more conduit(s) are required to connect to the outlet, then only metal outlet box shall be provided.
      2) Or device mounting bracket with trim ring, without (backless) enclosed outlet box. Do not use bracket-trim/ring configuration where conduit connection to the outlet with conduit is required, provide metal outlet boxes. Shall provide attachment for low voltage device(s), cover plates and low voltage wire strain relief.

7. Low Voltage outlet installed into accessible suspended ceiling with removable ceiling panels.
   a. Support outlet independent of ceiling supports and ceiling.
   b. Provide a minimum of three (3) independent hanger wires for each outlet. Attach hanger wires to building structure above ceiling and to outlet.

8. Low Voltage Outlets in existing walls and existing ceilings
   a. Outlets installed (recessed into) existing walls or (recessed into) existing ceilings. Cut and patch to match existing surfaces for outlet installation.
   b. Provide “cut-in” retrofit mounting-attachment into existing ceiling/wall construction. Shall be UL rated for retrofit into “old-work”.
   c. Provide the following for each outlet location,
      1) Metal outlet box, enclosed type. Required for all Fire rated construction locations. Also permitted for non-Fire rated construction locations.
      2) Or device mounting bracket with trim ring. Permitted only for non-Fire rated construction locations only where no conduit connection
to the outlet is required. Do not use in Fire rated construction locations. Do not use where conduit connection to outlet is required.

d. Where the existing wall/ceiling existing fire rating is indeterminate, Contractor shall assume the existing fire rating is not less than 2-hours. Provide metal outlet box and Fire-Wrap for each recessed outlet box.

F. Multi-outlet Raceway Work Station Outlets
   1. Copper wire outlet:  
      a. Where copper wire connection is indicated for the workstation outlet, provide one universal outlet connector for each outlet.
      b. Each universal outlet connector shall be single connector housing type.
      c. Provide a rectangular cutout and metal device plate in the raceway sized to outlet Manufacturer's recommendations. The workstation copper wire outlet shall mount a modular faceplate kit with outlet bezel and faceplate sized to match the workstation outlet.
      d. Offset the location of outlets for electronic network systems 6-inches in the raceway from other outlets, do not "stack" outlets one above the other in the raceway.
   2. Fiber optic outlet:

G. Combination Outlets
   1. Infrastructure outlet connectors shown at the same location for either wall box outlet locations and floor box outlets locations.
   2. The outlet connectors shall be installed in a common outlet box with a common cover plate in the respective wall location or floor location.
   3. In infrastructure patch panels install the connectors in the respective patch panels.

2.16 PORTABLE PATCH CORDS

A. General
   1. Provide portable patch cords for all copper wire and fiber optic cable infrastructure outlets:
      a. For interconnecting electronic network equipment to electronic network workstation outlets.
      b. For interconnecting equipment rack patch panel outlet patch locations with each other.
      c. For interconnecting patch panel outlets equipment rack mounted hubs, switches, routers, telephone equipment, A/V equipment, access control and intrusion detection equipment etc.
   2. Patch cords shall be factory assembled tested and certified with factory terminated plugs at each end. Field terminated portable patch cords shall not be permitted. Terminated plugs shall incorporate integral bending radius limiting molded “boots” and strain relief. Patch cord assemblies shall be rated for "heavy duty", “high-abuse” service.
   3. Patch cords shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed specified requirements. ANSI/EIA/T1A-568C, related Standards, Addendums and TSB.
      a. NEC - OFNG/OFN for fiber optic portable patch cords.
      b. NEC - MPP/CMP/CMR/CMG/MPG for copper wire twisted pair portable patch cords.
      c. NEC - CATV for coaxial cable portable patch cords.
4. Patch cords which are not installed shall be delivered to the OWNER in cardboard boxes. The patch cords shall be neatly bundled and tied together. Mark each box with quantity and type of cords contained in the box.

5. Patch cords shall comply with the same cable communication performance, requirements, protocol requirements and testing requirements as the respective infrastructure cables and outlets to which the patch cords are intended to be connected (plug-in). Patch cords shall be the product of the same Manufacturer.

6. The outer jacket of each portable patch cord shall be imprinted with date, Manufacturer’s model and catalog number and AHJ listing identification.

7. Provide a permanent, visible, factory applied identification number on each end of each patch cord. The identification number shall be the same on each end. However, the numbers shall increase sequentially on each patch cord and shall be unique and not duplicated on other patch cords. Permanently apply the identification numbers on the cable jacket or connectors.

B. Twisted Pairs, Copper Wire Portable Patch Cords

1. Twisted Pairs portable patch cords, general:
   a. "Male" eight (8) position modular "RJ" male style jacks install on each end of the patch cord cable. The jack shall be provided with a rear "fin" to prevent the plug tab from snagging when pulled backwards through adjacent wiring.
   b. Patch cord cable shall be UTP [or ScTP] and ANSI/EIA-Category rating, shall match respective permise wiring, 4-pair twisted, stranded copper individually insulated wires, thermoplastic jacket over all the wires [and shield].
   c. Connectors shall comply with FCC 68.5 and Part 68 Subpart F.
   d. Connectors UL listed and shall comply with UL-94V-O.
   e. Contacts gold plated with not less than a 750 insertion/withdraw cycle rating.

2. Portable patch cord quantities and lengths for connecting port-to-port equipment rack patch panels
   a. Patch cord quantity: Provide one (1) complete patch cord assembly for each copper wire equipment workstation outlet patch port in the equipment rack patch panels. One-to-one straight through pin-to-pin wiring. Provide additional spare patch cords, quantity equal to 25% of the total quantity of patch cords provided for copper wire computer workstation outlets in the equipment rack patch panels. Cable jacket color shall be blue:
   b. Provide the following lengths of copper wire patch cables for copper wire equipment rack patch panel outlets.
      1) 2-feet long - 10% of total quantity
      2) 4-feet long - 30% of total quantity
      3) 6-feet long - 30% of total quantity
      4) 10-feet long - 20% of total quantity
      5) 16-feet long - 10% of total quantity

3. Portable patch cord quantities and lengths - for connection from equipment workstations to equipment workstation outlets, located remote from equipment racks.
   a. Patch cord quantity: Provide one complete patch cord assembly for each copper wire workstation outlet located remote from the equipment rack patch panels. Provide additional spare patch cords, quantity equal to 15%
of the total quantity of patch cords provided for each copper-wire computer workstation outlets. Cable jacket color shall be blue:

1) Infrastructure network outlet segments the pin-to-pin patch cord wiring configuration and jacks shall be compatible with the equipment protocol communications interface, and the respective workstation outlet.

b. Provide the following lengths of copper wire patch cables for equipment copper wire infrastructure network workstation outlets. The patch cords shall provide internal cross-over wiring to conform the pin-to-pin connections required between the equipment workstation outlet and the equipment protocol communications interface installed in the respective workstation equipment:

- 8-feet long - 30% of total quantity
- 15-feet long - 70% of total quantity

4. Portable patch cord quantities and lengths for connection from electronic equipment rack patch panel ports to equipment installed in equipment racks, such as HUB's, servers, switches, router, telephone and concentrator equipment ports. Cable jacket color shall be white.

a. Patch cord quantity: Provide one complete patch cord assembly for each copper wire outlet port located in electronic equipment. Provide additional spare patch cords, quantity equal to 25% of the total quantity of the equipment rack equipment ports.

- The pin-to-pin patch cord wiring configuration and jacks shall be compatible with the respective equipment and patch panel outlets as applicable.

b. Provide the following lengths of copper wire patch cables for outlet ports located in electronic equipment installed in equipment racks. The patch cords shall provide quantity of conductors, wiring shall conform the pin-to-pin connectors and jack/ connectors to the ports in the equipment mounted in the equipment racks.

- 4-feet long - 15% of total quantity
- 6-feet long - 30% of total quantity
- 10-feet long - 35% of total quantity
- 16-feet long - 20% of total quantity

5. Portable patch cord quantities and lengths for connection of equipment requiring customized pin-to-pin wiring configurations and/or customized port connector configurations. Cable jacket color shall be tan.

a. Patch cord quantity: Provide one complete patch cord assembly for each outlet port install as part of the Contract and not identified in any other patch cord descriptions. The patch cords shall be customized and configured to comply with the respective Manufacturers recommendations.

b. Provide one patch cord for each port-to-port connection length as required for actual installation condition.

- Provide 100% spare but not less than one spare patch cord for each custom configuration.

C. Telephone/Voice Copper Wire Portable Patch Cords-110 style

1. 110 style jacks for plugging into the 110 style connecting blocks located in the telephone/voice terminal blocks.

2. Patch cords shall be UTP 4-pair twisted, 24AWG stranded copper individually insulated wires with a thermoplastic jacket over all the wires. Cable shall be ANSI/TIA/EIA-568C.
3. Patch cord quantity and length - telephone/voice terminal block:
   a. Provide one complete patch cord assembly for each copper wire telephone/voice outlet connecting to the telephone/voice terminal block. Provide additional spare patch cords, quantity equal to 25% of the total quantity of patch cords provided for telephone/voice 110 patch cords.
   b. Provide the following lengths of copper wire patch cables for telephone/voice 110 style connecting block portable patch cords.
      1) 3-feet long - 25% of total
      2) 5-feet long - 50% of total
      3) 15-feet long - 25% of total

D. Coaxial Cable Portable Patch Cords
   1. BNC type connectors on each end of each patch cord. Shall be compatible with patch panel outlets, workstation outlets and respective equipment rack electronic equipment.
   2. Patch cord quantity: Provide two (2) complete patch cord assemblies for each coaxial cable outlet.
      a. One patch cord for workstation outlet located remote from the equipment rack patch panel, 15-feet long each patch cord.
      b. One patch cord for equipment rack (IDF/MDF) patch panel each outlet location, 10-feet long each patch cord.
      c. Provide 15% additional spare patch cords of each patch cord length.

E. Fiber Optic Portable Patch Cords
   1. General
      a. Provide fiber optic fiber connectors installed on each fiber end of the patch cord cable. The fiber optic portable patch cord shall be ["single" with one (1) fiber strand] ["duplex" with two (2) fiber strands] type, for each patch cable. The connector shall be mechanically and optical compatible with the respective connecting patch panel couplers and network work equipment couplers.
      b. The entire patch cord assembly total insertion loss shall be less than 1.0dB at the specified operating wavelengths.
      c. Operating temperature range 30-degrees centigrade through +60 degrees centigrade. Cables shall be flame retarding.
      d. Each fiber shall be individually identified with factory color-coding and factory imprinted label. The outer cable jacket shall be imprinted with date, Manufacturer's model and catalog number, along with agency listing identification. The cable jacket color shall be yellow.
      e. All fiber optic patch cord cable shall be a product of the same Manufacturer.
      f. Optical fiber shall be coated, 900 micron diameter uniform coating, with uniform tight buffering over the coating, uniform dielectric strength member surrounding the buffering coating and an overall jacket around each optical fiber assembly.
      g. A dielectric strength member shall surround the fiber assemblies.
      h. An outer dielectric jacket shall envelope the entire cable.
      i. The cable shall be UL listed and comply with NEC and NFPA requirements for each installation location shown in the Contract Documents.
      j. Patch cord quantity and length
         1) Patch cord quantity: Provide one complete patch cord assembly for each fiber optic patch panel outlet in the equipment rack.
2) Provide one complete patch cord assembly for each computer workstation fiber optic outlet remote from the patch panel.
3) Provide additional spare patch cords, quantity equal to 25% of the total quantity of patch cords provided.

k. Provide the following quantities and lengths of fiber optic patch cords.
   1) 3-feet long - 20% of total
   2) 6-feet long - 35% of total
   3) 10-feet long - 30% of total
   4) 20-feet long - 15% of total

2. Multimode patch cords
   a. Patch cord cable shall be fiber optic cable with equal or better characteristics as the premise fiber optic cables.

2.17 CIRCUIT PROTECTORS

A. General
   1. The circuit protectors shall be UL listed, complying with National Electrical Code, ETL Tested and Certified to comply with or exceed specified requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.

B. Circuit Protectors
   1. Cables containing non-dielectric electrical conducting components entering from the exterior of the building shall be provided with individual circuit protectors combining both lightning circuit protection and TVSS circuit protection on each circuit conducting component, as required in NEC [CEC] Articles 770 and 800.
   2. Install circuit protectors in the respective backboard/equipment rack where copper wire conductors terminate, connect each protector to room/closet ground bus equipment with #10AWG green insulated bond/ground copper conductors.

PART 3 - EXECUTION

3.01 NETWORK CABLE TESTING AND COMMISSIONING (ADDITIONAL REQUIREMENTS)

A. General
   1. In addition to the testing recommended in ANSI/TIA/ EIA-568C and related Standards, Amendments and TSB. End-to-End test 100% of all individual optical fiber, individual copper wire conductors, each outlet and each connector in all terminated and unterminated cables, portable patch cord, outlets and patch panels provided in the Contract, shall be tested after installation as a complete channel pathway installation, splicing outlets and termination is completed, including the following end-to-end tests on each installed individual circuit;
      a. Each circuit wire and fiber map and length
      b. Each circuit insertion Loss
      c. Each circuit NEXT (Pair-to-Pair) Loss
      d. Each circuit NEXT Loss (Power Sum) PS
      e. Each circuit ELFEXT Loss (Pair-to-Pair)
      f. Each circuit ELFEXT Loss (Power Sum) PS
      g. Each circuit return Loss (RL)
      h. Each circuit propagation delay
      i. Each circuit propagation delay-skew
2. The test equipment and (Tester) shall comply with the accuracy requirements for Field Testers as defined in the ANSI/EIA/TIA Standards for the specific cable type. The Tester including the appropriate interface adapter shall meet the specified accuracy requirements. The Tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy. The Tester shall be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The CONTRACTOR shall provide proof that the interface has been calibrated within the period recommended by the Vendor.

3. The Pass or Fail condition for the channel pathway link-under-test is determined by the results of the required individual tests (ANSI/EIA/TIA) Any Fail result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter must Pass. A Pass or Fail result for each parameter is determined by comparing the measured values with the ANSI/EIA/TIA test limits for that parameter. The test result of a parameter shall be marked with an asterisk (*) when the result is closer to the test limit than the accuracy of the field test. The Field Test Equipment Manufacturer shall provide documentation as an aid to interpret results marked with asterisks.


5. Provide six (6) copies of all test reports, bound in three ring binders. Provide three (3) digital CD/DVD ROM copies. Organize test reports into rows-and-columns spread-sheet format, with data common groupings by IDF and NDF location. Submit to Owner’s Representative.

6. The CONTRACTOR shall repair or replace equipment, cables, outlets, connectors, splices, terminations, etc. identified during testing as not complying with the Contract Documents, without additional cost to the Contract. Retest all replaced or repaired components at CONTRACTOR’S expense.

B. Twisted Pair Copper Wire Testing
1. Channel insertion loss (dB).
2. Channel near-end cross-talk NEXT loss (dB).
3. Channel equal-level far-end cross-talk ELFEXT (dB).
4. Channel return loss (dB).
5. Channel power sum PSACR (dB).
6. Channel propagation delay, propagation speed, and delay skew.
7. Channel wire map and circuit length.
8. Channel ring-out test for continuity and correct point-to-point matching terminals.
9. Channel DC resistance and capacitance.
10. Channel attenuation-to-cross-talk ratio ACR.

C. Coaxial Cable Testing
1. Channel full specified frequency spectrum attenuation insertion loss (dB).
2. Channel wire mapping, ring-out and circuit length.
3. Channel propagation delay and propagation speed.
4. Channel impedance and continuity for center conductor and shields.

D. Fiber Optic Cable Testing, Optical Testing for Each Specified Wave-Lengths for Both laser and LED sources.
1. Channel link insertion losses (dB) OLTS.
2. Channel loop-back attenuation (dB).
3. Channel signature Optical Time Domain Reflectometer – OTDR, for installation characterization testing (event and attenuation resolution dead zone at specified wave lengths, shall be less than 10-feet).
4. Channel continuity and correct point-to-point matching terminals.
5. Channel propagation delay and propagation speed.
6. Channel fiber optic mapping, circuit length, and tracing.

3.02 FIBER OPTIC CABLE TYPE

A. General
1. Cables shown as fiber optic type shall comply with the following installation locations.
2. Provide matching compatible outlets and terminate all fiber optic cables into matching fiber optic connectors.
3. Fiber optic cable installed in indoor locations without enclosed raceway or conduit.
   a. Provide non-metallic, flexible corrugated continuous inner duct-raceway and install fiber optic cable in the innerduct.
   b. Innerduct shall be heavy duty, plenum-rated, Limited-Combustible (LC) type UL FHC – 25/50, orange color. Support innerduct 36-inches on center, independent of ceiling supports and independent of other equipment supports.
   c. Innerduct size shall be selected to insure percentage-fill with fiber optic cables shall not exceed 30%, but in no case less than 1.25-inch diameter innerduct.

B. Provide loose tube gel filled or indoor/outdoor type fiber optic cable for any of the following installation location conditions.
1. Inter building (between buildings)
2. In a conduit or raceway located underground below grade.
3. In an exposed outdoor conduit or raceway not located underground or below grade.
4. Do not install loose tube gel filled type fiber optic cable inside a building or exposed on a building without providing Rigid Steel (RGS) conduit raceway for the loose tube gel filled fiber optic cable along the entire length of the cable inside the building or on the building.

C. Provide tight buffered or indoor/outdoor type fiber optic cable for any of the following installation location conditions.
1. Intra-building (inside a building) where raceway continuously encloses the cable and the raceway is not located underground, below grade.
2. In an exposed outdoor conduit or raceway not located underground or below grade.

D. Provide plenum rated type fiber optic cable for any of the following installation location conditions in building spaces.
1. Any building space air plenum (supply or return) when a conduit or enclosing raceway is not provided for the entire cable length. Additionally, Cables shall be rated Limited-Combustible (LC) type UL FHC-25/50.
2. All building space locations where the cable is installed without a conduit or the cable is not fully enclosed in a raceway along the entire cable length in a building. Additionally, Cables shall be rated Limited-Combustible (LC) type UL FHC-25/50.
3. Building spaces and/or cavities that are 100% fully protected with fire sprinklers, including fire sprinklers located above in ceiling cavities and fire sprinklers located below in access floor cavities. Cables installed in these locations shall be rated with one or more of the following additional characteristics.
   a. Limited–Combustible (LC) UL FHC-25/50 plenum rated cable.
   b. Or plenum rated cable without the UL FHC-25/50 Limited-Combustible (LC) rating.

E. Optical Fiber Quantity:
1. The minimum fiber quantities in each fiber optic cable shall be as follows, but in no case less than indicated on the Drawings.
2. Between main IDF (SUB-MDF) in separate buildings and the MDF main terminal rack fiber optic patch bay for the entire site/campus.
   a. Twenty-four (24) optical fibers, multimode plus six (6) optical fibers, single mode.
3. Between satellite IDF terminal rack fiber optic patch bays and the main terminal rack IDF (sub-MDF) patch bay located in the same building.
   a. Twenty-Four (24) optical fibers, multimode plus six (6) optical fibers, single mode.
4. Between a terminal rack patch bays (IDF or MDF):
   a. To an individual workstation outlet located inside the same building - two (2) multimode optical fibers, (typical only for locations where fiber is specifically shown on the Drawings for the specific work station outlet).
   b. To each network file server outlet location whether or not shown on the Drawings, four (4) optical fiber, and multimode.
5. Between a terminal rack patch bay and individual multimedia network (television/video/audio) workstation outlets and/or intrusion/access program display devices located inside the same building - two (2) optical fibers, multimode.
6. Other locations as indicated on the Drawings or described in the Contract Documents.

3.03 COPPER WIRE CABLE TYPE

A. General
1. Cables shown as copper wire type shall comply with the following installation conditions, unless noted otherwise on the Drawings.
2. Provide matching compatible outlets and terminate all copper wire cables into matching copper wire connectors.

B. Cable Types and Quantities - Cable types and quantities shall be as follows unless specifically noted otherwise on the Drawings. The following minimum type and quantity of copper wire cables from each individual workstation/device outlet, to the respective terminal equipment patch panel/bay, (unless specifically noted otherwise), but in no case less than what is shown on the Drawings and in no case less than one (1) 4-pair cable to each outlet “Jack” position:
1. Two (2) Category-6A, UTP 4-pair cable:
   a. Each network workstation outlet location.
   b. Each network “wireless-access-point” outlet location.
2. One (1) Category-6A UTP 4-pair cable, for each telephone handset (instrument) workstation outlet location.
3. Trunking-Cables shall be Category-5E.
   a. 100-pair between buildings main IDF (SUB-MDF) and campus main MDF.
   b. 50-pair inside building between SUB-IDF to buildings main IDF (SUB-MDF).

8. Other locations as indicated on the Drawings or described in Contract Documents.

C. Provide plenum rated copper wire cable for any of the following installation location conditions in building spaces.
   1. Any air plenum (supply or return) when a conduit or enclosed raceway is not provided for the entire cable length. Additionally, cables shall be rated Limited-Combustible (LC) type UL FHC-25/50.
   2. All building space locations where the cable is installed without a conduit or the cable is not fully enclosed in a raceway along the entire cable length in the building. Additionally, cables shall be rated Limited-Combustible (LC) type UL FHC-25/50.
   3. Building spaces and/or cavities that are 100% fully protected with fire sprinklers, including fire sprinklers located above in ceiling cavities and fire sprinklers located below in access floor cavities. Cables installed in these locations shall be rated with one or more of the following additional characteristics.
      a. Limited–Combustible (LC) UL FHC-25/50 plenum rated cable.
      b. Or plenum rated cable without the UL FHC-25/50 Limited-Combustible (LC) rating.

D. OSP Insulated Copper Wire Cables
   1. Outside – Plant (OSP) CEC/NEC rated, UL listed, labeled and approved insulated copper wire cable assemblies. Moisture barrier resistant and UV resistant cable jacket. Non-flammable, water blocking, non-conductive gel internally filled infrastructure cable assembly.
   2. Provide rated insulated copper wire OSP type cable for any of the following copper wire infrastructure cable install locations.
      a. In underground conduit or in conduit under the building.
      b. In conduit exterior to the building, or in conduit exposed outdoor on the building.
      c. Outdoor aerial with aerial messenger wire cable carrier.
   3. Except for aerial install locations, install all OSP cable in continuous conduit pathways, end-to-end.

3.04 CABLE INSTALLATION

A. General
   1. Cables connecting to equipment racks and terminal blocks shall be installed with not less than 6-feet of slack cable between the equipment rack/terminal block and terminal backboard. The slack cable shall be coiled and supported on the backboard and/or cable tray.
   2. Cables in terminal closets and terminal rooms shall be trained, dressed and racked on the plywood backboards. Provide cable, metal support arms and re-enterable type cable support rings not less than 12-inches on center mounted onto the plywood along the entire length of all cables.
   3. Provide separate routing paths on plywood backboards for fiber optic cables, computer data and copper wire cables and telephone/voice copper wire cables and multimedia, audio/video, TV cables. Provide separate routing paths on
plywood backboards for shielded copper wire cables and unshielded copper wire cables.

4. Cables shall be routed parallel to floors and walls. Do not route cables diagonally on backboards.

5. Spare cable slack
   a. Provide 25-feet of cable slack where unterminated cables are specified at terminal backboards.
   b. Provide a minimum of 18-inches of slack cable in each workstation outlet box and outlet locations.
   c. Provide 10-feet of cable slack in ceiling above each work station outlet.
   d. Provide 24-inches of slack in each cable at patch panel locations.
   e. Coil and "Velcro" wrap slack cable.

6. Provide "horizontal wiring" cables installed from individual equipment locations and workstation outlets to respective MDF/IDF terminal closet/room patch panel. Cables shall be continuous without cutting or splices.

7. Provide "backbone" cables installed from each IDF location to respective MDF/Sub-MDF location terminal closet/room patch panels. Cables shall be continuous without cutting or splices.

B. Cable Pulling Lubrication

1. Cable pulling lubricants shall be specifically approved by the Cable Manufacturer. The following lubricants shall be used where approved by the Cable Manufacturer.
   a. Slip X -300, American Colloid Co.
   b. Bishop #45, Bishop Electric.
   c. MacLube CA51, MacProducts.
   d. Minerallac H2B,- Minerallac Electric.
   e. Winter grade #7437-PC, General Machine Products.
   f. Gel-lube 7/5, Cable associates.

2. Lubricants shall be continuously applied as cable enters raceway.

C. Cable Installation:

1. Do not pull conductors until factory test reports have been submitted and reviewed.

2. Minimum bending radius of fiber optic cables shall not be less than the following. Maximum pulling tension shall not exceed the following. In no case shall the Manufacturer's recommendations be violated.

<table>
<thead>
<tr>
<th>Cable Type</th>
<th>Cable Fiber</th>
<th>Minimum Bend Radius</th>
<th>Maximum Pulling Tension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loose Tube</td>
<td>2-84</td>
<td>9 inches</td>
<td>600 pounds</td>
</tr>
<tr>
<td>Loose Tube</td>
<td>86-192</td>
<td>10 inches</td>
<td>600 pounds</td>
</tr>
<tr>
<td>Tight Buffered</td>
<td>2-12</td>
<td>5 inches</td>
<td>400 pounds</td>
</tr>
<tr>
<td>Tight Buffered</td>
<td>14-24</td>
<td>7 inches</td>
<td>600 pounds</td>
</tr>
<tr>
<td>Tight Buffered</td>
<td>26-28</td>
<td>11 inches</td>
<td>1100 pounds</td>
</tr>
<tr>
<td>Tight Buffered</td>
<td>48-72</td>
<td>12 inches</td>
<td>1200 pounds</td>
</tr>
</tbody>
</table>

3. The minimum bending radius for copper wire cables shall be 10 times the cable outside diameter. The maximum pulling tension and minimum bending radius shall not violate Manufacturer's recommendations.

4. Cables installed in manholes and pullboxes on terminal backboards shall be installed on wall mounted cable support racks.

5. Provide a full 360-degree loop of cable around manhole and pullbox interiors.
6. The attachment of pulling devices directly to the cables shall be with individual split mesh basket grips. Direct connection for pulling cables to cable fibers and copper wires shall not occur. Securely tape cable ends to prevent moisture or pulling compound from penetrating cable.

7. The attachment of the pulling device to the cable basket grips shall be made through a swivel connector.

8. The Contractor shall ensure that the cables are fed straight into the raceway taking care to avoid short bends, sharp edges and cable "cross-overs".

9. All lashings used for temporary bunching of the individual cables shall be removed before the cables enter the raceway.

10. Cables shall be "pulled through" or pulled from a "center of run pull" without splices or terminations and minimize cable rolling tension. Lead-out the cables at all manholes, pullboxes and conduits taking care to feed them in again by hand for the next portion of the cable run.

11. For each cable pull where a cable direction change is required, flexible feed-in tubes, pullout devices, multi-segmented sheaves etc. shall be used to insure proper cable pulling tensions and side wall pressures. Cables shall not be pulled directly around a short right angle bend. Any device or surface the cable comes in contact with when under pull-in tension shall have a minimum radius 50% greater than the final specified minimum installed cable bending radius. The maximum possible size radius sheaves and feed-in tubes, usable in the available working space, shall be provided in all situations, to insure the minimum possible cable side-wall pulling pressure. Do not use devices with multi-segment "roller" type sheaves.

12. Cable lengths over 50 feet shall be machine pulled not hand pulled into and through all raceways. Cables shall be pulled in a continuous, smooth operation without jerking or stop-start motion after initiation of pull. Maximum cable pulling speed shall be less than 50 feet per minute. Minimum cable pulling speed shall be greater than 15 feet per minute.

13. Cables shall be pulled straight into or out of the raceway without bends at the raceway entrance or exit. Pull in cable from the end having the sharpest bend (i.e., bend shall be closest to reel). Keep pulling tension to minimum by liberal use of lubricant, hand turning of reel, and slack feeding of cable into duct entrance. Employ not less than one man at reel and one at manhole or pull-hole during this operation. Cables shall be pulled directly from cable reels.

14. Cables shall be trained or racked in trenches, vaults, manholes and pull boxes with consideration given for the minimum specified bending radius of the cable and the possibility of cable movements due to load cycling. The cables shall be racked and supported in such a manner that adequate space is allowed for splicing and the cables shall always be fanned out from the duct or conduit so as not to cross other ducts, conduits or cables. To prevent damage from falling objects or personnel entering the manhole the cables shall not pass directly under the manhole opening.

15. Cable shall be supported in manholes, pull boxes and vaults a minimum of 18-inch on center with cable racks. Provide hot dip galvanized, T-slot racks and support arms. Secure cables to racks with porcelain supports for each cable on the racks. Loosely lash cables to racks. Splices shall be directly supported, on racks. Do not install cables more than one (1) feeder on the same rack hook.

16. Cables shall be routed the long way around manhole, pull-hole, etc. with not less than a full 360-degree loop around the perimeter walls unless noted otherwise.
17. Existing conductors shall be protected at all times when Contract work occurs in the same area, including but not limited to pullboxes, vaults manholes, cable trenches etc. Provide temporary electrical insulating blankets and barriers over existing conductors to reduce the possibility of accidental mechanical damage to existing conductors.

18. Where cable tray is provided, all cables shall be routed and trained on the cable tray. The cables shall enter the cable tray and route along the tray prior to entering any equipment racks or computer works station outlets.

19. A dynamometer to measure pulling tension shall be used on all cable runs in excess 200-feet or with more than 180 degrees in bends. The actual pulling tension value shall be calculated and recorded for each pull.

20. Bends shall not be made in cable splices or terminations.

21. The portions of cables installed without raceways or cable tray supports shall be installed with metal “J-hook” cable supports.
   a. The “J-hooks” shall provide multi-tiered “J” shaped hooks, with wide flat cable support base (0.5 inch wide minimum) and smooth rounded corners. Specifically designed for copper wire and fiber optic infrastructure cable support as manufactured by Erico Inc.
   b. The individual “J-hook” attachment to the building structure shall be metal, “beam clamp”, “hanger rod”, clevis hanger styles as applicable for each attachment location.
   c. Install “J-hooks” not more than 48-inches on center along the entire cable length and within 6 inches of each cable change in direction. Locations of “J-Hooks” and tension of cables shall insure between 4-inches and 6-inches of cable sag between adjacent hooks. Secure cables to “J-hooks” with re-enterable cable tie wraps. “J-hook” supported cables, bundle cables together with re-enterable tie wraps not less than 12 inches on center along the entire cable length.
   d. Each J-hook shall not support more than 12 individual cables. Provide multiple “tiered” J-hooks for additional cable quantities at each location.
   e. “Bridle rings” shall NOT be used to support cables.
   f. Cables shall not lay directly on nor attach to ceilings, ceiling hangers, lighting fixtures, air ducts, piping, or equipment.

22. Re-enterable cable tie wraps shall be, “limited-combustible” and air plenum rated, reusable, colorcoded. Chemically and mechanically compatible with the respective cables and install locations. Shall allow multiple open-close operations for securing cables.

23. Electronic network cables containing non-dielectric components shall be installed with a minimum separation from other electrical power conductors and equipment as follows:

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Minimum Separation</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Lighting fixtures</td>
<td>12 inches</td>
</tr>
<tr>
<td>b. Electric motors, electric solenoids, electric Heaters</td>
<td>40 inches</td>
</tr>
<tr>
<td>c. Transformers</td>
<td>48 inches</td>
</tr>
<tr>
<td>d. Circuits over 100 volts to ground, in metallic raceways</td>
<td>5 inches</td>
</tr>
<tr>
<td>e. Circuits over 100 volts to ground, in non-metallic raceway or without any raceway</td>
<td>12 inches</td>
</tr>
<tr>
<td>f. Circuits over 100 volts to ground, suspended on overhead pole lines</td>
<td>48 inches</td>
</tr>
</tbody>
</table>

D. Movement, Storage, and Handling of Cable:
1. Reels of cable shall not be dropped from any height, from trucks or other transporting equipment.
2. Lift and move cable reels using following methods:
   a. Crane or boom type equipment-insert shaft (heavy rod or pipe) through reel hubs and lift with slings on shaft, with spreader or yoke to reduce or avoid sling pressure against reel head.
   b. Forklift type of equipment may be used to move smaller, narrower width reels. Fork tines should be placed so that lift pressure is on reel heads, not on cable, and shall reach all the way across reels so lift is against both reel heads.
   c. Reels may be moved short distances by rolling. Reels shall be rolled in the direction indicated by arrows painted on reel heads. Surfaces over which the reels are to be rolled shall be solid clear of debris, and also clear of protruding stones, humps, etc. which might damage the cable if the reel straddles them.

3. Storage of reels of cable:
   a. Cable ends shall be sealed prior to shipment to prevent moisture entry into cable. Cable ends shall remain sealed at all times including during installation. Where ends seals are removed, reseal cable ends by stripping cable finishes back 2-inches down to insulation. Then apply four layers of an insulating tape criss-cross over the cable end and carry back at least 4-inches onto cable outer finish. Add a containing cover of two layers of vinyl electrical tape completely over the end seal.
   b. Cable reels shall be shipped with factory applied lagging (protective cover) left in place until removal is absolutely necessary. Additional covering such as tarpaulin, plastic sheeting, etc. shall be used if cable is to be stored outdoors.
   c. Store reels of cable on a firm surface, paved, or on planking to prevent settling into soft ground.
   d. Use fencing or other barriers to protect cables and reels against damage by vehicles or other equipment moving about in the storage area.

3.05 CABLE SPLICES

A. General
   1. Splice(s) in cables shall occur only in the following locations:
      a. Pullboxes or manholes.
      b. Terminal backboard, closets or rooms.
      c. Equipment racks.
      d. Wall mounted interface cabinet.
      e. Do not splice cables in conduit, cable tray, raceways or plenums.
   2. Polarity and color-coding shall be maintained consistent through splices, terminations and outlets for the entire electronic network system.
   3. Cable splices in outdoor areas, manholes, pullholes shall be water tight, inside universal splice enclosures.

B. Fiber optic cable splices unless specifically indicated otherwise below, fiber optic cable splices between fiber optic cables fibers shall be fusion type splices.
   1. Splices between loose tube gel filled fiber optic cable fibers shall be fusion type splices.
   2. Splices between indoor/outdoor fiber optic cable fibers shall be fusion type.
   3. "Pigtail" splices of tight buffered and indoor/outdoor fiber optic cable fibers to loose tube gel filled cables shall be fusion type splice.
   4. Splices between tight buffered fiber optic cable fibers to indoor/outdoor fiber optic cables shall be fusion type splice or mechanical type splice.
5. Splices between tight buffered fiber optic cable fibers shall be mechanical type splice or fusion type splice.
6. "Pigtail" splices of tight buffered fiber optic cable fibers to tight buffered fiber optic cable fibers shall be mechanical type splice or fusion type splice.
7. Fiber optic splices shall be performed to maintain the data transmission rates specified for the entire respective system.

C. Copper Wire Splice
1. Copper wire extending from infrastructure workstation outlets to respective equipment rack patch panel outlets shall not be cut or broken and shall be continuous end to end.
2. Copper wire extending from telephone/voice workstation outlets to respective terminal blocks shall not be cut or broken and shall be continuous end to end.
3. Continuity of cable shields (where occurs), polarity and color coding shall be maintained across all splices.
4. Copper wire splices shall be performed to maintain the data transmission rates specified for the entire respective system.

3.06 CABLE TERMINATIONS

A. General
1. Infrastructure workstation outlets connecting to ports in patch panels [and terminal blocks] shall be grouped together in the patch panel [and terminal block] by outlet function, room location and building area location (i.e. Group #1 Room #120 1st floor; Group #2 Room #200 east wing, etc.). Each group shall be identified with engraved (etched) nameplates indicating grouping identification and individual port numbers.
2. Polarity and color coding of cable connections at splices, terminations and outlets shall be consistently maintained throughout the entire electronic network system.
3. Terminate all cables onto respective outlets connectors, interconnection couplers and terminals. Terminations shall comply with Manufacturer's recommendations, ANSI/TIA/EIA-568C related standards, amendments and TSB.
4. Fiber optic cable fiber strands and copper wire cable conductors terminated at outlet locations shall be connected with a strain relief device attached to the cable jacket to prevent cable tension from being transmitted to the termination connectors.
5. Cable terminations shall be performed to maintain the data transmission rates specified for respective entire system.

B. Fiber Optic Terminations
1. Individual fiber optic fibers shall each be terminated with a fiber optic fiber connector. The connector for each fiber shall be "plugged" into separate fiber optic fiber interconnection couplers on the rear of each respective outlet.
2. Each fiber optic termination ferrule shall be inspected, after completion of the termination, visually with a fiber optic inspection microscope and an interferometer, to insure fiber “undercut”, “protruding” fiber, over polish and under polish of fiber termination ends does not exist in the finished termination ferrule.
3. Fiber optic cables terminated between two fiber optic patch panels located in separate equipment racks. The fibers shall be paired together (Duplex-Pair) for purposes of identification and connection transmit/ receive pair. Each pair of
connectors for fibers shall be "plugged" into separate, physically adjacent fiber optic fiber duplex-pair interconnection couplers at each patch panel. The horizontal/vertical arrangement of paired patch panel fiber couplers shall match at both ends of the fiber cable.

4. Fiber optic cable fiber strands terminated at patch panels shall be installed with a minimum of 540 degrees of each fiber strand looped around the splice tray individual fiber "training" rings.

5. Fiber optic cable connecting from infrastructure workstation outlet to a fiber optic patch panel.
   a. The connectors for fibers shall be "plugged" into separate, physically adjacent fiber optic fiber interconnection couplers.
   b. The patch panel coupler shall be color coded to identify the polarity of the transmitting and receiving optical fibers.

6. Fiber optic cable connections at workstation outlets.
   a. The connectors for fibers shall be "plugged" into separate physically adjacent fiber optic fiber interconnection couplers in the outlet.

C. Copper Wire Terminations
   1. Where occurs, the shield on metal shielded copper wire shall be terminated and connected to the shield grounding connection at each termination point.
   2. Twisted wire pairs shall not be untwisted for a length of more than 0.4-inch at any location and the cable jacket shall not be stripped back not more than 0.5 inch any location including splices and terminations.
   3. Unless specifically directed otherwise by the Owner's Representative, Pin assignment for wiring terminations shall comply with ANSI/TIA/EIA-568C type T568A or Type T568B as required for compatibility with the electronic network equipment. The termination type shall be consistent throughout the project Contract area.
   4. Copper wire termination's shall be performed to maintain the transmission rates specified for the respective entire system.

3.07 EQUIPMENT RACKS

A. General
   1. Install, assemble, mount and connect devices and equipment in the respective equipment racks, bolted securely to the rack frame with stainless steel hardware. "Star" style lock washers shall be provided to insure an electrically continuous ground path between the equipment/devices and rack frames.
   2. Provide blank metal filler panels to close unused equipment "front" mounting space in equipment racks, Manufacturer's standard finish color.
   3. Provide a copper wire outlet connector in the respective equipment rack for each remote copper wire infrastructure workstation outlet and copper wire cable shown connected to the respective equipment rack, plus the spare copper wire outlet connectors required in the Contract Documents. The copper wire outlet connectors in the equipment racks shall be provided in equipment rack mounted copper wire patch panels. In no case shall the quantity of equipment rack mounted copper wire outlet connectors be less than the quantity of cables indicated on the Drawings, plus required spaces/spares.
   4. Provide fiber optic fiber connectors and fiber optic fiber interconnection couplers in the respective equipment rack for each remote fiber optic infrastructure workstation outlet, and fiber optics cable fiber shown connected to the respective equipment rack, plus the spare fiber optic fiber connectors required in the Contract Documents. The fiber optic fiber connectors and fiber
optic fiber interconnection couplers in the equipment racks shall be provided in
equipment rack mounted fiber optic fiber distribution enclosures (RTDE). In no
case shall the quantity of equipment rack mounted fiber optic fiber connectors
and fiber optic fiber interconnection couplers be less than the quantity of cables
indicated on the Drawings, plus required spaces /spares.

5. Fiber optics cable fibers specifically shown as non-terminated "splicing-thru" in
the equipment rack shall route through fiber optic splice only enclosures
(RMSE), mounted in the respective equipment rack.

6. The maximum quantity of cable terminations, in each equipment rack mounted
patch panels shall not exceed the following. To insure not less than 50% of the
rack space remains available for equipment installation:
   a. 100% copper wire outlet connectors, 196 maximum per rack.
   b. 100% fiber optic fiber terminations, 144 maximum per rack.
   c. Combination of copper wire outlet connectors and fiber optic fiber
terminations in the same rack; 48 maximum fiber optic fibers plus 144
maximum copper wire outlet connectors per rack. 18 maximum fiber plus
48 maximum copper wire in 30 inches high.
   d. In addition to the quantity of patch panel outlets for termination of incoming
and outgoing cables, provide not less than an additional 15% of patch
panel spare outlets of each type, in each equipment rack for future use.

7. Provide additional equipment racks, quantity of racks to ensure the maximum
specified quantity of terminations in single rack are not exceeded and the
quantity of cable terminations complies with the requirements of the Contract
Documents.

8. Terminal racks, equipment locations, patch panels, and cross connects shall be
arranged to allow for natural cabling progression, minimize crossing of cables
and allow easy access to each system component.

9. Equipment Rack Anchorage:
   a. Equipment racks installed on raised "access floor" systems, shall be
supported and anchored with bolts that extend into the "structural" floor
located below the "access floor".
   b. Securely anchor the support arms of swing gate racks to the wall structural
support system.
   c. Securely anchor fixed support base of the racks to the floor.
   d. Mounting method shall support the total rack weight including installed
equipment, but in no case less than 500 pounds with a 2.0 times safety
factor.
   e. Attachments and anchorages shall comply with the requirements for
earthquake seismic rating at the install location.

10. Unless specifically noted, otherwise provide the following equipment rack
types:
   a. Floor standing equipment racks containing patch panel locations,
computer/data network HUBS/ switches and computer data network
concentrators, shall be Swing Gate style equipment racks.
   b. Floor standing equipment racks containing multimedia, audio/video, TV
head end equipment, shall be Metal Enclosed equipment racks.
   c. Wall mounted external to dedicated IDF/MDF terminal rooms/closets (i.e.
inside individual classrooms), shall be Mini-Equipment racks.

11. Install ground bus, PDU/TVSS, cable management rings, equipment, patch
panel and patch panel outlets, etc. in equipment racks.

12. Equipment rack terminology:
   a. The location containing the main campus equipment rack location shall be
identified as the Main Distribution Frame – (MDF).
b. The locations remote from the MDF containing satellite equipment racks shall be identified as Intermediate Distribution Frames (IDF).

c. A individual building located on a multi-building campus site with multiple equipment rack locations in the building, the building main rack location shall be identified as Sub-MDF (or building MDF) and the remaining equipment rack locations in the building shall be identified as IDF.

B. Swing Gate Racks

1. Position the swing gate rack frame to provide a minimum of 30-inches clear space behind the moveable swing gate, for deep recess rack mounted equipment enclosure clearance. 42-inches in front of each rack to allow space for swing-gate 90-degree open position and still allow personnel passage way with the swing gate open. Not closer than 30-inches from rack frame to side-adjacent walls, to allow rack to swing full open with installed equipment.

2. All incoming cables shall enter from the back of the rack. The cables shall cross the hinge side of the rack with sufficient cable slack to allow opening and closing of the swing gate.

3. Provide unobstructed open-close operation clearances of the moveable swing gate. Do not install the edge of the rack closer than 30 inches to an intersecting perpendicular surface or wall.

4. The bottom of the moveable swing gate frame shall be approximately 6-inches above the finish floor.

5. Multiple swing gate equipment racks installed adjacent to each other along a common backboard/wall shall be spaced not less than 44-inches center line to center line and to insure the rack-gate can swing open a full 90-degree Arc with 24-inches deep rack mount equipment enclosures. Adjacent equipment rack with side-by-side hinges on the same side of the rack (left-right) may reduce the edge-to-edge rack side by side spacing to 6-inches for the respective combined two rack location.

6. The fixed non-moving bottom of the rack shall be securely anchored to floor.

C. Floor Standing Equipment Racks

1. General:
   a. Securely anchor racks to floor.
   b. All incoming cables shall enter through the top or bottom of the racks.
   c. The front of the racks shall maintain a minimum of 42-inches of clear working space.
   d. Multiple floor standing racks shall be installed directly adjacent to each other (i.e. side by side), with not less than 6-inches (edge-to-edge) space between adjacent racks.
   e. Cables entering racks shall enter into the top of the rack from overhead cable tray, or from wall along wall support arms to rack.

2. Floor standing metal enclosed equipment racks:
   a. The rear of the rack shall maintain a minimum of 36 inches clear working space.
   b. Provide a minimum spacing between adjacent (edge-to-edge) racks of not less than 6-inches.

3. Floor standing open (non-swing gate) equipment racks.
   a. The rear of the rack shall maintain a minimum of 54-inches clear working space behind the rack frame rails for adequate installation depth of HUBS/switches equipment, for "walk" behind access to equipment and for cable terminations access.
b. Provide a minimum spacing between (edge-to-edge) racks of not less than 6-inches.

4. Floor standing modular frame equipment racks:
   a. The rear of the racks shall abut against the wall, or as shown on the Drawing.

3.08 TELEPHONE/VOICE TERMINAL BLOCKS

A. The telephone/voice terminal blocks shall be assembled in vertical sections, for wall mounting. Install adjacent vertical sections with not less than 8-inch blank space between sections, for cable training space.

B. Install terminal blocks on plywood terminal backboard with #8 x 1-inch wood screws. Minimum 6-inches on center, along each side of each terminal block.

C. Terminal block wire pair capacity:
   1. The minimum wire termination capacity shall not be less than 600 [900, 1200] pairs of telephone/voice conductors, at any telephone/voice terminal block.
   2. The quantity of wire pair terminations provided at each terminal block shall be based on the following formula. However, under no case shall any terminal block wire pair capacity be less than the specified minimum.
      \[ \text{Total quantity of telephone/voice feeder copper wire pairs connected to the terminal board} = QFP \]
      \[ \text{Total quantity of telephone/voice outlets connected to terminal board} - QTO \]
      \[ (QFP) \times (QTO \times 4) + \text{(specified spares)} = \text{Minimum terminal block pair capacity}. \]

3.09 MDF AND IDF CIRCUIT TERMINAL ROOMS AND CLOSETS

A. Terminal Backboard
   1. A ¾-inch thick marine "A-C" grade plywood backboard shall fully cover each wall of terminal closets and terminal rooms, including all MDF and IDF rooms/closets. Provide backboard on the wall for equipment racks, incoming cable raceways and terminal blocks. Plywood shall extend continuous from the finish floor to 8-feet above the finish floor on all walls. "A" side of plywood shall be exposed.
   2. Attach plywood to wall structural framing with mechanical fasteners a minimum 6-inches on center vertically on walls at each framing vertical member, and along the length of the wall, but not less than 16 inches on center horizontally along the length of the wall.
   3. Paint plywood terminal backboards after installation and prior to mounting any equipment. One (1) coat of wood paint fire resistant primer and two (2) coats of fire resistant/intumescent, non-conductive finish coats of paint. Finish color matt/flat white, acrylic enamel fire resistant/retardant latex paint.

B. Cable Tray
   1. Locations with equipment racks, and/or terminal blocks are installed in the same room/closet (MDF or IDF).
      a. Provide a horizontal cable tray above the equipment racks and terminal blocks in each circuit terminal room and closet.
      b. Provide a horizontal cable tray continuous "loop" around the perimeter inside each MDF and IDF room, within 12-inches of the ceiling. Parallel with and adjacent to all walls in the room.
   2. Ladder type cable tray 18 inches wide by 6 inches deep; length-end wall to end wall, of the closet or room.
3. Install the cable tray centered above all equipment racks, and around the room perimeter at ceiling/walls [and terminal blocks] with ceiling and wall suspension system. Install trays not more than 36-inches above and not less than 12-inches above the top of the equipment racks.

4. Where multiple segments of cable trays occur in terminal closets and rooms, provide interconnecting cable trays between each segment located in the respective room/closet.

C. Conductor Training and Support
1. Provide conductor/cable training and racking support distribution rings installed on backboards. As manufactured by Newton 3042 series, Saunders or equal.

2. Support rings shall be spaced a minimum of 10-inches on center along all cable/conductor routing paths on backboards and within 4-inches of each change in cable/conductor direction.

3. The capacity of support rings shall be equal to the weight and quantity of conductors/cables passing through the respective support ring plus 100% spare capacity for installation future conductors/cables. In no case shall support rings be smaller than 3 inches.

4. Attach support rings to backboards with not less than two (2) 3/8-inch diameter by 1⅛-inch long threaded wood anchor bolts for each individual bracket.

D. Environment Space Monitoring (MDF and IDF)
1. In each room/closet provide one (1) automatic environmental monitor. Self-calibrating, simultaneous monitoring and software programmable, with alarm set points. Shall measure and monitor ambient conditions and provide data-logging for conditions in the space for the following:
   a. One (1) ambient temperature port and plug-in indoor sensor.
   b. One (1) ambient humidity port and plug-in indoor sensor.
   c. One (1) spare plug-in port for an external digital sensor.

2. Digital Fast Ethernet LAN RJ-45 communications port, with alarm alerting and communications software for remote monitoring of the ambient conditions via the LAN. Multi-user site wide software license, compatible with PC-computer and IP-WEB HTTP remote operations.

3. Local internal audio and visual alert annunciators, with local silence and reset.

4. 120 volt, 60Hz AC input power supply operation. Equipment rack mount self-contained unit housing configuration. Provide all interconnect cabling and connectors.

5. Provide the environmental unit in one of the equipment racks located in each of the respective spaces.

6. As manufactured by Avtech-Room Alert; or SensaTronic-Environmental Systems; or IT Watch Dog-Climate Monitors.

3.10 GROUND (ADDITIONAL REQUIREMENTS)

A. Electronic Equipment MDF, IDF and Terminal Rooms and Closets
1. Terminal Equipment Ground Bus (TEGB) - Provide a wall mounted TEGB ground bus in each MDF location. Also provide a TEGB where two or more equipment racks and/or terminal blocks are provided in each IDF. The TEGB ground bus shall be copper ¼-inch by 2-inches (nominal) by 12-inches long (minimum). Install the TEGB on the wall with a minimum of two (2) "stand-off" electrical insulators. Drill and tap the ground bus and provide bolted type ground lugs for connection of each ground conductors size #10AWG - #1AWG. Provide (4) spare unused ground lugs on the TEGB.
2. Provide 1.25-inch conduit with 1#1AWG copper insulated ground conductor from the TEGB homerun to the building main ground reference bus. Provide 1.25-inch conduit with 1#1AWG copper insulated ground conductor from the TEGB homerun to the nearest building main structural steel member and to the nearest metal cold water pipe larger than 0.6-inch diameter pipe.
   a. Provide the same ground connections from the equipment rack ground bus where only a single equipment rack occurs in the IDF location.

3. The ground conductor required from the TEGB to the building main ground reference bus may be looped and connected between separate TEGB ground bus locations if all of the following conditions are met.
   a. The ground conductor is increased to 1.5-inch conduit with 1#2/0AWG copper insulated and the total end to end length does not exceed 300-feet.
   b. The building exceeds two (2) floors in height.
   c. Not more than four (4) TEGB buses are connected to the same "looped" ground conductor.
   d. The TEGB ground conductor is continuous (not cut, spliced or broken) along its entire length.
   e. The TEGB ground conductor is connected to the TEGB ground buses with a UL listed "Exothermic" welding process.

B. Equipment Racks:
1. Provide a separate 12AWG copper stranded green insulated ground conductor from each individual equipment element in the rack to the respective rack ground bus.
2. Provide a separate #8AWG copper insulated ground conductor from each equipment rack ground bus to the TEGB terminal equipment ground bus located in the same space.
3. Where only one equipment rack is installed, provide 1.25-inch conduit with 1#1AWG copper insulated ground homerun conductor from the equipment rack ground bus homerun to the building main ground reference bus and provide 1.25-inch conduit with 1#1AWG copper insulated ground conductor from the TEGB or single equipment rack ground bus (as applicable), to the nearest building main structural steel member and to the nearest metal cold water pipe larger than 0.6-inch diameter pipe.
4. Provide 1.25-inch conduit with 1#4AWG copper insulated ground conductor from each wall mounted fiber interface cabinet to the respective TEGB ground buses.
5. Provide a 1#10AWG copper insulated ground conductor connecting in a continuous loop to all miscellaneous cable trays and metal support equipment located in the terminal closet or room and connect to the TEGB ground bus.

C. Telephone/Voice Terminal Blocks:
1. Provide a separate #8 copper insulated ground conductor from each terminal block section ground bus to the TEGB terminal equipment ground bus.
2. Provide a separate #6 copper insulated ground conductor from the terminal room/closet to the lightning ground system.

3.11 WALL MOUNTED FIBER INTERFACE CABINET - WMIC
3.12 IDENTIFICATION (ADDITIONAL REQUIREMENTS)

A. General
1. Fiber optic and copper wire cables shall be identified in each manhole, pull box, equipment rack, patch panel and computer workstation outlets.
2. Infrastructure documentation, identification labels and color coding shall comply with ANSI/TIA/EIA-606A Administration Standard for Telecommunications Infrastructures, Class-1 thru Class-4. Provide management software MS-Windows-based single user license, with all as-built data entry documentation information complete.

B. Identification tags shall include the following information:
1. Cable name as indicated on Drawings (i.e., HV1, F4, MSB3 etc.).
2. Installation month and date (i.e., 3/92, 4/78 etc.).
3. Conductor size conductor type (i.e., loose tube fiber; #24AWG ScTP Category 5, 200-pair, telephone/voice etc.).
4. Feeder taps to equipment or building shall also be identified with equipment name or building (i.e. library, SW1, Rack #21, etc.)

C. Identification Tags
1. Tags shall be ⅛-inch thick 98% lead, approximately 2-inch square with chamfered corners. Two (2) holes shall be drilled for attachment to primary cable. Lettering shall be ⅛-inch high, engraved or die stamped. Attach tags to primary cables with two (2) #14AWG (THWN insulated) solid copper conductors "twist-tied", with insulated CAP wire-nut on the tie-wire ends, to cover sharp edges of tie-wire conductor.
2. Alternate identification tags, at the CONTRACTOR'S option in lieu of lead tags. Provide polypropylene tag holders with interchangeable, yellow polypropylene tag with black alphanumeric characters sets. Characters shall be approximately .25-inch high. As manufactured by Almetek industries "EZTAG" - Ledgewood, New Jersey.

D. Equipment and outlet naming identification and color-coding shall comply with ANSI/EIA/TIA latest revision.
1. Naming method for equipment, outlets and cables; where a position in the naming string is unused, provide multiple "*****" symbols.
   Typical naming string "ADM-02-1141-PP17-1271"
   a. "ADM" - Abbreviated Building Name or Number (i.e., Administration, B127, etc.)
   b. "02" - Floor Level #2 or as applicable.
   c. "1141" - Outlet, Equipment or Terminal Room/Closet name or room number as applicable.
   e. "1271" - Individual Outlet or Port Identification.
2. Connecting hardware color coding shall be as follows:
   "Green" - Main central terminal location for entire site.
   "White" - Distributed terminal locations other than the main terminal.
   "Blue" - Horizontal wiring hardware systems for workstations.

E. Provide warning nameplates on fiber optic patch panels, fiber optic outlets, and any location where fiber optic cables are terminated. Minimum ⅛-inch high engraved/etched letters. "WARNING - LASER LIGHT SOURCE. DO NOT LOOK DIRECTLY AT OUTLET OR FIBER CABLE ENDS. RISK OF SEVERE EYE DAMAGE OR BLINDNESS".
SECTION 27 4100

AUDIO/VIDEO COMMUNICATIONS

PART 1- GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessary limited to the following:
   1. Examine all other Sections for work related to those other Sections and required to the included as work under this Section.
   2. General provisions and requirements for electrical work.
   3. Design, provides equipment for, and installs a complete instructional classroom Audio-Video technology system.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Submit product data sheets for all wire, supports, conduit, fittings and splicing equipment.

B. Product Data:
   1. Provide a complete bill of materials, including all quantities of components, devices, equipment, and wiring required to complete this work.
   2. Submit product data, including Manufacturer's data sheets for all proposed system components.

C. Shop Drawings, Indicate on a Floor Plan for each room system topology with the following:
   1. All equipment part numbers shall be listed to the bill of materials and the system Drawings.
   2. Configuration.
   3. Wiring diagram.
   4. Sizes.
   5. Materials.
   6. Finishes.
   7. Locations.
   8. Utility connections, types, and locations.

D. Manufacturer's Qualification Statement.

E. Specimen Warranty.

F. Certificate: Certify that products of this section meet or exceed specified requirements.

G. Evaluation Service Reports: Show compliance with specified requirements.

H. Installer's Qualification Statement.
I. Project Record Documents: Record actual locations of equipment and wiring types with color coding.

J. Warranty: Submit Manufacturer warranty, dated at Substantial Completion and ensure that forms have been completed in District’s name and registered with Manufacturer.

K. Maintenance Materials: Furnish the following for District's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Spare Parts: One (1) of each kind of equipment or portable device.
   3. Tools: One (1) each of every special tool required for maintenance of equipment.

1.03 REFERENCE STANDARDS


B. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the installation of conduits, switches, and equipment with size, location and installation of service utilities.

B. Pre-installation Meeting: Conduct a pre-installation meeting one week prior to the start of the work of this Section; require attendance by all affected Installers.

C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this Section, with not less than 3-years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of this Section with minimum 5-years of experience.
   1. Must be an Authorized Extron Reseller at time of bid.
   2. Must be an Epson Reseller at time of bid.
   3. Must have a CTS-D Engineer on Staff at time of bid.
   4. Must have a RCCD on Staff at time of bid.
   5. Installing Technicians must be Trained and Certified for the implementation of PoleVault Systems at time of bid.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver Equipment to Project Site in unopened boxes.

B. Store Equipment under cover and elevated above grade.
   1. Equipment shall be kept in a locked environment to avoid theft.
1.07 WARRANTY
A. See Section 01 7800 Closeout Submittals, for additional warranty requirements.
B. Correct Defective Work within a 2-year period after Date of Substantial Completion.
C. Provide 5-year Manufacturer Warranty for Equipment.

PART 2 - PRODUCTS

2.01 REGULATORY REQUIREMENTS
A. All systems must be approved under Part 15, Subpart B, and Section 17.107b of the FCC Rules and Regulations.
B. All material and systems must be UL approved.
C. The system shall follow Local and National Codes and be installed in accordance.
D. All enclosures and A/V equipment shall be anchored to the structure and shall comply with CBC Section 163A.

2.02 BASE BID MANUFACTURER
A. Extron Electronics: www.extron.com; 1230 South Lewis Street, Anaheim, California 92805, (714) 491-1500 or (800) 633-9876.
B. Other Acceptable Manufacturers:
   1. Substitutions: Extron matches District Standards. No substitutions will be approved.

2.03 SYSTEM DESCRIPTION
A. Provide a complete Audiovisual System in each classroom where shown on plans. The system switching and audio amplification equipment shall be securely mounted and concealed in an enclosure mounted to the ceiling. Audio and image source equipment can be connected to the system and displayed via active (powered) interface panels located throughout the room. The audio and image signals from source devices shall be transmitted from the active interface panels over standard UTP Cabling Architecture.
B. Classroom Definition: Rooms that has fixed instructional media video projection capabilities, internet connectivity at the teacher’s station, student networking (usually wireless), a document camera, DVD/VCR and-or other multimedia input devices, standard laptop interface, multimedia control system that is connected to the network and capabilities for additional add-on modular features.
C. Technology Enhanced Classrooms (TECs) use standardized control/interface systems and employ a standardized operational protocol. The principles of this recommendation are to establish desirable goals with respect to classroom design and installed technology. The TEC Classroom Standard includes control systems that have ADA, Section 508 compliant buttons that are discernible without activating the controls or buttons on the control panel, easily reached control panel locations, closed captioning, hearing assistance capability and user friendly operator protocols among the features that are consistent with universal design principles.
D. Provide the following media source equipment for the audiovisual system in each classroom, conference room and platform area listed above and shall include the following:
1. Pole Vault PVS-400
2. District provided, Contractor installed LCD projector
3. All required connectors, cabling and installation for a complete Audio/Video Integrated System

2.04 GENERAL EQUIPMENT REQUIREMENTS

A. The room shall be equipped with a standard easy to operate teacher interface (a tactile button keypad layout). The audio system may be monaural or stereo for program sound. The instructional media system will be controlled by a control system with a control panel mounted near the Teacher's area. System parameters can be monitored, administered and controlled over the data network. The instructional media equipment will be located within close proximity to the Teacher's area or through a Graphical User Interface (GUI) on a computer to allow for ease of operation during instruction.

B. Acceptable functionality requirements are listed below in this specification categorized by type of equipment. Quantities are listed for movable, portable or loose equipment, and other selected entries. Where quantities are not listed, refer to the System Drawings.

C. Deviations from this Specification must be documented in writing to the Architect and Owner at least 10-business days before the submittal date.

D. The System components shall all be correctly listed and labeled by Underwriters Laboratories Incorporated (UL) for their intended use.

E. All products shall be new and under warranty at the time of installation. B-stock, previously installed, refurbished or used equipment shall not be allowed on this Project.

F. Where Specification lists several Manufacturers for a major item, or group of items, the A/V Contractor shall provide that entire item from one Manufacturer only.

G. The Contractor shall provide all options, accessories and hardware necessary to meet the function of the design even if they are not specifically listed (i.e. mounting kits, separate or additional power supplies, input modules, transformers, etc.).

2.05 FIXED EQUIPMENT

A. Provide the following Audio Visual System as an all-inclusive system as described below, one system for each room:
1. Projector Mounting - shall be mounted using the following components.
   a. Extron PCM 340 projector drop ceiling mount with adjustable pole.
      1) The PCM 340 projector mount must be capable of mounting to the structural ceiling (concrete or wood joists) above the suspended t-bar ceiling via trunbuckles and tie wire or threaded rod, to provide a full 100 degrees of adjustment enabling a PMP Series pole to hang level.
      2) The mount shall be capable of supporting up to 50 pounds (23kgs) of A/V equipment.
3) The mount must also include a 1.5-inches threaded pipe adapter for projector mount poles.

b. Extron UPB 25 Universal Projector Bracket.
   1) The bracket shall be able to support projectors up to 25 pounds.
   2) The projector bracket must have independent adjustments of horizontal tilt or roll (± 4 degrees of horizontal tilt), vertical angle or pitch (± 25 degrees of vertical angle), and rotation or yaw (360 degrees of rotation).
   3) The projector bracket shall also use a 1.5-inches NTP (National Tapered Pipe) threaded pipe adapter for mounting a projector pole.
   4) The projector bracket should also maintain positioning adjustments even if the projector is removed for service.
   5) The bracket should also feature security flanges that enable the entire unit to be padlocked to prevent theft.

c. Extron PMP Projector Mounting Pole.
   1) The projector mounting pole shall be 1.5-inches NTP (National Tapered Pipe) threaded pipe threaded at both ends to facilitate mounting the projector to the ceiling mount and to the universal projector mount.
   2) The projector mounting pole shall be of a custom length for proper mounting from building structure.
   3) The pole shall provide a cutout section to all for cable access.

d. Extron PMK 550 Pole Mount Kit.
   1) The Project Mounting Kit is a lightweight, fully enclosed vented housing for quickly installing and securing Extron PoleVault System components above a pole-mounted projector. These products may be Extron PVS 305SA TP, Switcher, power supplies, audio amplifiers, IP Link products and other Extron quarter rack product options.

2. Media Source Switching:
   a. System source selection and switching shall be provided by a PVS A/V Switcher.
   b. The switcher shall have two (2) RGB video inputs capable of VGA - UXGA RGBHV, RGBS, RbSb and RsGsBs input resolution via two (2) pairs of female RJ-45 connectors.
   c. The switcher shall have two (2) inputs that can be configurable for either composite video via two (2) female RJ-45 connectors or two (2) additional RGB video inputs capable of VGA-UXGA RGBHV, RGBS, RbSb and RsGsBs input resolution via two (2) pairs of female RJ-45 connectors.
   d. Audio input shall be via four (4) stereo, balanced/unbalanced inputs via the same four (4) and/or six (6) (4 and/or 6) RJ-45 RGB and composite video connectors.
   e. The switcher shall have two (2) video outputs, one (1) RGB output capable of outputting VGA - UXGA RGBHV, RGBS, RbSb and RsGsBs (following input type) via a 15-pin HD female connector and one (1) composite video via one (1) RCA female connector.
   f. Connection from the switcher to the display device shall be provided with one 3-foot VGA to VGA and one 3-foot composite video cable.
   g. An onboard audio amplifier shall provide gain/volume adjustment from -10db to +10db, adjustable in 1db steps. The speaker amplifier shall have two (2) channels, one (1) stereo (default) or dual mono channels via one (1) 5.0mm 4 pole captive screw connector. The output of the amplifier shall be 25watts (rms) per channel at 2/4/8 ohms.
In addition to the stereo/mono speaker output, an additional audio output that will produce line level output shall also be available. This line level audio output must be capable of being set at "fixed" or "variable" and with Balanced or Unbalanced settings.

3. Media Source Control:
   a. Provide Media Source Controllers, MLC 104 IP Plus, in each designated classroom.
   b. The room media sources shall be controlled with a MediaLink Controller with IP Link.
   c. The MediaLink Controller shall contain six (6) tri-color, multi-status LEDs push-buttons for device selection and projector on/off control. A rotary volume control knob with five (5) LED volume indicators shall permit system volume level control.
   d. The MLC Controller shall feature Extron IP Link Ethernet for monitoring, scheduling and control. This IP technology shall enable the device to be controlled, scheduled, and monitored over a LAN, WAN or the Internet using Extron Global Viewer or MLC controller software.
   e. The Controller shall contain a serial host port which shall consist of one (1) bi-directional RS-232 front panel 2.5mm mini stereo jack. This host connection port shall be for configuration and control of the controller itself and to install device drivers for the equipment to be controlled.
   f. The Controller shall also feature two (2) bi-directional serial ports to provide device control. These two (2) ports shall control the display device and PBS Switcher respectively via two (2) bi-directional RS-232 control via one (1) 3.5mm direct insertion captive screw connector.
   g. The MLC Controller shall also have two (2) configurable (via software) digital input/outputs for devices such as sensors, switches, LEDs and relays via one (1) 3.5mm 4-pole direct insertion captive screw connector.
   h. Connection from the MLC Controller to the display shall be provided by one (1) 50-foot Projector control cable.
   i. Connection from the MLC Controller to the PVS Switcher shall be provided by one (1) 50-foot Switcher Control cable.

4. Audio and Speech Reinforcement:
   a. Speakers: In suspended ceiling applications, provide one (1) pair of Extron FF120 speakers in each designated classroom and conference room.
      1) These speakers shall be 3.5-inches deep low profile featuring a deep aluminized composite enclosure, rectangular shape with a metal grille.
      2) The coverage angle of the speaker offers an extraordinary wide dispersion area of 170 degrees, providing a very wide room coverage pattern.
      3) Meeting the Regulatory Compliance Safety Specifications of NFPA90A, NFPA70, UL listed for use in plenum air-spaces, meets UL 2043 for heat and smoke release meets UL 1480 for commercial and professional audio.
      4) The speakers feature a frequency response of 68Hz to 18kHz-10db, half space.
      5) The power capacity is 16watts of continuous pink noise or 32watts of continuous program media.
      6) The nominal impedance is 8ohms.
      7) The input connector shall be one (1) 5mm captive screw for one (1) input.
8) Connection from the PVS 305SA Plus switcher to the FF120 speaker is provided by one (1) 50-foot plenum rated 18 Gauge Speaker Cable Extron SPK-18.

5. Media Source Interfacing:
   a. The media source equipment shall be connected to the audiovisual system via two (2) or four (4) Active (powered) Twisted Pair Transmitter Wall Plates as shown on plans. These wall plates shall enable the system to display video and graphic data from Laptop computers, DVD and VCRs, document camera, camcorders, etc.
   b. These active interface transmitters shall be placed in convenient locations throughout the room to facilitate easy connection of sources.
   c. Provide two types of active interface transmitter panels. The RGB Video Twisted Pair Transmitter – Wall plate shall be used to connect up to one (1) RGB device to the system and transmit the video and audio data to the switcher.
   d. The RGB Video Twisted Pair Transmitter - Wall Plates shall fit a standard, single-gang electrical box with typical type faceplates.
   e. The RGB Video Active Twisted Pair Transmitter – Wall plates shall transmit RGB video over UTP cable to the PVS Switcher and support video input resolutions of VGA - UXGA RGBHV, RGBS, RBsB and RsGsBs via one (1) female 15-pin HD connector. The RGB input plate shall also support EDID emulation.
   f. Stereo audio shall be input via one (1) 3.5mm mini stereo jack.
   g. Connection to each PVT RGB D shall be provided via an Extron male VGA to male VA and male 3.5mm TRS to male 3.5mm TRS cable for RGBHV and audio, length to be coordinated by Owner.
   h. The output of the interface shall be via two (2) female RJ-45 connectors.
   i. Connection to the PVS Switcher shall be via two (2) UL plenum rated UTP cables.
   j. The System shall include one (1) Extron PVT CV D Composite Video Twisted Pair Transmitter – Wall Plate.
   k. The Composite Video Active Twisted Pair Transmitter – Wall Plates shall transmit composite video over UTP cable to the PVS Switcher and support video input via a RCA female connector.
   l. The Composite Video Twisted Pair Transmitter – Wall plates shall fit in a standard, single-gang electrical box and feature Decora type faceplates.
   m. Stereo audio shall be input via two (2) RCA female connectors.
   n. Connections to the PVT CV D from the DVD/VCR shall be provided via one (1) Extron male 3 x RCA to male 3 x RCA cable for composite video and audio, cable length to be coordinated by Owner.
   o. The output of the interface shall be via one (1) female RJ-45 connector.
   p. Connection to the PVS Switcher shall be via one (1) UL plenum rated UTP cable.
   q. Provide USB Extender D Rx and connect via one (1) UL plenum rated UTP cable to USB Extender Rx located at the PVS switcher.

2.06 ACCESSORIES

A. Supports:
   1. All supports shall meet or exceed the load requirements of the intended application with a minimum safety factor of five.
   2. Provide support structure and hardware with a SAE Grade 8 load rating (minimum).
PART 3 - EXECUTION

3.01 GENERAL

A. All Equipment and Enclosures described in this Specification shall be installed plumb and square per Manufacturer’s instructions.

B. All Equipment, except that designated as movable, portable or loose equipment, shall be secured and permanently attached to the permanent structure in a manner which will require the use of a tool (e.g.: screw driver, nut driver, etc.) for removal.

3.02 EXAMINATION

A. Site Verification of Conditions: Verify that related conditions, including equipment that has been previously installed under other sections, are acceptable for product installation in accordance with Manufacturer’s instructions.

B. All Devices Connected to Equipment specified in this section shall bear the UL label and comply with the applicable California Electrical Code (CEC) Standards.

3.03 INSTALLATION

A. Contractor shall furnish all equipment, labor, system setup, and other services necessary for the proper installation of the products/system as indicated on the Drawings and specified herein. System setup information shall include each components proper mounting and alignment and properly verified signal pathways and operation. Proper operational and network support control functions shall be verified.

B. Install in accordance with Manufacturer’s handling and installation instructions.

C. Install in accordance with all local and pertaining Codes and Regulations

D. Utilize an Installer with demonstrated experience in Projects of similar size and complexity.

E. Equipment shall be configured and ready for use to condition at the end of installation.

F. Energize and commission equipment in accordance with Manufacturer’s instructions.

3.04 PROTECTION AND CLEANING

A. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the Manufacturer.

B. Repair or replace damaged components before Substantial Completion of the Project.

C. Remove temporary tags, coverings, and construction debris from interior and exterior surfaces of the equipment. Remove construction debris from equipment area and dispose of properly.

END OF SECTION
120715/223015
SECTION 27 5126

ASSISTIVE LISTENING SYSTEM

PART 1 – GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
2. General provisions and requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Submit block wiring diagrams and catalog data showing component interconnection and descriptive literature for all component parts and cabinets.

1.03 EQUIPMENT QUALIFICATION

A. All Equipment shall conform to Federal, State and Local applicable Codes, Ordinances and AHJ, and shall be listed and labeled by Underwriters Laboratories.

B. Assistive-Listening Systems
1. Assistive-listening systems shall be provided in accordance with CBC Section 11B-219 and shall comply with CBC Section 11B-706.
2. The minimum number of receivers to be provided shall be equal to 4% of the total number of seats, but in no case less than two (2). 25% minimum of the receivers provided, but no less than two (2), shall be hearing-aid compatible in accordance with CBC Section 11B-706.3.
3. If the system provided is limited to specific areas or seats, then such areas or seats shall be within a 50-foot viewing distance of, and have a complete view of, the stage or playing area. CBC Section 11B-219.4.

PART 2 - PRODUCTS

2.01 GENERAL

A. The Assistive Listening System shall include the following items
1. Instructor (program source) wireless transmitter units.
2. Student (audience) portable wireless receiver units.
3. Plug-in microphones and earphones, for each unit.
4. Multiple program source inputs for, Instructor’s microphone, respective room audio/video A/V system input/output and Instructor’s computer audio input/output.
5. System accessories.
B. Function

1. The Assistive Listening System shall provide amplified available audio programs for hearing impaired students/audience, originating from classroom/stage/room instructors and audio/video instructional program source materials, and equipment in respective building spaces, rooms, classrooms and outdoor areas.

2. The audible program shall be transmitted wireless from the program source to the student/audience, with reception coverage throughout not less than approximately 80% of the respective floor space/area space.

3. Shall provide automatic stereo or mono audio full system operation, depending on program source input.

4. The system in each space shall comply with Federal ADA, State and Local AHJ requirements for the hearing impaired.

2.02 MATERIALS (RF WIRELESS)

A. General

1. Power for each portable unit operation shall be supplied by internal, changeable rechargeable NiCad batteries and alternately by alkaline disposable batteries. Rechargeable batteries shall be recharged without removal from the unit. Each unit shall have a charging indicator light. The batteries shall be recharged from either a portable charger/organizer and with wall transformer/two unit chargers. The units shall operate for up to 40-hours with alkaline batteries, and up to 10-hours with NiCad (NiMH) batteries. The batteries shall be rechargeable without removal from unit.

2. Provide power on-off control on each unit, to extend battery duration.

3. A protection circuit shall prevent battery “back-drain” if the power to the charger is turned off while the unit is being recharged.

4. The receivers and transmitters shall be US Government FCC and Industry Canada-approved, for FM-RF (radio frequency) wireless operation.

5. All components shall be the product of the same Manufacturer.

6. As manufactured by Williams Sound; or PhonicEar; or Listen Technologies; or Centrum Sound.

B. Instructors Portable (Program Source) RF Transmitter Units

1. The transmitter, shall be compact, easily portable units, self-contained ABS, plastic housing/enclosure shall clip to a pocket or belt.

2. Each portable transmitter shall provide RF transmitting on one of the US Government 40 different FCC – and Industry Canada-approved narrow-band channels in the 72-86MHz RF band.

   a. Line-of-sight transmit distance range of not less than 100-feet up to 150-feet from transmitter to receiver.

3. Easy-to-read channel label and volume adjustment on the front unit face. Stereo and mono audio processing.

4. 3.5mm auxiliary input jack that allows transmission of audio from an auxiliary source such as a cassette recorder, computer, CD/DVD player or television audio source. The transmitter shall also provide a second 3.5mm microphone input source jack. The two (2) input sources shall be simultaneously operational to provide a mixed signal output RF transmission of the two (2) sources.

5. Select the separate independent RF transmission frequency for each transmitter to prevent transmission interference between units and to provide
for at least two (2) student receiver units to selectively overlap reception of the transmitter.

6. Quantity of instructor’s portable RF transmitters
   a. Provide quantity of nine (9) instructor portable transmitters, 3-on low band; 3-on mid band and 3-on high band RF frequencies.
   b. Provide a quantity of one (1) portable transmitter at the respective room audio/video (A/V) equipment, program output source. Provide 120 volt AC-to-DC power-supply for portable transmitter at the A/V equipment location.

7. Extended range fixed base non-portable RF transmitter.
   a. Provide fixed location non-portable base unit RF transmitter for spaces larger than 9,000 square foot indoor or outdoor spaces.
   b. Shall have the same RF characteristics and performance as the portable transmitter except as follows:
      1) Line-of-sight transmit distance range of not less than 800-feet from transmitter to receiver.
      2) Fixed install location non-portable, with NEMA-1 metal housing.
      3) Radiated RF energy intensity shall provide manual attenuation adjustments to prevent multiple adjacency RF interferences.
   c. Provide a student/audience portable RF receiver unit at the RF base unit to receive RF signals from an instructors RF transmitter. Connect to the base unit to rebroadcast. Provide a self-contained 120-volt AC-to-DC power-supply for the portable receiver at the base unit transmitter.
   d. Shall operate on 120 volt 60Hz AC branch circuit. Provide remote system master on-off control.
   e. Provide remote RF antenna (outdoor/indoor) rated, for fixed base RF transmitter. Antenna shall extend the transmitter range for large spaces. Provide two (2) RG-6 coaxial cable connects from antenna to base transmitter.

C. Student/Audience Receiver Units
   1. The multi-channel narrow-band FM receivers shall be compact easily portable units, self-contained ABS/plastic housing/enclosure and shall clip to a pocket or belt.
   2. The receiver shall provide an on/off switch and volume control which adjusts the output level as required by the listener.
   3. The receiver shall have a 3.5mm output jack which accepts one of any of the plug-in listening accessories. Headsets shall provide magnetic induction pick-up for hearing impaired, hearing aid interface operation.
   4. The receiver shall have an easy-to-read channel label on the front face. The receiver shall incorporate an automatic squelch circuit which eliminates white noise when the receiver is out of transmission range. Stereo and mono audio reception and processing.
   5. The multi-channel receiver shall receive any six (6) of the US Government forty (40) different FCC- approved narrow-band FM frequencies within the 72-76MHz band from the respective transmitter units. The user shall be able to change to any one of these six (6) frequencies by using a slide or rotary switch on the receiver. Label on the front face shall indicate the receiver is a multi-channel unit. A label inside the battery compartment shall indicate the six (6) channels that are available to the user.
   6. Quantity of portable RF receivers
      a. Provide a quantity of two (2) receivers with matching frequencies for each transmitter, not less than eighteen (18) total quantities of receivers.
b. Provide a quantity of one (1) receiver with matching RF frequency of the transmitter at the respective room audio/video (A/V) equipment, program input source. Provide 120 volt AC-to-DC power-supply for portable receiver at the A/V equipment location.

c. Provide hearing aid compatible units at a ratio of one (1) per four (4) receivers in accordance with ADA 219.3.

D. RF System Accessories
   Locking, portable case with cover, shall accept a group of not less than twelve (12) plug-in portable transmitter and receiver units in each pack for simultaneous multi-unit battery recharging. Provide a quantity of one (1) organizer for each quantity group of twelve (12) (or fraction thereof) transmitters receivers provided as part of the Contract.

2. Stereo audio headset style automatic noise canceling microphone, integral on-off-volume control and with behind the neck support style each with cable and outlet plug-jacks to match transmitter jacks. Provide two (2) cables for each transmitter.

3. Equipment wall mount support brackets.

4. Auxiliary audio program source 15-feet long cables with plug-in at both ends to match transmitter jacks. Provide two (2) for each transmitter.

5. Stereo audio headset style ear phones with cable and plug to match receiver jacks. Headsets shall provide magnetic induction pick-up for hearing impaired, hearing aid interface operation. Provide one (1) headset for each receiver.

6. Rechargeable Ni-Cad (NiMH) batteries, one (1) complete set for each transmitter and receiver unit.

7. Locking auxiliary equipment storage cases for cables, microphones and headsets, with quantity and capacity for all auxiliary accessories furnished as part of the Contract.

2.03 MATERIAL (INFRARED WIRELESS)

A. General
1. All equipment shall be the product of the same Manufacturer.

2. The receivers and transmitters shall be US Government FCC and Industry Canada-approved.

3. Provide power on-off control on each unit, to extend battery duration.

4. As manufactured by Williams Sound; or PhonicEar; or Listen Technologies; or Centrum Sound.

B. Master (Program Source) Transmitter (Infrared Emitter) Units
1. The infrared emitter/transmitter shall be compact, portable units, self-contained ABS/plastic housing/enclosure.

2. The emitter panel shall be a dual-channel system operating on both 2.3 and 2.8MHz invisible infrared light waves frequencies. The channels shall be designated “CHANNEL A” for the left and “CHANNEL B” for the right.

3. The emitter shall provide left and right AUDIO IN jacks to accept an input signal from a sound system, left and right “SYNC IN/SYNC OUT” jacks for master/slave daisy-chaining with other emitters if desired, and left and right “MIC-IN” jacks to accept an audio signal from a microphone or Audio/Video preamplifier.

4. The emitter shall provide separate LED input level detectors for each channel which illuminate when the audio signal peaks. Stereo and mono audio processing.
5. The emitter shall be mounted by the following methods:
   a. Fixed to a wall with an adjustable, wall-mounting support bracket accessory.
   b. Portable mounted to a table-top-or floor-stand, using accessory support-stand adapter.

6. Each emitter shall provide an array of not less than 130-infrared LEDs covered by an infrared transparent acrylic lens. The infrared signal from each emitter shall cover not less than 3,000 square feet (32,000 cubic feet) enclosed space. **Note:** For room sizes smaller than 3000 square feet, the infrared transmitter/emitter infrared output shall be reduced to accommodate the actual smaller room square feet size and height.

7. 120 volt 60Hz AC input to nominal 24-volt DC output (plug-in “power-brick”) power supply external transformer shall be UL approved, with cable “plug-in” connection to emitter/transmitter. Provide remote system master on-off control.

8. Slave emitter/transmitter for rooms exceeding 30,000 cubic feet. Provide one (1) additional infrared emitter/transmitter repeater slave unit, for each additional 30,000 cubic feet room volume, or fraction thereof. The slave repeater shall receive and retransmit the program signals from the master unit. Provide one (1) 100-foot long “master-to-slave” auxiliary portable extension wire cable for each slave unit.

9. Provide wall mount plug-in outlets for instructors’ microphone outlet connect ports to emitter/transmitter.
   a. Provide 1.0-inch conduit and wire, homerun connect from microphone outlet to each room respective emitter/transmitter and slaves. Provide conductors as recommended by Manufacturer.
   b. Provide 1.0-inch conduit and wire homerun connect from microphone outlet to respective room Audio/Video (A/V) equipment, microphone program source input. Provide conductors as recommended by Manufacturer.

10. Provide a quantity of nine (9) emitter/transmitter “master” units, plus additional “slave” units for adjusted room sizes.

C. Student/Audience Receiver Units

1. Battery Power
   a. Power for each unit operation shall be supplied by internal, changeable rechargeable NiCad batteries and alternately by alkaline disposable batteries. Rechargeable batteries shall be recharged without removal from the unit. Each unit shall have a charging indicator light. The batteries shall be recharged from either a portable charger/organizer and with wall transformer/two unit chargers. The units shall operate for up to 40-hours with alkaline batteries, and up to 15-hours with NiCad (NiMH) batteries.
   b. Provide power on-off control on each unit, to extend battery duration.
   c. A protection circuit shall prevent battery “back-drain” if the power to the charger is turned off while the unit is being recharged.

2. The receiver shall be a dual-channel unit for wearing around the neck with an adjustable strap. Stereo and mono audio reception and processing.

3. Compatible with the transmitter (emitter) and operate on 2.3MHz and 2.8MHz frequencies invisible infrared light waves. Self-contained and switchable from “CHANNEL A” to “CHANNEL B” through a switch located on the back of the unit.

4. The receiver shall provide an infrared light-gathering lens on the front of the unit to focus the light signal from the emitter onto the infrared detector element.
The receiver shall detect and decode the infrared emitter/transmitter light source within a 160° acceptance angle.

5. Audio squelch circuit which turns the output circuit off when the infrared signal is reduced or not received, with on/off and volume control.

6. Output jack, which accepts any of the listening accessories. Headsets shall provide magnetic induction pick-up for hearing impaired, hearing aid interface operation.

7. Shall be compact easily portable units, self-contained ABS/plastic housing/enclosure with red infrared receiver lens. Shall clip to pocket or belt.

8. Provide quantity of two (2) infrared receivers for each master transmitter, not less than eighteen (18) total quantities of receivers.

D. Infrared System Accessories

1. Battery recharger portable charger/organizer pack. Locking, portable case with cover, shall accept a group of not less than twelve (12) plug-in portable transmitters and receivers units in each pack for simultaneous multi-unit battery recharging. Provide a quantity of one (1) organizer for each quantity group of twelve (12) (or fraction thereof) receivers provided as part of the contract.

2. Stereo audio headset style automatic noise canceling microphones, integral on-off-volume control and with behind the neck support style. Each with 25-feet long extension cables and outlet plug-jacks to match transmitter outlet jacks. Provide two (2) cables for each emitter/transmitter.

3. Equipment wall mount support brackets.

4. Auxiliary audio program source 15-feet long cables with plug-in at both ends to match transmitter jacks. Provide two (2) for each transmitter.

5. Headset style ear phones with cable and plug to match receiver jacks. Headsets shall provide magnetic induction pick-up for hearing impaired, hearing aid interface operation. Provide one (1) headset for each receiver.

6. Rechargeable Ni-Cad (NiMH) batteries, one (1) complete set for each unit.

7. Locking auxiliary equipment storage cases for cables, microphones and headsets. Quantity and capacity as required to store all accessories.

8. Portable floor stand, for infrared emitter/transmitter units mounting and support, with variable height adjustment and tip-resistant weighted base. Provide one (1) floor stand for each infrared emitter/transmitter.

9. Locking, portable case for infrared emitter/transmitter. One (1) for each emitter/transmitter unit.

10. Provide microphone extension cable with plug to match microphone and infrared emitter/transmitter microphone input jack, 25-feet length. One (1) for each microphone.

PART 3 - EXECUTION

3.01 GENERAL

A. Each System General

1. Assemble, set up, and test each transmitter, receiver, and accessories units.

2. Install and fully charge all batteries prior to and after testing/set up is complete.

B. Wireless RF Units

1. Perform an onsite RF frequency survey to determine available unused RF channels, prior to selecting unit operating channels and prior to ordering the equipment.
2. Select operational RF frequency to prevent system RF interference’s with other equipment.

3. Provide - one (1) 0.75-inch conduit with two (2) Category–6A, ANSI/EIA/TIA-568C 4-pair, UTP cables connecting from each emitter/transmitter master outlet box location to respective room instructors microphone outlet box location. Provide matching RJ-45 Category-6A female jacks at each outlet box for each cable. Provide an audio circuit matching Balun at each outlet RJ-45 jack location, for RJ-45-to-portable cable plug-in transition and circuit impedance matching audio/transformer, into respective equipment. Additionally provide four (4) portable Category-6A patch cables with RJ-45 jacks on each end of 7-foot long patch cable. Typical for each outlet location.

C. Wireless Infrared Units

1. Provide aiming and intensity adjustments of emitter/transmitter units to insure complete room coverage.

2. Provide - one (1) 0.75-inch conduit with two (2) Category–6A, ANSI/EIA/TIA-568C 4-pair, UTP cables connecting from each emitter/transmitter master outlet box location to respective room instructors microphone outlet box location. Provide matching RJ-45 Category-6A female jacks at each outlet box for each cable. Provide an audio circuit matching Balun at each outlet RJ-45 jack location, for RJ-45-to-portable cable plug-in transition and circuit impedance matching audio/transformer, into respective equipment. Additionally provide four (4) portable Category-6A patch cables with RJ-45 jacks on each end of 7-foot long patch cable. Typical for each outlet location.

3. Provide - one (1) 0.75-inch conduit with two (2) Category–6A, ANSI/EIA/TIA – 568C, 4-pair UTP cables connecting from each emitter/transmitter master outlet box location to respective room audio amplifier/preamplifier location. Provide matching RJ-45 Category-6A female jacks at each outlet box location for each UTP cable. Provide an audio circuit matching Balun at each outlet RJ-45 jack location, for RJ-45-to-portable cable plug-in transition and circuit impedance matching audio/transformer, into respective equipment. Additionally provide four (4) portable Category-6A patch cables with RJ-45 jacks on each end of 7-foot long patch cable. Typical for each outlet location.

END OF SECTION

100715/223015
PART 1- GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
   2. General provisions and requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Submit Product Data Sheets and Descriptive Literature for all Component Parts.

B. Submit Block Wiring Diagram of the Clock and Paging systems. Showing headend equipment, terminal cabinets, remote power supplies, and typical clock for each zone.

1.03 EQUIPMENT QUALIFICATION

A. The Specification is based on the Equipment of Manufacturers who have been approved by the District and the Manufacturers herein named shall be considered as meeting the requirements of this Specification. For all items which are identified by part number and Manufacturer the Performance Specifications which are published in the most recent Manufacturer’s data sheets available at the time of bidding this project shall be applicable to the present work as though fully written out herein.

B. All Equipment shall conform to all local applicable Codes and Ordinances, and shall be listed by Underwriters Laboratories.

1.04 QUALIFICATIONS

A. To Qualify as an Acceptable Bidder, whether the bid is submitted to the District, his Agent, a General Contractor or a Sub-contractor, the System Bidder or Contractor shall be Qualified Sound Contractor and shall hold a valid C61 License issued by the Contractors State License Board of California. The System Bidder or Contractor shall hereinafter be referred to as the Contractor. The Contractor shall hold all other licenses required by the legally constituted Authorities Having Jurisdiction over the work. The Contractor shall be the Factory Authorized Distributor for the brand of equipment offered and shall have been engaged in the business of supplying and installing the specified type of system for at least 5-years. The Contractor shall maintain a fully equipped service organization capable of furnishing adequate repair service to the equipment.
1.05 GENERAL REQUIREMENTS AND SCOPE

A. Furnish and Install a complete new GPS Wireless clock system using Primex Wireless Inc. GPS Wireless system or equal by American Time and Signal, Sapling. All bids shall be based on the equipment as specified herein.

B. Section includes Transmission Systems GPS Receiver, Primary Transmitter, and Satellite Transmitter.
   1. Clocks:
      a. Analog
      b. Digital

1.06 RELATED SECTIONS

A. Division 26 – Electrical (120 volt grounded outlet required for transmitter).

1.07 REFERENCES


1.08 DEFINITIONS

A. GPS: Global Positioning System, a worldwide system that employs twenty-four (24) satellites in an integrated network to determine geographic location anywhere in the world, and which employs and transmits Universal Coordinated Time, the world’s most accurate and reliable time.

1.09 SYSTEM DESCRIPTION

A. GPS Wireless Clock System shall continually synchronize clocks throughout the facility, and shall be capable of clock readouts in multiple time zones where desired.

B. The System shall provide wireless time using GPS and be synchronized to UTC. The system shall not require hard wiring. Clocks shall automatically adjust for Daylight Saving Time

C. Analog Clocks shall be synchronized to within 10-milliseconds 6-times per day, and the system shall have an internal oscillator that maintains plus or minus one second per day between synchronizations, so that clock accuracy shall not exceed plus or minus 0.2 seconds.

D. The System shall include an internal clock reference so that failure of the GPS signal shall not cause the clocks to fail in indicating time.

E. The System shall incorporate a “Fail-Safe” design so that failure of any component shall not cause failure of the system. Upon restoration of power or repair of failed component, the system shall resume normal Operation without the need to reset the system or any component thereof.

F. Clock Locations shall be as indicated, and clocks shall be fully portable, capable of being relocated at any time.
G. The System must operate in accordance with a “Radio Station Authorization”, Form FCC 601 – LM, granted by the Federal Communications Commission (FCC). This license will be issued to and held by the end user.

1.10 REGULATORY REQUIREMENTS

A. Equipment and Components Furnished shall be of Manufacturer’s latest model.

B. The End User Will Hold a License, known as a “Radio Station Authorization” granted by the FCC.
   1. This license grants the end user protected use for wireless transmission at the designated frequency.
   2. This license will designate a unique “call sign” for each end user.

C. Transmitter and Receiver shall comply with Part 90 of FCC rules as follows:
   1. This device may not cause harmful interference, and
   2. This device must accept interference received, including interference that may cause undesired operation.
   3. Transmitter frequency shall be governed by FCC Part 90.35.
   4. Transmitter output power shall be governed by FCC Part 90 257 (b)

D. System shall be installed in compliance with Local and State Authorities Having Jurisdiction.

E. Operating License: Submit evidence of application for FCC Radio Station Authorization prior to installing equipment. Furnish the license or a copy of the application for the license, to the District/End User prior to operating the equipment. The original license must be delivered to the District/End User.

F. Samples: Submit one (1) clock for approval. Approved sample shall be tagged and shall be installed in the work at location directed.

G. Manufacturer’s Instructions: Submit complete installation, set-up and maintenance instructions.

H. Floor Plans indicating the location of system transmitter(s), approved by Manufacturer, will be submitted to District prior to installation.

1.11 QUALITY ASSURANCE

A. Permits: Obtain Operating License for the Transmitter from the FCC.
   1. Qualifications:
      a. Manufacturer: Company specializing in manufacturing commercial time system products with a minimum of 30 continuous years of documented experience including 4 years’ experience producing GPS wireless time systems.
      b. Installer: Company with documented experience in the installation of commercial time systems.
   2. Prior to installation, a site survey must be performed to determine proper transmitter placement.
1.12 DELIVERY STORAGE AND HANDLING

A. Deliver all Components to the Site in the Manufacturer's original packaging. Packaging shall contain Manufacturer's name and address, product identification number, and other related information.

B. Store Equipment in finished building, unopened containers until ready for installation.

1.13 PROJECT SITE CONDITIONS

Clocks shall not be installed until painting and other finish work in each room is complete. Coordinate installation of GPS receiver for access to the roof or exterior side wall so that the bracket and related fasteners are watertight.

1.14 SYSTEM STARTUP

At completion of installation and prior to final acceptance, turn on the equipment; ensure that all equipment is operating properly, and that all clocks are functioning.

1.15 WARRANTY

Manufacturer will provide a 1-year warranty on GPS receiver, transmitter, and satellite transmitter. All other components will have a 1-year warranty.

Part 2 - PRODUCTS

2.01 MANUFACTURER


2.02 SEQUENCE OF OPERATION

A. Transmitter Operation: When power is first applied to the transmitter, it checks for and displays the software version. It then checks the position of the switches and stores their position in memory. The transmitter looks for the GPS time signal. Once the transmitter has received the GPS time, it sets its internal clock to that time. The transmitter then starts to transmit its internal time once every second. The transmitter updates its internal clock every time it receives valid time data from the GPS.

B. Analog Clock Operation:
   1. Apply power or insert batteries. Follow set up procedures detailed in Manufacturer’s instructions.
   2. After initial setup, the clock will shut off the receiver. Six times each day, the microprocessor will activate the receiver and starting with the stored channel, it will again look for a valid time signal. If necessary, the clocks will resynchronize to the correct time.
   3. If the clock has not decoded a valid time signal for a pre-determined number of days, it will go to a step mode. Non signal reception can be caused by low battery voltage. If this occurs, replace the batteries.
2.03 EQUIPMENT

A. General: The Clock System shall include a transmitter, a roof or window mounted GPS receiver, indicating clocks, and all accessories for complete operation.

B. The GPS Receiver shall be a complete GPS receiver including antenna in a waterproof case, designed for roof or outdoor mounting. Provide mounting bracket for attachment to roof structure.

C. The GPS Receiver cable must be plenum rated where required by local code.

D. Transmitter: Primex Wireless Model 14400, consisting of wireless transmitter with GPS receiver, a surge suppressor/battery backup, and a mounting shelf. Unit shall obtain current atomic time from satellite. The clock system shall transmit time continuously to all clocks in the system.

1. Transmission:
   a. Frequency Range: 72.100 to 72.400 MHz.
   b. Transmission Power: 1 watt (30dBm) maximum
   c. Radio technology: narrow band FM
   d. Number of channels: 16
   e. Channel bandwidth: 20kHz maximum
   f. Transition mode: one-way communication
   g. Data rate: 2 KBps
   h. Operating range: 32 degree F to 158 degrees F (0 degrees C. to 70 degrees C).

2. Transmitter:
   a. Transmitter output power: +26 to +30 dBm
   b. Frequency deviation: +/- 4 kHz
   c. Transmitter power requirements: 120 VAC 60 Hz
   d. Internal power requirements: 5 VDC
   e. Carrier frequency stability: +/- 20 ppm

3. Transmitter shall have 16 selectable channels to assure interference-free reception.

4. Transmitter shall have the following switches:
   b. Daylight Saving Time bypass switch.
   c. 12-hours or 24-hours display.

5. Transmitter housing shall be black metal case, 16-3/4 inches (424.4mm) by 12 inches (304.8mm) by 1-7/8 inches (46.4mm) in size.

6. Antenna shall be 46-inches (1168mm) high, commercial type, mounted on top center of transmitter housing. Antenna gain shall be < 2.2 dB. Antenna polarization shall be vertical.

7. Transmitter housing shall incorporate a display which shall include the following:
   a. Time readout
   b. AM and PM indicator if 12-hour time display is set
   c. Day and date readout
   d. Indicator for daylight savings or standard time
   e. LED which shall flash red in event of reception problem
   f. GPS reception indicator

8. Transmitter shall contain an internal clock such that failure of reception from the GPS will not disable the operation of the clocks.
9. Power supply (included):
   Input: 120 volt AC 50/60 Hz, 0.4 amps.
   Output: 9 volt DC, 1.5 amps.

E. Surge Protector/Battery Backup (included).
   Input: 120 volt AC 60 Hz +/- 1 Hz.
   Output: 120 volt AC, 500VA, 300 watts
   Surge Energy Rating: 365 joules

F. Additional Equipment
   1. Wireless Receiver Switches: Switches shall receive time packets from the
      Primary Transmitter and relay the synchronized time to the Satellite Transmitter
      connected to it. The unit shall include the following:
      a. Antenna mounted on top of the switch housing, 11 1/2-inches (292mm) long.
         Power Supply:
         · Input 120 VAC 50/60Hz, 0.4 amps
         · Output: 9 volt DC, 1.5 amps RS 232 data cable, 5 feet (1.5mm) long
      b. Daylight Savings Time bypass switch
      c. Dimensions: 4 1/4-inches (108mm) long, 5 3/4-inches (146mm) wide, 1 1/4-
         inches (31.75mm) deep.
      d. Weight: 12 ounces (.34kg)
      e. Operating Range: 32 degrees F to 158 degrees F (0 to 70 degrees C)
   2. Satellite Transmitters Primex Wireless Model 14401: Satellite Transmitters
      shall receive the signal from the Wireless Receiver Switches and transmit the
      signal to the devices in its vicinity, which are out of the range from the Master
      Transmitter. The unit shall include the following:
      a. Antenna mounted on top of the housing, 46 inches (1168mm) long.
      b. Wireless Receiver Switch.
      c. Power Supply Input: 120
      d. VAC, 50/60Hz, 0.4 amps
      e. Output: 9 volt DC, 1.5 amps.
      f. 6 foot (1.83m) cord
      g. Surge Suppressor/Battery Backup
      h. Mounting Shelf.
      i. Transmission Power: 1 watt maximum
      j. 72 MHz frequency.
   3. Traditional analog clocks (battery): Analog clocks shall be wall mounted.
      Clocks shall have polycarbonate frame and polycarbonate lens. Face shall be
      white. Hour and minute hands shall be black.
      a. 9 inches (228.6mm) diameter analog clock: Primex Wireless Model 14280
      b. 12 1/2-inch (317.5mm) diameter analog clock: Primex Wireless Model 14155
      c. 16 inches (406.4mm) diameter analog clock: Primex Wireless Model 14163
      d. 24 inches (610mm) diameter analog clock: Primex Wireless Model 14346
   4. Additional colors, finishes, and dial faces are available from Manufacturer.
      a. Analog clocks shall be battery-operated,
      b. Analog clocks shall be capable of automatically adjusting for Daylight
         Saving Time. An on-off switch located on the transmitter shall disable this
         function if desired.
      c. Time shall be automatically updated from the transmitter 6 times per day.
      d. Analog clocks shall remember the time during changing of batteries.
e. 9 inches (228.6 mm) and 12.5 inches (317.5 mm) analog clocks shall have a tamper proof/ theft resistant clock lock mounting slots.

5. Analog clock receivers shall be as follows:
   a. Receiver sensitivity: >-110 dBm
   b. Receiver power: 24 VAC or 120 VAC (see model #)
   c. Antenna type: internal
   d. Antenna gain: -7 dBi

If transmitter stops transmitting valid time signals due to power failure, the clocks will continue to function as accurate quartz clocks until a valid time signal is decoded. If signal transmission is not restored after 96 hours, the second hand will “five step” as a visual indicator that the signal has been lost. Should the clocks lose power and signal, the clocks will not function.

6. Wire guards: Provide one for each analog clock as follows:
   a. Analog clock wire guard Primex Wireless Model 14131, 14-inches by 14-inches (355.6 by 355.6 mm) size, for nominal 12½-inch (317.5 mm) diameter analog clocks.
   b. Analog clock wire guard Primex Wireless Model 14123, 18-inches by 18-inches (457.2 by 457.2mm) size, for 16 inches (406.4mm) diameter analog clocks.

7. Cable Connection Sealant: Radio Shack Coaxial Cable Connector Sealant 278-1645, or approved electrical grade silicone sealant.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that construction is complete in spaces to receive equipment and that rooms are clean and dry.
B. Verify that 120-volt electrical outlet is located within 6 feet (1.83m) of location of transmitter and the outlet is operational and properly grounded.

3.02 INSTALLATION

A. Provide All Equipment necessary for a complete and operable system.
B. Transmitter:
   Locate transmitter where indicated, a minimum of 2 feet to 3 feet (.6 to 1 meter) above the floor, away from large metal objects such as filing cabinets, lockers or metal framed walls. Transmitter(s) will be placed at locations indicated below:
   1. Attach receiver to transmitter using cable.
   2. Connect antenna to transmitter, using care not to strip threads.
   3. Connect power supply to the transmitter. Set the channel number on the display to correspond to the FCC license.
   4. Plug power supply into electrical outlet.
C. Analog Clocks shall perform the following operations with each clock:
   1. Set clock to correct time in accordance with Manufacturer's instructions.
   2. Observe analog clock until valid signals are received and analog clock adjusts itself to correct time.
   3. Install the analog clock on the wall in the indicated location, plumb, level and tight against the wall. If using 12½-inch (317.5mm) clock, attach using clock-lock hanging method and suitable fasteners as approved by Clock Manufacturer.
4. Wire guards: Secure to wall, using approved theft-resistant fasteners.

3.03 ADJUSTING

A. Prior to final acceptance, inspect each clock, adjust as required, and replace parts which are found defective.

3.04 CLEANING

A. Prior to final acceptance, clean exposed surfaces of clocks, using cleaning methods recommended by Clock Manufacturer. Remove temporary labels from clock faces. Do not remove labels from backs of clocks.

3.05 DEMONSTRATION

A. Provide Training to District's Representative on setting and adjusting clocks, replacing batteries and routine maintenance.

3.06 PROTECTION

A. Protect Finished Installation Until Final Acceptance of the Project.

3.07 TESTING

A. All Devices must be tested at their operational location under normal operational conditions to assure reception of signal.

END OF SECTION
100715/223015
SECTION 28 1600
INTRUSION DETECTION SYSTEM

PART 1 GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other Specifications Sections and Drawings for related work required to be included as work under Division 26 0000, 27 0000, and 28 0000.
   2. General provisions and requirements for electrical work.

1.02 QUALIFICATION OF BIDDERS AND EQUIPMENT

A. To Qualify as an acceptable Bidder, whether the bid is submitted to the District, his Agent, a General Contractor or a Sub-contractor, the System Bidder or Contractor shall be Qualified Contractor and shall hold a valid License issued by the State of California Department of Consumer Affairs Collection and Investigation Services for the purpose of installing security systems. The System Bidder or Contractor shall hereinafter be referred to as the Contractor. The Contractor shall hold all other licenses required by the legally constituted Authorities Having Jurisdiction over the work. The Contractor shall be the Factory Authorized Distributor for the branch of equipment offered and shall have been engaged in the business of supplying and installing the specified type of system for at least 5-years. The Contractor shall maintain a fully equipped service organization capable of furnishing adequate repair service to the equipment. The Contractor shall be financially able to provide a performance bond covering the work and the guarantee described. The Contractor shall provide that bond if requested.

B. The Equipment specified herein shall be DMP #XR-500N or equal.

C. The System shall be serviced by a field supported 2-year warranty.

D. The Specification is based on the Equipment of Manufacturers who have been approved by the District and the Manufacturers herein named shall be considered as meeting the requirements of this Specification. For all items which are identified by part number and Manufacturer the Performance Specifications which are published in the most recent Manufacturers data sheets available at the time of bidding this Project shall be applicable to the present work as though fully written out herein.

E. All Equipment shall conform to all local applicable Codes and Ordinances, and shall be listed by Underwriters Laboratories.

F. Installation Certification
   1. Work and Material for Cables, cable terminations and related components shall be performed by certified installers. The Installer shall be Certified by the respective Product Manufacturers.
   2. The Manufacturers of the indicated work and material shall provide an Installer education/training and Certification Program for the supplied products.
3. The Installers performing the Contract Work for the indicated products shall have attended and successfully completed each of the respective Manufacturer's installation Training Education Programs for the specified products.

4. Submit six (6) copies of the Manufacturer's Certifications for each Installer performing the work. The submittal shall be approved prior to initiating any related Contract Work.

5. Contract material installed and work performed by Installers not complying with these requirements shall be removed. Removal of work and material not in compliance with these requirements shall done at the CONTRACTOR'S expense, without any additional cost to the Contract and without any additional Contract completion due date extensions. New material and work required to replace the non-compiling removed work and material shall be provided at the CONTRACTOR'S expense, without any additional cost to the Contract and without any additional Contract completion due date extensions.

1.03 PERFORMANCE REQUIREMENTS

A. Provide Main Control Panel, Terminal Cabinets, Keypads, and Site Underground Conduits as indicated.

B. Provide Motion Sensor(s) in each room having exterior doors, exterior glass, or skylights. Quantity of sensors in each room shall be as required to detect entry through exterior doors, exterior glass, or skylights.

C. Provide a Magnetic Switch at the entry door to each building, near its respective keypad. Connect to the system to initiate a timing circuit for keypad operation.

D. Provide Magnetic Switches at roof hatches.

E. Provide all conduits, cabling, and outlet boxes required for a complete and operable system.

F. Meet with Representatives of the District at a time and location convenient to the District. Advise the District of programming options and incorporate all requirements onto the Shop Drawings before submittal to the Architect.

1.04 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Submit Evidence of having met with District Representatives as specified herein.

B. Submit Product data sheets for all switches, keypads, wiring devices, device plates, controllers, power supplies, cabinets, etc.

C. Submit detailed Shop Diagrams including dimensioned plans, elevations, details, schematic and point-to-point wiring diagrams and descriptive literature for all component parts and cabinets.

D. Submit six (6) copies redrawn Building Floor Plans showing all components of the intrusion detection system including interconnecting cabling and conduits. Sensors shall be located on the Drawings in the location conforming to the requirements stated herein. Drawings shall be prepared to scale and show all exterior glass, exterior doors, all interior and exterior building walls, roof hatches, architectural and...
structural elements relevant to the installation of the system. Each zone shall be shown on the Plans.

**PART 2 PRODUCTS**

**2.01 SYSTEM FUNCTIONS**

A. Provide a Complete and Operable Supervised Intrusion Detection System as shown on the Plans including but not limited to master control panel, key pad stations, motion detectors, connections to door switches, a State Fire Marshal listed digital communicator and an automatic dialer.

B. Upon Detection of an intruder by initiation of any device in the system, the system shall cause the annunciator LED to light and sound an alarm signal on the school's telecommunication system. Alarm information shall be sent by digital dialer to Central Station Alarm Monitoring Agency.

C. Systems shall detect the motion of a body taking not more than four (4) steps in an area secured with motion detection equipment where entry doors or windows are possible access.

D. Each Building Area shall be on a separate zone with each zone controlled separately so that any building area may be secured while others remain unsecured.

E. The System shall be capable of off-site computerized access for remote access, programming and control.

**2.02 CONTROL PANEL**

A. Control/Communicator Panel shall be a DMP control panel with an integral digital communicator and shall be Underwriters Laboratories listed. All external circuit connections shall be UL listed as power limited in accordance with the provisions of Article 760 of the California Electrical Code (CEC).

1. Provide Point of Protection (POPEX) modules at the control panel for Popit module supervision.

2. Provide Point of Protection Identification Transponders (Popit) modules at building terminal cabinets to individually identify each detector in the system.

B. The Control/Communicator shall be IP based.

C. System shall include the following features:

1. Real time clock and test timer.
2. Battery charging circuit.
3. Battery voltage supervision.
4. Supervised automatic reset circuit breakers.
5. Onboard warning buzzer and diagnostic LEDs.
6. Automatic answer modem.
7. Lightning and RFI protection.
8. Central Station reporting format.
9. Printer/CRT interface module for on-site serial data printer recording or CRT display of events.
10. Quad serial output module for enhanced serial data interface capability for specific accessory modules and devices.
11. Individual zone responses.
12. Custom annunciator text.
13. Audible alarm output, steady or pulsed.
15. Attack-Resistant enclosure and lock meeting Underwriters Laboratory Local Burglary requirements.
16. A minimum of eight (8) auxiliary form "C" dry contacts for a variety of programmable responses to alarm and trouble conditions.
17. Transformer enclosure for internal mounting of Class 2 transformer.
18. Two (2) telephone numbers with selective signaling options.
20. Automatic test reports.

2.03 BAR-CODE PROGRAMMER FOR DIAGNOSTICS AND PROGRAMMING CAPABILITY.

2.04 RECEIVER

A. Receiver shall be Bosch Security System #D6600 Series, UL listed for fire and intrusion detection.

B. Provide a 50VA Class 2 plug in transformer for power input.

C. System shall contain 48 hours of standby power utilizing rechargeable sealed lead acid batteries and a battery charger.

D. System shall be FCC approved for telephone connections.

E. An Alphanumeric LCD Display shall indicate account number, area number, time, date, event, zone or point number, line or group number, status and external devices.

F. Twenty-four hour Clock and 128 year calendar.

G. Forty Character Line internal printer and interface capability with an external serial printer.

H. Transmission Verification appropriate with the format utilized.

I. Storage of 249 separate events.

J. Transmission Format shall support the control panel.

K. Turn the Receiver over to the District for Central Station or Campus Monitoring.

2.05 REMOTE ACCOUNT MANAGER

A. System shall be Bosch Security Systems #D5300 Series or equal with all equipment necessary for computerized access, programming, diagnostics, and remote control of the system. It shall be possible to remotely change passcodes, locate faults, shunt problem zones, arm and disarm the system, silence alarms, and control the auxiliary output contacts in the control panel.

B. System shall permit remote diagnostics including utility and battery power conditions, phone line condition, event memory by zone, and current clock and calendar settings.
C. System shall be 100% IBM compatible for use with personal computers.

D. System shall include a plug-in modem and software necessary for a complete and operable installation. Furnish the District with a Software License Agreement for updated software enhancements as they develop.

2.06 KEYPADS

A. Master Keypad shall be DMP or equal capable of displaying system status and controlling the alarm system. Unit shall receive its operating power from the main control panel. Keypad shall be flush-mounted on a wall near the entry doors of each building. Faceplate shall be brass or stainless steel as selected by the Architect.

B. Sub-Zone Keypads shall be DMP or equal to allow individual zones to be bypassed. Keypad shall be flush wall where shown on Plans Faceplate shall be brass or stainless steel as selected by the Architect.

2.07 MOTION SENSORS SHALL BE HONEYWELL DT-7450 WITH BOSCH B328 MOUNTING BRACKET. SENSORS SHALL BE DUAL PERFORMANCE, DUAL EVENT DEVICES TO MINIMIZE FALSE ALARMS OR EQUAL PASSIVE INFRARED DEVICES DETECTING THERMAL MOTION SIGNALS. SENSOR COVERAGE PATTERNS SHALL BE AS REQUIRED FOR OPTIMUM COVERAGE AT EACH INDIVIDUAL LOCATION. SENSOR SHALL BE ADJUSTABLE GIMBAL MOUNTED WITH PLATE AND OUTLET BOX. PROVIDE AN ATTACK RESISTANT ENCLOSURE DS AE774 AT MULTIPURPOSE AND GYMNASIUM AREAS.

2.08 MAGNETIC SWITCH SHALL BE FULLY CONCEALED IN THE DOOR FRAME, ADMECO, SENTROL OR EQUAL.

2.09 EACH INTRUSION DETECTION SYSTEM TERMINAL CABINET SHALL CONTAIN A POWER SUPPLY FOR MOTION SENSORS AND/OR POPIT/POPEX (ZONEX) MODULES.

2.10 CABLEING SHALL BE AS REQUIRED FOR SYSTEM OPERATION. ALL CABLEING SHALL BE SHIELDED.

2.11 SIREN SHALL BE ATW (MASCON) PR-D550PW OR EQUAL.

PART 3 EXECUTION

3.01 ALL CONNECTIONS THROUGHOUT THE SYSTEM SHALL BE SOLDERED, CRIMPED BY MEANS OF AMP LUGS, FASTENED WITH SCREW TYPE TERMINALS, MADE BY SPRING TENSION CLIP “PUNCH BLOCK” TERMINALS OR MAKE BY STANDARD PLUGS AND RECEPTACLES. EACH WIRE TWISTED PAIR OR CABLE SHALL BE TAGGED THROUGHOUT THE SITE WITH EZ MARKERS WITH THE ROOM NUMBER IT SERVES. ALL CONDUCTORS IN TERMINAL CABINETS SHALL BE CAREFULLY FORMED AND HARNESSED IN A WORKMANLIKE MANNER.

3.02 ALL SYSTEM CABLEING SHALL BE INSTALLED IN CONDUIT EXCEPT WHERE WIRING OCCURS ABOVE ACCESSIBLE CEILINGS. WIRING NOT IN CONDUIT SHALL BE UL LISTED PLENUM-TYPE CABLE. ALL WIRING IN WALLS SHALL BE IN CONDUIT. ALL CONDUITS SHALL BE RUN CONCEALED. WHERE ARCHITECTURE PRECLUDES CONCEALED CONDUITS, RUN CONDUITS ON TOP OF BEAMS OR
TRUSSES AND MINIMIZE THE EXPOSURE TO VIEW. IDENTIFY ON THE SUBMITTAL DRAWINGS ALL LOCATIONS WHERE CONDUITS MUST RUN EXPOSED.

3.03 LOCATE MOTION SENSORS TO PROVIDE OPTIMUM COVERAGE OF THE SPACE AND TO AVOID CONFLICTS WITH THE ARCHITECTURAL AESTHETICS OF THE BUILDING. SUBMITTAL DRAWINGS SHALL SHOW THE EXACT LOCATIONS OF ALL SYSTEM SENSORS AND KEYPADS FOR APPROVAL BY DISTRICT’S MAINTENANCE MANAGERS.

3.04 COORDINATE CONCEALED DOOR SWITCH INSTALLATIONS WITH FINISH HARDWARE MANUFACTURER.

3.05 PROVIDE ALL SYSTEM PROGRAMMING AS REQUIRED BY THE DISTRICT’S MAINTENANCE MANAGERS, INCLUDING THE NECESSARY PRODUCT HANDLERS, SO THAT ALL PARAMETERS ARE ENTERED INTO THE SYSTEM AND THE ANNUNCIATOR DISPLAYS A TEXT, WHICH IS CUSTOMIZED TO THE FACILITY.

3.06 SYSTEM TESTING AND DOCUMENTATION

A. Before the Contract shall be considered complete, the Contractor shall program the system per District requirements and demonstrate the performance of the system in the presence of the District. The Contractor shall provide all test and reception gear required to prove the performance as outlined.

B. Actuate Motion Sensing Devices and Verify that the system performs as specified.

C. The Communication Loops shall be opened in at least two (2) locations per building to check for the presence of correct supervisory circuitry.

D. When the Testing has been completed to the satisfaction of both Contractor’s Job Foreman and the Representatives of the Manufacturer and the DSA Inspector, a notarized letter co-signed by each attesting to the satisfactory completion of said testing shall be provided by the Contractor and forwarded to the Architect.

3.07 PROVIDE A MINIMUM OF TWO (2) 4-HOUR PERIODS TO INSTRUCT DISTRICT PERSONNEL IN PROPER OPERATION OF ALL SYSTEMS. THE FIRST INSTRUCTIONAL PERIOD SHALL BE HELD PRIOR TO FINAL ACCEPTANCE OF THE SYSTEMS. INSTRUCTIONAL TRAINING SHALL BE DONE AT THE PROJECT SITE AND SHALL BE CONDUCTED BY FACTORY-TRAINED TECHNICAL PERSONNEL. FURNISH THE DISTRICT WITH VIDEOTAPE VHS CASSETTE(S) OF THE FIRST INSTRUCTION SESSION. THE SECOND INSTRUCTIONAL PERIOD SHALL BE WITHIN A PERIOD OF 1-YEAR AFTER FINAL ACCEPTANCE OF THE SYSTEMS, UPON REQUEST OF THE DISTRICT.
SECTION 28 3100

DIGITAL ADDRESSABLE FIRE ALARM AND VOICE EVACUATION SYSTEM

PART 1 GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
1. Examine all other Specifications Sections and Drawings for related work required to be included as work under Division 26 0000, 27 0000, and 28 0000.
2. General provisions and requirements for electrical work.

B. This Specification provides the minimum requirements for the Fire Alarm and Detection System. The system shall include, but not limited to all equipment, materials, labor, documentation and services necessary to furnish and install a complete, operational system to include but not limited to the following functions:
1. Smoke and fire detection.
2. Off-premise notification.
4. One-way voice communication notification system.
5. Two-way voice communication system.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Submit Eight (8) Copies of the following to the Architect for approval.
1. A listing of all fire alarm components and equipment including the California State Fire Marshal (CSFM) listing numbers.
2. CSFM listing sheets of all devices being used.
   a. The submittal shall be arranged in the order of the Specification and shall list the Specification paragraph number, the name, the proposed model and Manufacturer for each item as well as a reference indicating the specific piece of data which can be easily located in the brochure.
   b. The Manufacturers’ data sheets shall be marked to indicate the specific item being proposed in cases where the sheet covers several types or sizes of item. The data sheet shall completely describe the proposed item.
   c. Where modification to the equipment is necessary to meet the operational requirements of the Contract Documents and the data sheets shall include complete Mechanical and Electrical Shop Drawings detailing the modification.
4. A listing of the outlet rough-in needed for every device and equipment item. The applicable symbol which illustrates that rough-in item on the job plans shall be drawn on the proposal, opposite the description of the rough-in to facilitate locating the data by Field Personnel.
5. Elevation and dimensional information.
1.03 APPLICABLE STANDARDS

A. The Equipment shall be listed, labeled, and approved for the application shown in Contract Documents, as fire alarm equipment complying with the following requirements:

1. List of applicable Codes as of January 1, 2014:
   a. 2013 Building Standards Administrative Code, Part 1, Title 24 C.C.R.
   b. 2013 California Building Code (CBC), Part 2, Title 24 C.C.R.
   c. 2013 California Electrical Code (CEC), Part 3, Title 24 C.C.R.
   d. 2013 California Mechanical Code (CMC), Part 4, Title 24 C.C.R.
   e. 2013 California Plumbing Code (CPC), Part 5, Title 24 C.C.R.
   f. 2013 California Fire Code (CFC), Part 9, Title 24, C.C.R.
   g. 2013 California Referenced Standards Code, Part 12, Title 24, C.C.R.
   h. Title 19, C.C.R., Public Safety, State Fire Marshal Regulations.
   i. 2013 California Energy Code (CEC, Part 6, Title 24 C.C.R.

2. NFPA Standards and Guides:

3. The fire alarm system shall conform to the applicable Standards and Guides referenced in CBC Chapter 60.

B. Written Certification by the Fire Alarm Equipment Manufacturer shall be submitted to the Architect, stating that the system and its component parts are listed and approved by the California State Fire Marshal and the installation has been tested, is operational and conforms to the requirements as set forth in Part 3, Article 24, Title 19, California Code of Regulations.

1.04 EQUIPMENT AND INSTALLING QUALIFICATIONS

A. The Equipment shall be manufactured by Notifier to match existing fire alarm equipment on the Campus.

B. The Specification is based on the Equipment of Manufacturers who have been approved by the District and the Manufacturers herein named shall be considered as meeting the requirements of this Specification. For all items which are identified by part number and Manufacturer the Performance specifications which are published in the most recent Manufacturer’s data sheets available at the time of bidding this project shall be applicable to the present work as though fully written out herein.

C. All Equipment shall conform to all local applicable Codes and Ordinances, and shall be listed by Underwriters Laboratories.

D. To qualify as an acceptable Bidder, whether the bid is submitted to the District, his Agent, a General Contractor or a Sub-Contractor, the System Bidder or Contractor shall be Qualified Fire Alarm Contractor and shall hold a valid C10 License issued by the Contractors State License Board of California. The System Bidder or Contractor shall hereinafter be referred to as the Contractor. The Contractor shall hold all other licenses required by the legally constituted Authorities Having Jurisdiction over the
work. The Contractor shall be the Factory Authorized Distributor for the branch of equipment offered and shall have been engaged in the business of supplying and installing the specified type of system for at least 5-years. The Contractor shall maintain a fully equipped service organization capable of furnishing adequate repair service to the equipment. The Contractor shall be financially able to provide a performance bond covering the work and the guarantee described. The Contractor shall provide that bond if requested.

E. Installation Certification
   1. Work and material for cables, cable terminations and related components shall be performed by Certified Installers. The Installer shall be certified by the respective Product Manufacturers.
   2. The Manufacturers of the indicated work and material shall provide an Installer Education/Training and Certification Program for the supplied products.
   3. The Installers performing the Contract Work for the indicated products shall have attended and successfully completed each of the respective Manufacturer's installation training education programs for the specified products.
   4. Submit six (6) copies of the Manufacturer's Certifications for each Installer performing the work. The submittal shall be approved prior to initiating any related Contract Work.
   5. Contract Material Installed and work performed by Installers not complying with these requirements shall be removed. Removal of work and material not in compliance with these requirements shall done at the CONTRACTORS’ expense, without any additional cost to the Contract and without any additional Contract completion due date extensions. New material and work required to replace the non-compiling removed work and material shall be provided at the CONTRACTORS’ expense, without any additional cost to the Contract and without any additional Contract completion due date extensions.

PART 2 PRODUCTS

2.01 GENERAL SYSTEM OPERATION

   A. System shall be microprocessor-based, addressable, and power-limited with Class B supervised circuits, one-way and two-way emergency audio communications.
      1. The microprocessor shall execute all supervisory and control programming to detect, report the failure or disconnection of any system module or peripheral device and initiate programmed control sequences. An isolated supervision "watchdog" circuit shall monitor the microprocessor and, upon failure, shall activate the system trouble circuits.
      2. The automatic fire detection and alarm system shall consist of main control panel, transponder panel(s), notification alarm devices, remote annunciator, automatic detection devices, manual stations, printer, and CRT/keyboard, installed and wired in accordance with the Drawings and shall function as specified herein.
      3. The system shall be programmable in the field, by a non-computer trained person. All programmed information shall be stored in non-volatile memory.
      4. The system shall operate both addressable and non-addressable ionization, thermal and photoelectric detecting devices, manual stations, water-flow switches, and external control modules.
5. The control panel shall provide power, annunciation, supervision and control for the fire detection and alarm system. The system shall be designed such that alarm indications override trouble and control conditions.

6. External circuit supervision shall not require additional wires other than the pair used for detection or alarm (only two (2) wires shall be used from the control panel to each loop of initiating devices and two (2) wires for the notification alarm devices). These two (2) wires shall provide both supervision and notification alarm signals. There shall be no loss of supervision for Class "B" wired addressable devices. Class "A" supervision may be provided by adding an additional pair of wires.

B. Alarm Conditions
1. Actuation of any manual or automatic alarm initiating device, connected to the system shall cause the following automatic functions.
   a. All notification alarm signaling units shall activate continuously. Audible notification alarms shall sound the California State Coded Signal.
   b. The respective zone alarm lamp or annunciator alphanumeric readout on the central control panel, and remote annunciator panel, shall be activated.
   c. Activate the Digital Alarm Communicator system.
2. Actuation of HVAC air duct smoke detectors shall stop the designated fans and motors in the building's air distribution system.
3. Actuation of smoke detectors on either side of smoke doors shall energize the release mechanism on the smoke door causing the door to close.
4. Notification alarm signal duration shall be capable of continuous sounding or adjustable from three to 10-minutes.
5. Perform any additional functions as specified herein or shown on the Drawings.

C. Trouble Condition
1. A single open or single trouble condition in a manual or automatic fire initiating wiring circuit shall activate the respective zone trouble lamp or annunciator readout on the fire alarm control panel and sound a trouble signal at the control panel.
2. A single open or single trouble condition in the notification alarm signaling wiring circuit shall activate the trouble lamp or annunciator readout in the control panel and sound a trouble signal at the control panel.
3. 120 volt AC normal power shall be monitored with indication by a "power on" lamp. Upon normal power outage, the system shall activate power trouble condition lamp or annunciator readout, and indicate a trouble condition.
4. The control panel shall monitor the standby batteries and, upon a low battery condition, activate the low battery lamp or annunciator readout and indicate a trouble condition.
5. System ground detection shall be provided for the entire system. Upon ground detection, activate the ground detection lamp or annunciator readout and indicate a trouble condition.

D. Control Panels Employing Alphanumeric Readouts shall display the trouble condition along with a prompt to review the list chronologically. The end of the list shall be indicated.
2.02 FIRE ALARM CONTROL PANEL

A. General

1. The fire alarm control panel shall be software programmable, microprocessor controlled, solid state, electronic integrated system. The panel shall be the product of one Manufacturer. The control panel shall provide power, annunciation, supervision and control for the detection and alarm system. The detection system shall remain 100% operational, responding to an alarm condition while in the routine maintenance mode.

2. Addressable detection and control devices shall be individually identified by the system, and any quantity of addressable detection devices shall be in alarm and any quantity of addressable control units shall be operable at any time up to the total number connected to the system.

3. The microprocessor shall access the system program, which is stored in non-volatile programmable memory, for all Control-by-Event (CBE) functions. The system program shall not be lost upon failure of both primary and secondary power. Volatile memory shall not be acceptable.

4. A means shall be provided for acknowledging each abnormal condition. Each activation of the appropriate acknowledgement button shall sequentially acknowledge every point in the system. After all the points have been acknowledged, the LEDs shall glow steady and the panel audible signal will be silenced. The total number of alarms, supervisory, and trouble conditions shall be displayed along with a prompt to review each list chronologically. The end of the list shall be so indicated.

5. An alphanumeric annunciator readout shall indicate on the control panel the activation by type, loop, and address of the specific device, sub-loop or alarm/monitor/control point via an alphanumeric display. An audible alert shall sound at the control panel and an alarm light shall flash.

6. If the microprocessor fails, the system shall execute a default signaling program. This program shall enable the control panel to sound the audible signals and summon the Fire Department. In addition, a red LED shall light to indicate the communication loop wherein the alarm originated. Inability of the system to sound signals or summon the Fire Department during microprocessor failure shall not be acceptable.

7. Protected access to the system controls shall be provided to allow the user/operator access to the following system functions:
   a. Status of all addressable points.
   b. Status of all events logged.
   c. Set/change the real-time clock and date.
   d. Perform an operational manual test of the system from the control panel, including actuation of any initiating device and trouble circuit without alarming the remote central station. The panel shall automatically return to normal mode in the event the panel remains unattended in the service mode.
   e. Retrieve from event log the last 300 alarms, or control points and 300 trouble conditions.

8. Individual input (monitor) and output (control) device addressability shall all be performed on the same pair of wires. Wiring shall be Class "A" or "B". When Class "B" wiring is used, no special wiring sequence shall be required on addressable device circuits. An unlimited number of wiring branches shall be permitted with no loss of supervision.

9. A minimum of 25% addressable monitor, trouble and control points shall be provided.
B. Cabinet
   1. A metal tamper resistant cabinet shall contain the control panel components. Panel shall be surface or flush mounting as indicated on the Drawings. Provide a full height tamper resistant hinged locking cabinet door. The door shall have transparent, high impact windows to allow visual observation of all indicators and switches without opening the panel door.
   2. "In-out" circuit conductors shall terminate on numbered screw-type terminals.
   3. All groups of circuits or common equipment shall be clearly marked and shall be expandable by inserting interchangeable units.

C. The Control Panel shall provide positive protection against the fire alarm system inadvertently being left in a non-operating status. The alarm system shall automatically restore and resound alarms and trouble signals, if subsequent alarm initiating or trouble signals are received under any of the following conditions:
   1. After the alarm or trouble silence switch have been activated.
   2. Prior to resetting system after previous alarm or trouble conditions.

D. The System Indicating and Operational Control Devices shall be mounted on the control panel face behind the panel door and shall provide the following minimum functions:
   1. Individual visual indicating pilot lights annunciator or alphanumeric readout to monitor the following alarm system conditions:
      a. Input power.
      b. System common alarm.
      c. System common trouble.
      d. Alarm or trouble signal silenced.
      e. Ground fault.
      f. Battery condition.
      g. Each individual alarm, control or initiating zone-activation.
      h. Each individual alarm, control or notification zone-trouble.
      i. Report, by specific device number, any device removed from an addressable initiating circuit, all other devices shall continue to function.
   2. Manual control switches to allow the following system controls:
      a. Alarm silence.
      b. Trouble silence.
      c. Test all indicating pilot lights and readouts.
      d. System reset, including remote devices connected to the alarm panel.
      e. Alarm test to initiate an alarm condition from the control panel.
      f. Alarm disconnect for system testing without activating the Digital Alarm Communicator system.
      g. Changing the status of configured circuits (arming or disarming and changing status of relays). If any change in status degrades system operation as configured, a trouble condition shall be reported and remain until system operation again meets configured status.
      h. Perform multiple operations at the same time. These operations shall include but not be limited to timed functions and multiple configured sequences.

E. Alarm Initiating Zone Modules.
   1. Shall supervise and accept remote alarm actuating device input signals. An alphanumeric readout shall indicate separate zone alarm and trouble indicators for each zone.
2. Zones shall be compatible, and designed to operate with the connected initiating devices either addressable or non-addressable type.

3. A spare double throw set of software programmable auxiliary alarm relay contacts shall be provided for control of remote devices for each zone. Contacts shall be rated 120-volt 60Hz 3 Ampere.

4. Each device on the system shall report as its own unique address.

F. Notification Alarm Signal Control.
   1. Shall supervise and activate remote notification alarm devices.
   2. Notification alarm shall be compatible and designed to properly operate with the connected audio and visual notification alarm devices, with no signal degradation.
   3. The notification alarm shall provide group notification signal control of all notification zones.
   4. The alarm modules shall be field resettable to provide either continuous or Coded Notification Alarm Signals. The Coded Alarm Signal shall provide an intermittent "on-off" pulsed sound activation of audible notification alarm devices.
   5. A notification alarm circuit trouble indicating readout shall be provided for each notification zone.

G. Audio
The System shall be capable of delivering multi-channel audio messages simultaneously over copper and/or fiber media. All audio messages and live pages shall originate at the one-way audio control unit. The one-way audio control unit shall store pre-recorded audio messages digitally. These messages shall be automatically directed to various areas in a facility under program control. The system shall support remote cabinets with zoned amplifiers to receive, amplify and send messages through speakers over supervised circuits. The one-way emergency audio control shall provide control switches to direct paging messages as follows:

"All Call" to direct the page messages to all areas in the facility, overriding all other messages and tones.

"Page to Evacuation Area" to direct the message to the evacuation area(s), overriding all other messages and tones.

"Page to Alert Area" to direct page messages to the area(s) receiving the alert message and tones, overriding all other messages and tones.

"Page to Balance Building" to direct page messages to the areas) in the facility NOT receiving either the evacuation area or alert area messages.

"Page by Phone" switch to select the Fire Fighter's telephone system as the source for paging.

The System shall be capable of delivering multiple audio messages simultaneously over copper and/or fiber media. All audio messages and live pages shall originate at the one-way emergency audio control unit. The one-way emergency audio control unit shall store pre-recorded audio messages digitally. These messages shall automatically directed to various areas in a facility under program control. The
system shall support remote panels with zoned amplifiers to receive, amplify, and distribute messages through speakers over supervised circuits.

The two-way voice communications control unit shall provide two-way communications between remotely located phones and the Command Center. The control unit shall provide the ability to individually select and display each two-way voice communication circuit support up to five (5) remote telephones in simultaneous two-way voice communications.

Audio Amplifiers (Multi-Channel)

Provide one (1) 20-watt audio amplifier per paging zone. There will be a total of two (2) 20-watt amplifiers (one per floor). The system software shall be capable of selecting the required audio source signal for amplification. To enhance system survivability, each audio amplifier shall automatically provide a local 3-3-3 1000Hz temporal pattern output upon loss of the audio communications with the one-way audio control unit, during an alarm condition. Audio amplifiers shall be power limited and protected from short circuits conditions on the audio circuit wiring. Each amplifier output shall include a dedicated, selectable 25/70 Vrms output. Provide a standby audio amplifier that will automatically sense the failure of a primary amplifier, and replace the function of the failed amplifier.

H. Automatic Ground Detection shall detect either positive or negative voltages when earth connections of 50,000 OHMS or less occur, and activate the ground trouble signal.

1. A ground fault Code shall provide indication of either a positive or negative ground fault and shall operate the general trouble devices as specified herein but shall not cause an alarm to be sounded.

2. A short circuit error message shall be a standard feature of the fire alarm control panel. Each communication loop shall be monitored for short circuits and shall have a distinctive error message for visual indication of circuits and operating trouble devices as specified herein but shall not cause an alarm to be sounded.

I. Power Supply

1. The dedicated power supply shall be adequately sized to properly operate the equipment, including remotely connected, spare and future indicated equipment with all alarm devices in alarm condition. Provide 20% spare power supply capacity for future expansion. Provide transfer modules and multiple power supplies as required for proper operation.

2. Input voltage 120/240 volt or 120/208 volt 60Hz AC.

3. Surge transient voltage protection on the input and output phases of the power supply shall be provided.

4. Supervised voltage types (i.e., 120-volt 60Hz AC, 24 volt AC, 24 Volt D.C., etc.) required by special connected equipment shall be supplied, including but not limited to:

   a. Alarm initiating devices.

   b. Notification alarm devices.

   c. Control and annunciator panels.

   d. Fire and smoke dampers.

5. A solid-state power transfer circuit shall provide (UPS) Uninterrupted Power Supply between internal standby power and line power automatically and
instantaneously if normal power fails or falls below 15% of normal ("brown out" conditions).

6. Individual circuit fuses shall be provided for smoke alarm detector power, main power supply notification circuits, battery standby power, and auxiliary output.

7. Provide lock-on device on each power supply dedicated branch circuit breaker at panel.

J. Battery Back-Up Operation

1. Internal batteries and battery power supplies shall be provided to allow 60-hours continuous automatic normal operation of the entire control panel and fire alarm system after the failure of the incoming utility power. Sufficient battery capacity shall remain at the end of 60-hour period to provide ten minutes of continuous operation of all connected notification alarm devices.

2. Batteries shall be maintenance free, sealed, lead-acid or lead calcium or gelled electrolyte type rated 25% larger than required to provide power for the entire system upon loss of normal 120 VAC power for a period of 60-hours with 15-minutes of alarm signaling at the end of this 60-hour period.

3. The battery charger shall be automatic, dual rate with capacity to recharge completely discharged batteries in 18-hours. Charger shall be temperature compensated.

K. Lightning and Transient Voltage Surge Protection shall be a standard feature of the fire alarm control panel and shall be incorporated in the power supply circuit, common control circuits, signal circuits, and telephone line circuit.

L. Circuitry shall be provided in the control panel to permit transmission of trouble and alarm signals over leased or privately owned telephone cables to a remote receiving panel. A reverse polarity or a master box circuit as required shall be provided in the control panel. There shall be a supervised disconnect switch to allow testing of the fire alarm signal without transmitting an alarm signal to the central station.

M. The Alphanumeric Annunciator (printer and CRT/keyboard) shall list upon request:

1. Alarms with time, date and location.
2. Troubles with time, date and location.
3. Status of output functions, "on" or "off".
4. Sensitivity of addressable smoke detectors.
5. Detection device number, type and location.
6. Status of remote relays, "on" or "off".
7. Acknowledgment time and date.
8. Signal silence time and date.
9. Reset time and date.

N. The System shall also provide the following:

1. Counting the number of addressable detectors within a "zone".
2. Which are in alarm.
3. Counting "zones" which are in alarm.
4. Counting the number of addressable detectors which are in alarm.
5. Alarm on the system.
6. Differentiating among types of addressable detectors such as smoke detectors, manual stations, water-flow switches, thermal detectors.
7. Assigning priorities to types of detectors, zones or groups of detectors.
O. Control Functions

1. Control functions shall be assigned on the basis of multi-relational system initiation patterns of detection devices including full logic element equations using as "anding" zones, counting zones, counting devices, "anding" groups, conditional "if", "then", "or" programming and "anding" types of detection devices.

2. Control functions shall be assigned on the basis of cycle, delay, count, time of day, day of week, day of month and with a holiday schedule of up to 30-holidays per year. Each addressable detection device shall report its condition to the system control unit not less than every 4-seconds in a manner such that failure of the connections to the internal electronics of the device will result in a trouble signal which identifies the specific device involved.

3. The system shall be field programmable for the response of control points to monitored devices.

4. The operating software program shall provide programmable control for the Event-Initiated-Programs (E.I.P.) which shall allow automatic operation of system control points in the event of an alarm condition. To program this E.I.P.s, the system shall use a specifically designed user friendly programming language, which shall not require a knowledge of computer programming to learn and understand.

5. The operating software shall support the following additional capabilities:
   a. Three levels of designated and unique Priority Alarms for each point.
   b. Designated "Sense Mode" for status interpretation for each point.
   c. Designated Print/No Print/Vectoring Mode for each point.

6. The input statement defines the conditions required to activate the associated output statement. The input statement shall consist of single or multiple monitor point status, subroutine status, time comparison and the utilization of AND, OR, NOT, COUNT, and DELAY logic functions.

7. The output statement defines the action to be taken by the control panel. The output statement shall consist of activation/deactivation of single or multiple control functions, subroutines, and remote Annunciator status LED's. Output statements shall also include the "Alert" messages.

8. The software shall provide an "alert" message, unique to each point in the system, which will provide specific instructions for the operator on duty. These messages shall be up to five (5) lines with up to seventy (70) characters in each line. Each system monitor point shall have five (5) specific alert messages when in alarm. Control points shall also be assigned alert messages.

9. The hardware and software shall have the capacity to accept up to sixty-four (64) independent programs. Each program shall have "Edit" or "No Edit" capability. Each program shall be written in an equation format comparable to ladder-logic equations. The Equations shall consist of an input and an output statement.

10. Provide initial programming services for coding, loading and debugging the initial District specified programs, as part of the Contract.

11. Programming Command Definition
   a. Timing command shall provide time delay and time control functions based on internal clock/calendar by time of day; day of week; day of month; month in year.
   b. Count command shall provide a specific number of events to occur before a control action is initiated.
   c. Pulse command shall provide on control for a specific period of time.
   d. Cycle command shall provide on-off control for preset periods of time.
2.03 FIRE ALARM DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Enclosure shall be red.

B. Panel shall be solid state with eight zones for off premise monitoring of the fire alarm control panel.

C. System shall monitor alarm and trouble conditions. System shall be power limited.

D. System shall include dual telephone line switcher for central station reporting. Telephone lines shall be supervised.

E. System shall include dual battery harness, batteries, and battery charger.

F. System shall be UL listed for central station fire signaling systems (NFPA 71).

G. System shall be California State Fire Marshal approved for central station reporting.

H. System shall be Radionics D8112FA Series or Simplex 5071 Series. System shall be approved for connection to the fire alarm control panel.

I. Verify Specific Requirements with District and Central Station prior to submittals.

2.04 MANUALLY ACTIVATED ALARM INITIATING DEVICES

Manual Fire Alarm Boxes shall comply with CBC Sections 11B-309 and 11B-403.

A. An Electronic, Digital Multiplex, Addressable Module shall be incorporated into each device. The module shall communicate the status and trouble condition of each device with a unique address Code. The module shall communicate with and be supervised and monitored by the fire alarm control panel.

B. Devices shall be suitable for use on a Class "B", 2-wire supervised alarm initiating circuit.

C. Numbered Screw Type Terminals shall be provided for "in-out" connections of the alarm circuit wiring.

D. The Face of the Station shall have lettering indicating "FIRE" and operational instructions. Stations shall be tamper resistant, semi-flush mounting.

E. Auxiliary Spare Switch Contact shall be provided for control of remote devices rated 120 volts - 60Hz, AC - 3AMP minimum.

F. Stations shall provide visual indication the station has been activated. A key (and/or special tool) shall be required to gain access into the station to reset the station after being activated.

G. Stations shall be "Nonbreak-Glass" type.

H. RF and Transient Filtering shall be provided in the device electronics.
I. Pull Stations shall be non-coded double action, requiring a two (2) District manual "pulling" actions to initiate the fire alarm system.

J. Stations Installed Outdoors shall be weather resistant construction, double action to activate the pull station.

2.05 AUTOMATIC ALARM INITIATING DEVICES

A. General
1. An electronic digital, multiplex, addressable module shall be incorporated into each device. The module shall communicate the status and trouble condition of each device with a unique Address Code. The module shall communicate with and be supervised and monitored by the fire alarm control panel.

2. Devices shall be suitable for use on a Class "B", 2-wire supervised alarm initiating circuit. Where initiating devices are shown connected to an existing system, devices shall operate on 2 or 4-wire circuits plus, 2-wire power circuit as required by the existing equipment.

3. Numbered screw type terminals shall be provided for "in-out" connectors of the alarm circuit wiring.

4. Auxiliary double throw spare relay contact shall be provided for activation of remote rated devices 120-volt 60Hz, AC, 1 Ampere minimum.

5. RF and transient filtering shall be provided in the initiating device electronics.

6. Initiating devices shall be reset from the control panel and shall not require individual resetting.

B. Smoke Detector
1. Detectors shall comply with UL standard 268, 167 and 168, and shall use solid state electronic circuits throughout.

2. The smoke detector shall operate on a total of two circuit wires. Alarm signaling and detector power shall use the same conductors. Detector sensitivity shall be factory set at 1.5%. Provide testing provisions in accordance with CFC 907.9.3 – 907.9.4.1, NFPA72.

3. A fine mesh insect screen shall be provided on all detector openings.

4. The detector shall lock-in on alarm and shall provide a visual alarm/trouble indicator light. An electromechanical test feature shall provide functional testing of the unit without smoke.

5. The detector shall also incorporate a fixed temperature heat detector rated at 135 degrees F. The heat detector shall operate the alarm circuit and alarm/trouble light.

a. Photo electric type smoke detectors shall employ a Light Emitting Diode (LED) as the detector light source, activated by the presence of combustion smoke products. Failure of the LED shall activate the alarm/trouble light on the detector.

b. Ionization type smoke detector shall employ the triple chamber (dual chamber) ionization principle, activated by the presence of combustion products. The ionization chamber shall be RF shielded.

c. Air duct smoke detector photo electric or ionization type for installation on a mechanical air ducts. Two air tubes shall extend into the air duct. The sampling tube shall extend across the entire width of the air duct. The second tube shall allow air to escape back into the duct.
C. Fire Detector - Heat
   1. Heat detectors shall be dual action electro-thermostatic combination rate of
temperature rise and fixed temperature operation. An indicator shall be visible
when detector has activated.
   2. The rate of rise element shall be self-restoring, after activation.
   3. The fixed temperature unit shall be set at 136 degrees F (190 degrees F for
high temperature areas i.e. over 110 degrees F).
   4. Provide a wire guard cover for the detector.

2.06 NOTIFICATION ALARM DEVICES

A. General
   1. Notification alarm devices shall activate automatically from the control panel.
Devices shall operate on a Class "B" (Style Y), 2-wire supervised alarm
notification circuit. Series wired alarm devices shall not be used.
   2. Numbered screw type terminals shall be provided for "in-out" connections of
the alarm circuit wiring.
   3. Devices shall be installed in a box, 3½-inches deep maximum, flush mounting
unless indicated otherwise on the Drawings. Size as required for the alarm
indicating device and wiring connections. Provide a trim ring and metal grill
cover assembly. Cover assembly shall be a minimum of 1/16-inch minimum
thick flat stainless steel or aluminum. Finish color as selected by Architect.
The word "fire" shall appear on the grill minimum ½-inch letters. The grill shall
be attached with screws to the box.
   4. Each audible notification visual devices shall incorporate a visual alarm
indicator. The visual alarm indicating device shall be an integral part of the
audible alarm box assembly.
   5. Audible notification device and visual notification devices shall be connected to
separate notification alarm signal circuits. Do not connect these devices to the
same circuit conductors.

B. Notification Appliances
   1. Speakers
      Low Profile Speaker
      Provide low profile wall mount speakers at the locations shown on the
Drawings. The low profile speaker shall not extend more than 1-inch (2.5cm)
past the finished wall surface, and provide a switch selectable audible output of
2W (90dBA), 1W (87dBA), ½W (84dBA), or ¼W (81dBA) at 10 feet when
measured in reverberation room per UL-464.
      Wattage setting shall be visible with the cover installed. When the cover is
installed, no mounting hardware shall be visible. In and out screw terminals
shall be provided for all wiring. The low profile speaker shall mount in a North
American 4-inches x 2½-inches square electrical box, without trims or
extension rings.
   2. Speaker-Ceiling Mount-8in
      Provide 8-inches ceiling mounted speakers at the locations shown on the
Drawings. In and out screw terminals shall be provided for wiring. Speaker
baffles shall be round or square steel with white finish as required. Provide
square surface mount boxes with matching finish where required. Speakers
shall provide ½w, 1w, 2w, and 4W power taps for use with 25V or 70V
systems. At the 4 watt setting, the speaker shall provide a 94-dBA sound
output a frequency of 1000Hz when measured in an anechoic chamber at 10
feet.
3. **Speaker-Cone-4in**  
Provide 4-inches white speakers at the locations shown on the Drawings. Speakers shall have a 4-inch Mylar cone, paper cones are not acceptable. The rear of the speakers shall be completely sealed protecting the cone during and after installation. In and out screw terminals shall be provided for wiring. Speakers shall provide ¼w, ½w, 1w, and 2w power taps for use with 25V or 70V systems. At the 2-watt setting, the speaker shall provide a 90-dBA sound output over a frequency range of 400-4000Hz when measured in reverberation room per UL-1480.

4. **Speaker-Reentrant Surface**  
Provide 4-inch surface re-entrant speakers at the locations shown on the Drawings. Speakers shall provide 2w, 4w, 8w, and 15w power taps for use with 25V or 70V systems. The re-entrant speakers shall utilize a high efficiency compression drivers. Cone type drivers are not acceptable. At the 15 watt setting, the speaker shall provide a 102dBA sound output over a frequency range of 400-4000 Hz when measured in reverberation room per UL-1480. Weatherproof boxes shall be provided for outdoor mounting.

5. **Speaker-Strobes**  
**Low Profile Speaker-Strobe**  
Provide low profile wall mount speaker/strobes at the locations shown on the Drawings. The low profile speaker/strobe shall not extend more than 1-inch (2.5cm) past the finished wall surface, and provide a switch selectable audible output of 2W (90dBA), 1W (87dBA), 1/2W (84dBA), or 1/4W (81dBA) at 10 feet when measured in reverberation room per UL-464. Strobes shall provide synchronized flash output that shall be switch selectable for output values of 15cd, 30cd, 75cd and 110cd. Wattage and candela settings shall be visible with the cover installed. When the cover is installed, no mounting hardware shall be visible. In and out screw terminals shall be provided for all wiring. The low profile speaker/strobes shall mount in a North American 4-inches x 2½-inches square electrical box, without trims or extension rings.

6. **Speaker-Strobe 4in**  
Provide 4-inches red speakers/strobes at the locations shown on the Drawings. Speakers shall have a 4-inches Mylar cone, paper cones are not acceptable. The rear of the speakers shall be completely sealed protecting the cone during and after installation. In and out screw terminals shall be provided for wiring. Speakers shall provide ¼w, ½w, 1w, and 2w power taps for use with 25V or 70V systems. At the 2 watt setting, the speaker shall provide an 87dBA sound output over a frequency range of 400-4000Hz when measured in reverberation room per UL-1480. Strobes shall provide synchronized flash. Strobe output shall be determined as required by its specific location and application from a family of 15/75cd, 30cd, and 110cd devices.

7. **Speaker-Strobe Ceiling 8in**  
Provide 8-inches ceiling mounted speaker/strobes at the locations shown on the Drawings. In and out screw terminals shall be provided for wiring. Speaker baffles shall be round or square, steel with white finish as required. Provide square surface mount boxes with matching white finish as required. Speakers shall provide ½w, 1w, 2w, and 4W power taps for use with 25V or 70V systems. At the 4 watt setting, the speaker shall provide a 94dBA sound output a frequency of 1000Hz when measured in an anechoic chamber at 10 feet. Strobes shall provide synchronized flash outputs. Strobe output shall be determined as required by its specific location and application from a family of 15cd, 30cd, 75cd, and 110cd devices.
8. **Speaker-Strobe Re-entrant**  
Provide 4-inch red re-entrant speaker/strobes at the locations shown on the Drawings. Weatherproof boxes shall be provided for outdoor mounting. Speakers shall provide 2w, 4w, 8w, and 15w power taps for use with 25V or 70V systems. The re-entrant speakers shall utilize a high efficiency compression drivers. Cone type drivers are not acceptable. At the 15-watt setting, the speaker shall provide a 102dBA sound output over a frequency range of 400-4000Hz when measured in reverberation room per UL-1480. Strobes shall provide synchronized flash. Strobe output shall be determined as required by its specific location and application from a family of 15cd, 30cd, 75cd, and 110cd devices.

C. **Visual Alarm Indicator**  
1. Lamp/Strobe internally illuminated projecting lens assembly, with flasher system. Unit shall flash on and off to provide visual indicating of fire alarm.  
2. The word "fire" shall appear on the lens or lens plate.  
3. Flash rate, one flash per second, with a flash duration of approximately 0.001 second, flash rate independent of audible device.  
4. Light source, Xenon high intensity flash strobe tube white/clear color.  
5. Strobe shall have a minimum output of 75 candelas with a maximum flash intensity of 120 candelas.  
6. Strobe shall comply with NFPA requirements.

**2.07 REMOTE FIRE ALARM ANNUNCIATOR**

A. **General**  
1. The annunciator panel shall be powered and operated from the fire alarm control panel. "In-out" circuit conductors shall terminate on numbered screw-type terminals.  
2. A metal tamper resistant weatherproof cabinet shall contain the annunciator components. The panel shall be surface or flush mounted as indicated on the Drawings. Provide a full height tamper resistant, hinged locking cabinet door. Door shall have transparent high impact windows to allow visual observation of all indicators and switches.  
3. An electronic digital, multiplex, addressable module shall be incorporated into the annunciator. The module shall communicate the status and trouble condition of each device with a unique address code. The module shall communicate with and be supervised and monitored by the fire alarm control panel.

B. Each Alarm Initiating Zone (including spares) shall be individually annunciated in the annunciator panel.  

C. A Common Fire Trouble Alarm shall be annunciated in the annunciator panel from the fire alarm control panel.  

D. Annunciator Lamp Circuits shall be automatically supervised. Provide lamp test switch in the annunciator panel.  

E. An Audible Alarm/Trouble Buzzer with silence switch and automatic resound for subsequent alarm/trouble signals shall be provided. The annunciator panel shall be automatically reset when the control panel is reset.
F. A Keyed Switch shall be provided for remote reset of the system. The annunciation panel shall also be automatically reset when the control panel is reset.

G. Provide a Floor Plan of the facility framed under acrylic and mounted adjacent to the fire alarm annunciator. The floor plan shall be to scale and shall have room numbers clearly displayed on all rooms corresponding to the annunciator for the purpose of easily identifying the fire zones.

2.08 REMOTE EQUIPMENT MONITORING AND CONTROL

A. An Electronic Digital Multiplex Addressable Module shall be provided at each device or equipment indicated to be controlled by the multiplex system. Multiple addressable control ports shall be provided in each module quantity as required for each point controlled or monitored. The module shall communicate the monitor status control action and trouble condition of each device with a unique address Code. The module shall communicate with and be supervised and monitored by the fire alarm control panel.

B. Where Multiple Points are Monitored or Controlled, Provide Digital, Multiplex, Multi-points, Monitor, Control Panel (MMCP). The panel cabinet shall be self-contained NEMA 1 construction and hinged locking door. Provide tamper switch detection zone on the cabinet door; provide 60 hour battery UPS backup and power supply, the same as required for the fire alarm control panel. Panel shall be expandable using plug-in circuit monitor/control printed circuit cards. Provide barriered numbered terminal strips.

C. Each Control Point shall provide a supervised "dry" relay contact single pole double throw maintained contact rated 10 ampere, 227 volt, 60Hz AC.

D. Each Monitor Point shall provide not less than one of the following supervised methods of monitoring a remote device or equipment action or status.
   1. Remote "dry" contact operation normal open, normally closed or momentary contact operation.

PART 3 EXECUTION

3.01 IDENTIFICATION

A. The Inside Cover of Alarm Initiating Devices shall be marked with the zone initiating number corresponding to the zone number in the control panel. Marking shall be with a felt-tip pen.

B. Each Fire Alarm Terminal Cabinet shall be painted red.

C. Provide Nameplate: "Power to Main Fire Alarm Control Panel" screwed onto the branch circuit overcurrent device supplying power to the main fire alarm control panel.

3.02 WIRING

A. Review the Total System Point-to-Point Wiring layout to assure that the correct number and type of wires and conduit sizes are installed.
B. Final Connections, Testing, Adjusting and Calibration shall be made under the direct supervision of a Factory-Trained Technician of the System Supplier.

C. All Wiring shall be in conduit.

D. All Wiring in Cabinets shall be neatly formed, laced and made up on bolt and nut terminal blocks. Tag all spare conductors. All conductors shall terminate on terminal strips with spade lugs, of adequate size for all incoming and outgoing conductors. The strips shall be labeled as to their use and wiring diagram shall be placed on the cabinet door showing connections of all related equipment to these strips.

E. Wiring Requirements for shielding certain conductors shall be as recommended by the Manufacturer. Provide all conduit, raceways and conductors per Manufacturer's recommendations and include all material and labor costs in the Contract Price.

F. The Conductors used for digital, multiplex communication between the fire alarm control panel and external remote initiation devices, control points and annunciators, shall be twisted, shielded, multi-conductor cable, #16AWG copper minimum with a separate internal ground/drain conductor, UL listed for fire alarm system use. One (1) spare pair of multiplex conductors shall be provided in all main and branch device/equipment connections for future system use. "Tees" and taps at any junction box location in the communication lines, shall be permitted by the system to additional devices without affecting proper system operation.

G. Wire Size: Wire shall be sized to insure installed circuit voltage drop does not exceed 10% to all devices.

3.03 OUTLET BOXES

Device outlet boxes shall be flush mounted unless indicated otherwise on the Drawings. Provide extension rings to finish flush with finish surface. Where the Drawings indicate surface mounted devices, outlet boxes shall be cast metal with threaded hubs. Where the conduit entrances are not exposed for surface mounted devices, provide flush outlet box behind the device box, and omit the conduit hubs on the device box. Size device boxes and outlet boxes per Manufacturer's recommendation and as required by code for wire fill.

3.04 SPECIAL INSTALLATION REQUIREMENTS

A. Air Duct Smoke Detectors shall be installed in the supply air ducts and return air ducts with an air flow of 2000 CFM or greater, coordinate with Mechanical Contractor. Sampling tube shall extend across entire duct width. Provide ¾-inch conduit with 2#12 to respective motor control device to automatically shut down the respective fan motor upon detection of smoke in the air duct. Installation shall be in compliance with CMC 606.8.

B. Water Flow Switches shall be installed on each main fire sprinkler rise pipe, coordinate with the Fire Sprinkler Contractor.

C. Tamper Switches shall be installed on each main fire sprinkler shut-off valve, coordinate with the Fire Sprinkler Contractor.

D. Equipment shall be weatherproof gasketed where installed in locations exterior to the building, or where indicated on the Drawings. Weatherproof equipment shall be tamper resistant.
E. Provide Clear Vandal Resistant Protective Cover for all audio-visual devices located in student restrooms and public hallways.

F. Provide Wire Guard for Ceiling mounted smoke and heat detectors located in student restrooms.


H. Connect Fire Alarm Control Panel with Master Clock System to turn off class passing schedule, with paging system to turn off system when fire alarm system in alarm condition.

I. Conduit with Fire Alarm Wiring shall be painted red.

J. Fire Alarm System shall be programmed per actual building and room designation. Submit printout for review.

3.05 TESTING

A. The Entire Fire Alarm System shall be tested in the presence of the Local DSA Inspector and a Representative of the Manufacturer after the installation is complete.
   1. Individually activate each manual initiating station and verify correct alarm operation and control panel response.
   2. Individually test each automatic initiating device and verify correct alarm operation, control panel response and remote equipment operation.
   3. The communication loops and the notification alarm circuits shall be opened in at least two (2) locations per building to check for the presence of correct supervisory circuitry.

B. Test the Battery Back-up System by disconnecting the incoming normal power and allowing this alarm system to operate 24 hours on battery power. Sound the alarm system for 5-minutes at the end of 24 hours on battery power.

C. Perform all Electrical and Mechanical Tests required by the Equipment Manufacturer's Certification form. Measure and adjust each automatic detection detector to the maximum stable sensitivity setting. Detector tests shall be performed with the detector at its operational location and under normal operational environmental conditions in the area. Bench settings are not acceptable. An operational check-out test and report shall be performed. Submit six (6) copies of test report results. The tests and report shall include, but not be limited to:
   1. A complete list of equipment installed and wired.
   2. Indication that all equipment is properly installed and functions and conforms with these Specifications.
   3. Test of individual zones as applicable.
   4. Serial numbers locations by zone and model number for each installed detector.
   5. Voltage (sensitivity) settings for each ionization and photoelectric detector as measured in place with the HVAC system operating.
   6. Technician's name, certificate number and date.
   7. The completed manual and automatic monitoring and control system shall be tested to insure that it is operating properly. This test will consist of exposing the installed units to a standard fire test.
8. Acceptance of the system shall also require a demonstration of the stability of the system. This shall be adequately demonstrated if the system operates for a 90-day test period without any unwarranted alarms. Should an unwarranted alarm(s) occur, the Contractor shall readjust or replace the equipment and detector(s) and begin another 90-day test period. As required by the Architect, the Contractor shall recheck the detectors using the fire test after each readjustment or replacement of detectors. This test shall not start until the District has obtained beneficial use of the building under tests.

D. After the Testing has been completed to the satisfaction of CFC 907.9 – 907.9.4.1 the Inspectors, provide the NFPA Certificate of compliance to the District, the Local Fire Official, the Architect and DSA.

E. Upon the receipt of Certificate of Compliance, the Installer/Supplier shall supply the District with a written operating, testing and maintenance instructions, point-to-point As-Built Drawings, and Equipment Specifications. Maintenance provisions, CFC 907.4.5.

3.06 INSTRUCTIONAL SESSIONS

Provide a 2-hour Instructional Sessions conducted by a Factory-Authorized Technician at the Job Site after completion of all tests to instruct District Personnel on the use of the system. The first session shall be videotaped and conducted prior to final acceptance of the Project. The second session shall be held within 11-months of final acceptance of the Project, when requested by the District.

END OF SECTION
042115/223015
SECTION 31 00 00

EARTHWORK

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Materials, equipment and labor required to provide grading and fine grading as indicated on Drawings and specified herein. Work includes, but may not be limited to:
   a. Excavation, compacted engineered fill and preparing of subgrade for building footings, slabs, walks, and pavements.
   b. Excavating and backfilling of trenches.
   c. Sand moisture barrier for support of slabs is included as part of this work.

B. Incorporated Documents: Drawings and general provisions of the Contract, including General and Special Conditions and Division 01 specification sections, apply to this section.

C. Related Sections: Containing requirements related to this section include, but may not be limited to:
   1. Section 31 10 00: Site Clearing.
   2. Division 23: Mechanical Sections.
   3. Division 26: Electrical Sections.

D. Excavating and Backfilling for Mechanical and Electrical Work: Refer to Divisions 23 and 26 for excavation and backfill required for underground mechanical and electrical utilities and related buried appurtenances.

1.02 PROJECT DATA


1.03 DEFINITIONS

A. Excavation: Consists of removal of material encountered to subgrade elevations indicated and subsequent use of the excavated material as fill, disposal off-site or stockpiled for future use of materials removed.

B. Unauthorized Excavation: Consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Architect. Unauthorized excavation, as well as remedial work directed by the Soils Engineer upon receipt of written authorization from the Architect, shall be at Contractor’s expense.
1. Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position, when acceptable to Soils Engineer.

2. In locations other than those above, backfill and compact unauthorized excavations as specified by the Soils Engineer for authorized excavations of same classification, unless otherwise directed by Architect.

C. Additional Excavation: When excavation has reached required subgrade elevations, notify Architect, who will notify the Soils Engineer to make an inspection of conditions. If the Soils Engineer determines that bearing materials at required subgrade elevations are unsuitable, continue excavation until suitable bearing materials are encountered and replace excavated material as specified by the Soils Engineer and directed by Architect. The Contract sum may be adjusted by an appropriate Contract modification.

1. Removal of unsuitable material and its replacement as directed shall be paid on basis of conditions of the Contract relative to changes in work.

D. Subgrade: The undisturbed earth or the compacted soil layer immediately below granular sub-base, drainage fill, or topsoil materials.

1.04 REFERENCES

A. Published specifications, standards, tests, or recommended methods of trade, industry, or governmental organizations apply to Work of this Section where cited by abbreviations noted below (latest editions apply unless noted otherwise).

1. ASTM International (ASTM).

1.05 SUBMITTALS

A. Test Reports: Submit the following reports directly to Architect from the testing services, with copy to Contractor:

1. Test reports on borrow material.
2. Verification of suitability of each footing subgrade material, in accordance with specified requirements.
3. Field reports; in-place soil density tests.

1.06 QUALITY ASSURANCE

A. Codes and Standards: Perform excavation work in compliance with applicable requirements of authorities having jurisdiction.
B. Testing and Inspection Service: Owner shall employ and pay for a qualified independent geotechnical testing laboratory to perform soil testing and inspection service during earthwork operations.

C. Testing Laboratory Qualifications: To qualify for acceptance, the geotechnical testing laboratory must be Division of the State Architect (DSA) approved and demonstrate to Architect’s satisfaction, based on evaluation of laboratory-submitted criteria conforming to ASTM E 699, that it has the experience and capability to conduct required field and laboratory geotechnical testing without delaying the progress of the Work.

D. Foundation Soils: Excavate for foundations to sizes indicated, clean and leave in condition recommended by Geotechnical Investigation Report. Prior to placement of forms, reinforcing or concrete, obtain approval of Soils Engineer and DSA Project Inspector as required, for proper conditions and suitable bearing materials.

1.07 PROJECT CONDITIONS

A. Site Information: Data in subsurface investigation reports was used for the basis of the design and are available to the Contractor for information only. Conditions are not intended as representations or warranties of accuracy or continuity between soil borings. The Owner will not be responsible for interpretations or conclusions drawn from this data by Contractor.
   1. Contractor may perform additional test borings and other exploratory operations, at the Contractor's option and expense.

B. Existing Utilities: Locate existing underground utilities in areas of excavation work. If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations.
   1. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for direction. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.
   2. Do not interrupt existing utilities serving facilities occupied by Owner or others, during occupied hours, except when permitted in writing by Architect and then only after acceptable temporary utility services have been provided.
      a. Provide minimum of forty-eight (48) hour notice to Architect and Owner and receive written notice to proceed before interrupting any utility.
   3. Demolish and completely remove from Site existing underground utilities indicated to be removed. Backfill for abandoned underground utilities shall conform to Section 2.01 - Soil Materials and 3.05 - Backfill and Fill. Coordinate with utility companies for shutoff of service if lines are active.

C. Protection of Subgrade: Do not allow equipment to pump, rut, or disturb subgrade, stripped areas, or other areas prepared for backfill or paving operations.
PART 2 – PRODUCTS

2.01 SOIL MATERIALS

A. Reference: Soil Engineering Foundation Investigation for review at District office.

B. Imported Soil Materials: All fill soil imported to the site shall be granular and shall have an expansion index of less than twenty (20) and be classified as SM, SW, and SP in accordance with ASTM D 2487. Import fill shall be free of rock and lumps of soil larger than three inches in diameter and shall be at least sixty (60) percent finer than the 1/4” sieve.

C. Granular Base/Sand Moisture Barrier: A minimum four-inch thick layer of coarse, poorly graded sand or crushed rock shall be placed underneath the slab. This layer shall consist of material with 100 percent passing the 1/2” sieve, and not exceeding 10 and five percent passing the #100 and #200 sieves, respectively. Where moisture-sensitive floor coverings are planned, the slab should be underlain by a 15 mil Class A plastic meeting ASTM E 1745 with perm rating less than or equal to 0.012 perms as tested by ASTM E 96.

D. Utility Trench Backfill: Material for use in backfilling trenches shall consist of hard, durable, clean sand, gravel, or crushed stone, and shall be free from organic material, clay balls, or other deleterious substances.

E. Sub-base Material: When required under exterior on-grade slabs or playground pavement, sub-base material shall comply with the requirements for Disintegrated Granite as specified by Section 400-2.3 of the “Standard Specifications for Public Works Construction.”

F. Base Material: Base material under asphalt pavements shall be classified as Class II Aggregate Base as specified by Section 26-1, 02B of the “Standard Specifications for Public Works Construction.” Sub-base material, as specified in Paragraph D above, may be substituted for Class II Aggregate Base under playground pavements.

PART 3 – EXECUTION

3.01 EXCAVATION

A. Excavation Classifications: The following classifications of excavation will be made when rock is encountered:

1. Earth excavation includes excavation of pavements and other obstructions visible on surface; underground structures, utilities, and other items indicated to be demolished and removed; together with earth and other materials encountered that are not classified as rock or unauthorized excavation.

3.02 STABILITY OF EXCAVATIONS

A. General: Comply with local codes, ordinances, and requirements of agencies having jurisdiction.
B. Slope sides of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

3.03 STORAGE OF EXCAVATED MATERIALS

A. Stockpile excavated materials acceptable for backfill and fill where directed. Place, grade and shape stockpiles for proper drainage.
   1. Locate and retain soil materials horizontally away from edge of excavations equal to the depth of the excavation. Do not store within drip line of trees indicated to remain.
   2. Dispose of excess excavated soil materials not acceptable for use as backfill or fill.

3.04 TRENCH EXCAVATION FOR PIPES AND CONDUIT

A. Excavate trenches to uniform width, sufficiently wide to provide ample working room and a minimum of six (6) to nine (9) inches of clearance on both sides of pipe or conduit.

B. Excavate trenches and conduit to depth indicated or required to establish indicated slope and invert elevations and to support bottom of pipe or conduit on undisturbed soil. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
   1. Where rock is encountered, carry excavation six (6) inches below required elevation and backfill with a six (6) inch layer of crushed stone or gravel prior to installation of pipe.
   2. For pipes or conduit less than six (6) inches in nominal size, and for flat-bottomed, multiple-duct conduit units, do not excavate beyond indicated depths. Hand-excavate bottom cut to accurate elevations and support pipe or conduit on undisturbed soil.
   3. For pipes and equipment six (6) inches or larger in nominal size, shape bottom of trench to fit bottom of pipe for ninety (90) degrees (bottom 1/4 of the circumference). Fill depressions with tamped sand backfill. At each pipe joint, dig bell holes to relieve pipe bell of loads to ensure continuous bearing of pipe barrel on bearing surface.

3.05 BACKFILL AND FILL

A. General: All fill material and backfill material shall consist of satisfactory soil material or imported soil materials as specified in Part 2 of this section, and shall be placed in maximum six (6) inch-thick compacted layers to the required subgrade elevations, except as follows:
   1. Under walks, and playground pavement, the upper four (4) inches of fill shall consist of sub-base as defined in Section 2.01D or base material as defined by Section 2.01E.
   2. Under driveway and parking lot pavement, base material as defined by Section 2.01E shall be placed in the thickness specified on the construction drawings.
3. Under interior building slabs, the upper four (4) inches of fill shall consist of sand or rock as specified in Section 2.01B.

4. Under piping and conduit and equipment, use sub-base materials where required over rock bearing surface and for correction of unauthorized excavation. Shape excavation bottom to fit bottom ninety (90) degrees of cylinder.

5. Backfill trenches with concrete where trench excavations pass within eighteen (18) inches of column or wall footings and that are carried below bottom of such footings or that pass under wall footings. Place concrete to level of bottom of adjacent footing.
   a. Concrete is specified in Division 03.
   b. Do not backfill trenches until tests and inspections have been made and backfilling is authorized by Architect. Use care in backfilling to avoid damage or displacement of pipe systems.

B. Backfill excavations as promptly as work permits, but not until completion of the following:
   1. Acceptance of construction below finish grade including, where applicable, damp-proofing, waterproofing, and perimeter insulation.
   2. Inspection, testing, approval, and recording locations of underground utilities have been performed and recorded.
   4. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place if required.
   5. Removal of trash and debris from excavation.
   6. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

3.06 PLACEMENT AND COMPACTION

A. Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow strip, or break up sloped surfaces steeper than one (1) vertical to four (4) horizontal (1:4) so that fill material will bond with existing surface.
   1. When existing ground surface has a density less than that specified under "Compaction" for particular area classification, break up ground surface, pulverize, moisture-condition to optimum moisture content or slightly above, and compact to required depth and percentage of maximum density.
   2. If the unsuitable material described above is greater than twelve (12) inches thick, this material will have to be removed and recompacted as directed by the soil engineer.

B. Place backfill and fill materials in layers not more than eight (8) inches in loose depth for material compacted by heavy compaction equipment, and not more than four (4) inches in loose depth for material compacted by hand-operated tampers.

C. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content or slightly above. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification.
D. Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.

E. Control soil and fill compaction, providing minimum percentage of density specified for each area classification indicated below. Correct improperly compacted areas or lifts as directed by Architect if soil density tests indicate inadequate compaction.

1. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density, in accordance with ASTM D 1557:
   a. Under foundations, building slabs and steps: Compact top eighteen (18) inches of subgrade and each layer of backfill or fill material at ninety (90) percent maximum density.
   b. Under pavements: Compact top six (6) inches of subgrade to 95% and each layer of backfill or fill material at ninety (90) percent maximum density. Compact Aggregate paving base material to 95% maximum density.
   c. Under lawn or unpaved areas: Compact top six (6) inches of subgrade and each layer of backfill or fill material at eighty (80) percent maximum density.
   d. Under walkways: Compact top twelve (12) inches of subgrade and each layer of backfill or fill material at ninety (90) percent maximum density.

2. Moisture Control: (under the direction of the Soils Engineer)
   a. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material. Apply water in minimum quantity as necessary to prevent free water from appearing on surface during or subsequent to compaction operations.
   b. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density. Stockpile or spread soil material that has been removed because it is too wet to permit compaction. Assist drying by disking, harrowing or pulverizing until moisture content is reduced to a satisfactory value.

3.07 GRADING

A. General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated, or between such points and existing grades.

B. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces free from irregular surface changes and as follows:
   1. Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than 0.10 foot above or below required subgrade elevations.
2. Walks: Shape surface of areas under walks to line, grade and cross-section, with finish surface not more than 0.10 foot above or below required subgrade elevation.

3. Pavements: Shape surface of areas under pavement to line, grade, and cross-section, with finish surface not more than 1/2 inch above or below required subgrade elevation.

3.08 EROSION CONTROL

A. Provide erosion control methods in accordance with requirements of authorities having jurisdiction.

3.09 MAINTENANCE

A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

B. Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerances.

C. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.

3.10 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Removal from Owner’s Property: Remove waste materials, including unacceptable excavated material, trash, and debris, and dispose of it off Owner’s property.

END OF SECTION 31 0000
SECTION 31 1000
SITE CLEARING

PART 1 - GENERAL

1.01 SUMMARY

A. Provisions of Division 01 apply to this section.

B. Section Includes:

C. Related Sections:
   1. Section 31 0000: Earthwork
   2. Section 32 1100: Base Course.
   3. Section 31 3119: Chain Link Fences and Gates.

1.02 SUBMITTALS

A. Shop Drawings: Site plan indicating extent of site clearing.

1.03 QUALITY ASSURANCE

A. Comply with Standard Specifications for Public Works Construction (SSPWC), current edition, as minimum requirement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 TREE AND STUMP REMOVAL

A. Remove trees and stumps indicated or required to be removed. Remove trees, together with bulk of roots, to minimum depth of 4 feet below required grade, and within radius of approximately 7 feet beyond perimeter of trunk at grade.

B. Fill and compact excavation from tree and stump removal. Fill in 6-inch layers, each compacted to 90 percent of maximum density in accordance with ASTM D 1557.

   1. Back filling shall not commence until the excavation is inspected and tested.

3.02 CONCRETE AND BITUMINOUS SURFACING REMOVAL

A. Break up and completely remove existing concrete surfacing, curbs, gutters, walks and bituminous surfacing to indicated limits. Cutting shall be performed to neat and even line with proper tools or concrete cutting saw. Minimum depth of cut shall be 1-1/2 inches, unless otherwise indicated. Remove concrete broken beyond indicated limits to nearest joint or score line and replace with new concrete to match existing.
3.03 FENCING

A. Existing fences scheduled to remain may be removed to facilitate work, provided they are installed to their original condition in accordance with requirements of Section 32 3113.

B. Fencing indicated to be removed and not reinstalled shall be completely removed, including footings. Fill and compact excavations.

C. Install chain link fencing indicated to be relocated or reset in accordance with applicable requirements specified under Section 32 3113.

3.04 CLEANUP

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

END OF SECTION 31 1000
PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Removal of topsoil.
B. Rough grading the site for site structures, building pads, and paving areas.
C. Finish grading.

1.02 RELATED REQUIREMENTS

A. Section 31 1000 - Site Clearing.
B. Section 31 2316 - Excavation.
C. Section 31 2323 - Fill: Filling and compaction.
D. 2015 Standard Specifications for Public Works Construction (SSPWC) "Greenbook"
E. 2012 Standard Plans For Public Works Construction (SPPWC)
F. 2006 LA County Additions and Amendments to SSPWC "Graybook"

1.03 SUBMITTALS

A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with City of Torrance, Public Works Department standards.
   1. Maintain one copy on site.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Topsoil: See Landscape specifications.
B. Other Fill Materials: See Section 31 2323.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that survey bench mark and intended elevations for the Work are as indicated.
3.02 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Stake and flag locations of known utilities.

C. Locate, identify, and protect from damage above- and below-grade utilities to remain.

D. Notify utility company to remove and relocate utilities.

E. Protect site features to remain, including but not limited to bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs, from damage by grading equipment and vehicular traffic.

F. Protect trees to remain by providing substantial fencing around entire tree at the outer tips of its branches; no grading is to be performed inside this line.

G. Protect plants, lawns, rock outcroppings, and other features to remain as a portion of final landscaping.

3.03 ROUGH GRADING

A. Remove topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.

B. Do not remove topsoil when wet.

C. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.

D. Do not remove wet subsoil, unless it is subsequently processed to obtain optimum moisture content.

E. When excavating through roots, perform work by hand and cut roots with sharp axe.

F. See Section 31 2323 for filling procedures.

G. Benching Slopes: Horizontally bench existing slopes greater than 1:4 to key fill material to slope for firm bearing.

H. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

3.04 SOIL REMOVAL

A. Stockpile excavated topsoil on site.

B. Stockpile excavated subsoil on site.

C. Stockpiles: Use areas designated on site; pile depth not to exceed 8 feet (2.5 m); protect from erosion.
3.05 FINISH GRADING

A. Before Finish Grading:
   1. Verify building and trench backfilling have been inspected.
   2. Verify subgrade has been contoured and compacted.

B. Remove debris, roots, branches, stones, in excess of 1/2 inch (13 mm) in size. Remove soil contaminated with petroleum products.

C. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 3 inches (75 mm).

D. Place topsoil in areas indicated.

E. Place topsoil where required to level finish grade.

F. Place topsoil to thickness per Landscape specifications.

G. Place topsoil during dry weather.

H. Remove roots, weeds, rocks, and foreign material while spreading.

I. Near plants spread topsoil manually to prevent damage.

J. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.

K. Lightly compact placed topsoil.

3.06 TOLERANCES

A. Top Surface of Subgrade: Plus or minus 0.08 foot from required elevation.

B. Top Surface of Finish Grade: Plus or minus 0.05 foot (3/5 inch).

3.07 REPAIR AND RESTORATION

A. Existing Facilities, Utilities, and Site Features to Remain: If damaged due to this work, repair or replace to original condition.

B. Trees to Remain: If damaged due to this work, trim broken branches and repair bark wounds; if root damage has occurred, obtain instructions from Engineer as to remedy.

C. Other Existing Vegetation to Remain: If damaged due to this work, replace with vegetation of equivalent species and size.

3.08 FIELD QUALITY CONTROL

A. See Section 31 2323 for compaction density testing.
3.09 CLEANING

A. Remove unused stockpiled topsoil, subsoil, and other material. Grade stockpile area to prevent standing water.

B. Leave site clean and raked, ready to receive landscaping.

END OF SECTION 31 2200
SECTION 31 2316
EXCAVATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Excavating for footings, slabs-on-grade, paving, and site structures.

B. Trenching for utilities outside the building to utility main connections.

1.02 RELATED REQUIREMENTS


B. Section 01 5713 - Temporary Erosion and Sedimentation Control:  Slope protection and erosion control.

C. Section 01 7000 - Execution and Closeout Requirements:  General requirements for dewatering of excavations and water control.

D. Section 31 2200 - Grading:  Soil removal from surface of site.

E. Section 31 2200 - Grading:  Grading.

F. Section 31 2323 - Fill:  Fill materials, filling, and compacting.

G. 2015 Standard Specifications For Public Works Construction (SSPWC) "Greenbook"

H. 2012 Standard Plans For Public Works Construction (SPPWC)

I. 2006 LA County Additions and Amendments to SSPWC "Graybook"

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that survey bench mark and intended elevations for the work are as indicated.

3.02 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. See Section 31 2200 for additional requirements.

C. Locate, identify, and protect utilities that remain and protect from damage.

D. Notify utility company to remove and relocate utilities.
E. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

F. Protect plants, lawns, rock outcroppings, and other features to remain.

3.03 EXCAVATING

A. Underpin adjacent structures that could be damaged by excavating work.

B. Excavate to accommodate new structures, construction operations, and utilities.

C. Notify Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.

D. Slope banks of excavations deeper than 4 feet (1.2 meters) to angle of repose or less until shored.

E. Do not interfere with 45 degree bearing splay of foundations.

F. Cut utility trenches wide enough to allow inspection of installed utilities.

G. Hand trim excavations. Remove loose matter.

H. Correct areas that are over-excavated and load-bearing surfaces that are disturbed; see Section 31 2323.

I. Grade top perimeter of excavation to prevent surface water from draining into excavation.

J. Remove excavated material that is unsuitable for re-use from site.

K. Stockpile excavated material to be re-used in area designated on site in accordance with Section 31 2200.

L. Remove excess excavated material from site.

3.04 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with Greenbook standards.

B. Provide for visual inspection of load-bearing excavated surfaces before placement of foundations.

3.05 PROTECTION

A. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.

B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

END OF SECTION 31 2316
SECTION 31 2323
FILL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Filling, backfilling, and compacting for building volume below grade footings, slabs-on-grade, paving, and site structures.

B. Backfilling and compacting for utilities outside the building to utility main connections.

C. Filling holes, pits, and excavations generated as a result of removal (demolition) operations.

1.02 RELATED REQUIREMENTS


B. Section 31 2200 - Grading: Removal and handling of soil to be re-used.

C. Section 31 2200 - Grading: Site grading.

D. Section 31 2316 - Excavation: Removal and handling of soil to be re-used.

E. Section 31 2323 - Fill: Compacted subgrade for paving.

F. 2015 Standard Specifications For Public Works Construction (SSPWC) "Greenbook"

G. 2012 Standard Plans For Public Works Construction (SPPWC)

H. 2006 LA County Additions and Amendments to SSPWC "Graybook"

1.03 DEFINITIONS

A. Finish Grade Elevations: Indicated on drawings.

B. Subgrade Elevations: Indicated on drawings.

1.04 REFERENCE STANDARDS

A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials; 2010

B. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 2012.

D. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft³ (2,700 kN m/m³)); 2012.


F. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.

G. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2008.

1.05 SUBMITTALS

A. Bulk sample, sufficient to run required laboratory tests.

B. Materials Sources: Submit name of imported materials source.

C. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.

D. Compaction Density Test Reports.

1.06 DELIVERY, STORAGE, AND HANDLING

A. When necessary, store materials on site in advance of need.

B. When fill materials need to be stored on site, locate stockpiles where indicated.

1. Separate differing materials with dividers or stockpile separately to prevent intermixing.

2. Prevent contamination.

3. Protect stockpiles from erosion and deterioration of materials.

PART 2 - PRODUCTS

2.01 FILL MATERIALS

A. General Fill: Conforming to Geotechnical Report.

B. Granular Fill: Coarse aggregate, conforming to Geotechnical Report.

C. Sand: Conforming to Geotechnical Report.

D. Concrete for Fill: 100-E-100.

E. Topsoil: See Landscape specifications.

2.02 SOURCE QUALITY CONTROL

A. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.
B. If tests indicate materials do not meet specified requirements, change material and retest.

C. Provide materials of each type from same source throughout the work.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that survey bench marks and intended elevations for the Work are as indicated.

B. Identify required lines, levels, contours, and datum locations.

C. See Section 31 2200 for additional requirements.

D. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.

E. Verify structural ability of unsupported walls to support imposed loads by the fill.

3.02 PREPARATION

A. Scarify subgrade surface to a depth of 12 inches (300 mm) to identify soft spots.

B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.

C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.

D. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

3.03 FILLING

A. Fill to contours and elevations indicated using unfrozen materials.

B. Fill up to finish grade elevations unless otherwise indicated.

C. Employ a placement method that does not disturb or damage other work.

D. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.

E. Maintain optimum moisture content of fill materials to attain required compaction density.

F. Slope grade away from building minimum 2 inches in 10 ft (50 mm in 3 m), unless noted otherwise. Make gradual grade changes. Blend slope into level areas.

G. Correct areas that are over-excavated.
   1. Other areas: Use general fill, flush to required elevation, compacted to minimum 95 percent of maximum dry density.
H. Compaction Density Unless Otherwise Specified or Indicated:
   1. Under paving, slabs-on-grade, and similar construction: 95 percent of maximum dry density.

I. Reshape and re-compact fills subjected to vehicular traffic.

3.04 FILL AT SPECIFIC LOCATIONS

A. Use general fill unless otherwise specified or indicated.

B. Structural Fill:
   1. Use general fill.
   2. Fill up to finish grade elevations.
   3. Maximum depth per lift: 8 inches (150 mm), compacted.
   4. Compact to minimum 95 percent of maximum dry density.

C. Over Buried Utility Piping and Conduits in Trenches:
   1. Compact in maximum 8 inch (150 mm) lifts to 90 percent of maximum dry density.

3.05 TOLERANCES

A. Top Surface of General Filling: Plus or minus 1/2 inch (12 mm) from required elevations.

B. Top Surface of Filling Under Paved Areas: Plus or minus 1/2 inch (12 mm) from required elevations.

3.06 FIELD QUALITY CONTROL

A. Perform compaction density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, ASTM D3017, or ASTM D6938.

B. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D698 ("standard Proctor"), ASTM D1557 ("modified Proctor"), or AASHTO T 180.

C. If tests indicate work does not meet specified requirements, remove work, replace and retest.

D. Frequency of Tests: As required by the City inspector and green book requirements.

E. Proof roll compacted fill at surfaces that will be under slabs-on-grade and paving.

3.07 CLEANING

A. Leave unused materials in a neat, compact stockpile.

B. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION
SECTION 31 6329

DRILLED CONCRETE PIERS AND SHAFTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Dry-installed drilled piers.
   2. Slurry displacement-installed drilled piers.
   3. Dry-installed or slurry displacement-installed drilled piers at Contractor’s choice.

B. Related Sections:
   1. Section 03 3000: Cast-in-Place Concrete

1.02 REFERENCES

A. California Code of Regulations (CCR), Title 24
   1. Part 1, California Administrative Code, Chapter 4

B. ASTM International (ASTM):
   2. ASTM A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
   3. ASTM A706 – Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
   4. ASTM A767 – Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
   5. ASTM A775 – Standard Specification for Epoxy-Coated Steel Reinforcing Bars
   8. ASTM A934 – Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
   9. ASTM A1064 – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
   10. ASTM C31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field
   11. ASTM C33 – Standard Specification for Concrete Aggregates
   17. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete
18. ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
19. ASTM C1017 – Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete

C. American Welding Society (AWS):
   1. AWS D1.1 – Structural Welding Code - Steel.
   2. AWS D1.4 - Structural Welding Code - Reinforcing Steel.

D. American Concrete Institute (ACI):
   1. ACI 301 – Specifications for Structural Concrete

E. Concrete Reinforcing Steel Institute (CRSI):

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Experienced installer that has specialized in drilled-pier work.

B. Testing Agency Qualifications: Comply with requirements of CCR, Part 1, Chapter 4, Section 4-335.1 – DSA Laboratory Evaluation and Acceptance Criteria.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1 and AWS D1.4.

D. Drilled-Pier Standard: Comply with ACI 336.1 unless otherwise modified.
   1. This specification and requirements of ACI 336.1 (except as modified) shall apply to pier diameters specified for Project.
      a. Limitation of applicability of ACI 336.1 to piers 30 inches in diameter and larger, as stated in 1.1.1 of ACI 336.1, is hereby void and inapplicable to Project.

E. Trial Drilled Pier: Construct trial drilled pier of diameter and depth and at location indicated or, if not indicated, of same diameter and depth as largest drilled piers, located at least three diameters clear of permanent drilled piers, to demonstrate installer’s construction methods, equipment, standards of workmanship, and tolerances.
   1. Install reinforcement, fill with concrete, remove temporary casings, and terminate trial drilled pier 24 inches below subgrade and leave in place.
   2. Install permanent casings, excavate rock socket, and place slurry, as required for permanent drilled piers.
   3. When Owner/Owner’s Project Inspector determines that trial drilled pier does not comply with requirements, excavate for and cast another until it is accepted.

F. Preinstallation Conference: Conduct conference at Project Site.
   1. Review methods and procedures related to drilled piers including, but not limited to, following:
      a. Review geotechnical report.
b. Discuss existing utilities and subsurface conditions.
c. Review coordination with temporary controls and protections.
d. Contractor to develop and present detailed work plan for drilled pier installation methods and procedures.

1.04 SUBMITTALS

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

B. Design Mixtures: For each concrete mixture.
   1. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
   2. Indicate amounts of mixing water to be withheld for later addition at Project Site.

C. Shop Drawings: For concrete reinforcement detailing fabricating, bending, supporting, and placing.

D. Welding certificates.

E. Material Certificates:
   1. Submit following from manufacturer:
      a. Cementitious materials.
      b. Admixtures.
      c. Steel reinforcement and accessories.

F. Material Test Reports:
   1. Submit following from qualified testing agency, indicating compliance with specified requirements:
      a. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

G. Field quality-control reports.

H. Record Drawings: Comply with requirements of Section 01 7839.

1.05 PROJECT CONDITIONS

A. Existing Utilities: Locate existing underground utilities before excavating drilled piers.
   1. When utilities are to remain in place, provide protection from damage during drilled-pier operations.
   2. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, adapt drilling procedure when necessary to prevent damage to utilities.
   3. Cooperate with Owner and utility companies in keeping services and facilities in operation without interruption.
   4. Repair damaged utilities to satisfaction of utility owner.

B. Interruption of Existing Utilities: Do not interrupt utility to facilities occupied by Owner or others unless permitted under following conditions and then only after arranging to provide temporary utility according to requirements indicated:
1. Notify Owner no fewer than two days in advance of proposed interruption of utility.
2. Do not proceed with interruption of utility without Owner’s written permission.

C. Project Site Information: Geotechnical report has been prepared for this Project and is available from Owner for information only.
1. Refer to Section 31 5000 for geotechnical report information.
2. Opinions expressed in report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer.
   a. Owner will not be responsible for interpretations or conclusions drawn from this data.
3. Make additional test borings and conduct other exploratory operations necessary for drilled piers.

D. Survey Work: Engage qualified land surveyor or professional engineer in accordance with requirements specified in Section 01 7123 to perform surveys, layouts, and measurements for drilled piers.
1. Before excavating, lay out each drilled pier to lines and levels required.
2. Record actual measurements of each drilled pier's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.
3. Record and maintain information pertinent to each drilled pier and cooperate with Owner's testing and inspecting agency to provide data for required reports.

PART 2 – PRODUCTS

2.01 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706, deformed.

C. Galvanized Reinforcing Bars: ASTM A 615, Grade 60 or ASTM A 706, deformed bars, ASTM A 767 Class I or Class II zinc coated after fabrication and bending.

D. Epoxy-Coated Reinforcing Bars: ASTM A 615, Grade 60 or ASTM A 706, deformed bars, ASTM A 775 or ASTM A 934, epoxy coated, with less than 2 percent damaged coating in each 12 inch bar length.

E. Plain-Steel Wire: ASTM A 1064, as drawn.

F. Deformed-Steel Wire: ASTM A 1064.

G. Epoxy-Coated Wire: ASTM A 884, Class A, Type 1 coated, as-drawn, plain steel wire, with less than 2 percent damaged coating in each 12 inch wire length.

H. Joint Dowel Bars: ASTM A 615, Grade 60, plain.
   1. Cut bars true to length with ends square and free of burrs.
2.02 CONCRETE MATERIALS

A. Cementitious Material:
   1. Use following cementitious materials, of same type, brand, and source, throughout Project:
      a. Portland Cement: ASTM C 150, Type V.
      1) May be supplemented with following:
         a) Fly Ash: ASTM C 618, Class C or F.
         b) Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregate: ASTM C 33, graded, 1 inch nominal maximum coarse-aggregate size.
   1. Provide aggregate from single source with documented service record data of at least 10 years satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

C. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.


E. Chemical Admixtures:
   1. Use of admixtures is subject to approval of DSA.
   2. Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete.
      a. Do not use calcium chloride or admixtures containing calcium chloride.
   3. Water-Reducing Admixture: ASTM C 494, Type A.
   4. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
   5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
   6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.

F. Sand-Cement Grout: Sand-Cement grout may be used exclusively to fill visible voids and annular space between permanent casing and shaft wall or between permanent liner and oversized temporary casing.
   1. Grout shall consist of following:
      a. Portland cement, ASTM C 150, Type II
      b. Clean natural sand, ASTM C 404
      c. Water to result in grout with minimum 28 day compressive strength of 1000 psi, of consistency required for application.

2.03 PERMANENT STEEL CASINGS

A. Steel Pipe Casings: ASTM A 283, Grade C, or ASTM A 36, carbon-steel plate, with joints full-penetration welded according to AWS D1.1.


C. Liners: Comply with ACI 336.1.
2.04 SLURRY
   A. Slurry: Pulverized bentonite, pulverized attapulgite or polymers mixed with water to form stable colloidal suspension; complying with ACI 336.1 for density, viscosity, sand content, and pH.

2.05 CONCRETE MIXTURES
   A. Prepare design mixtures for each type and strength of concrete, proportioned on basis of laboratory trial mixture or field test data, or both, according to ACI 301.
   B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than Portland cement according to ACI 301 limits as when concrete is exposed to deicing chemicals.
   C. Limitations on water-soluble, chloride-ion content in hardened concrete shall be in accordance with ACI 301 based on in-service conditions for exposure to chlorides and moisture.
   D. Proportion normal-weight concrete mixture as follows:
      2. Maximum Water-Cementitious Materials Ratio: 0.45.
      3. Slump requirements and limitations shall be as set forth in ACI 336.1.
      4. Air Content: Do not air entrain concrete.

2.06 FABRICATING REINFORCEMENT
   A. Fabricate steel reinforcement according to CRSI Manual of Standard Practice.

2.07 CONCRETE MIXING
   A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/, and furnish batch ticket information.
      1. When air temperature is between 85 and 90 degrees F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 degrees F, reduce mixing and delivery time to 60 minutes.

PART 3 – EXECUTION

3.01 PREPARATION
   A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by drilled-pier operations.

3.02 EXCAVATION
   A. Unclassified Excavation: Excavate to bearing elevations regardless of character of surface and subsurface conditions encountered.
      1. Unclassified excavated materials may include rock, soil materials, and obstructions.
2. Obstructions: Unclassified excavation may include removal of unanticipated boulders, concrete, masonry, or other subsurface obstructions.
   a. No changes in Contract Sum or Contract Time will be authorized for removal of obstructions.
   b. Payment for removing obstructions that cannot be removed by conventional augers fitted with soil or rock teeth, drilling buckets, or underreaming tools attached to drilling equipment of size, power, torque, and downthrust necessary for Work will be according to Contract provisions for changes in Work specified in Section 01 2610.

B. Classified Excavation: Excavation is classified as standard excavation, special excavation, and obstruction removal
   1. Includes excavation to bearing elevations as follows:
      a. Standard excavation includes excavation accomplished with conventional augers fitted with soil or rock teeth, drilling buckets, or underreaming tools attached to drilling equipment of size, power, torque, and downthrust necessary for Work.
   2. Special excavation includes excavation that requires special equipment or procedures above or below indicated depth of drilled piers where drilled-pier excavation equipment used in standard excavation, operating at maximum power, torque, and downthrust, cannot advance the shaft.
      a. Special excavation requires use of special rock augers, core barrels, air tools, blasting, or other methods of hand excavation.
      b. Earth seams, rock fragments, and voids included in rock excavation area will be considered rock for full volume of shaft from initial contact with rock.
   3. Obstructions: Payment for removing unanticipated obstructions will be according to Contract provisions for changes in Work specified in Section 01 2610.

C Prevent surface water from entering excavated shafts.
   1. Conduct water to site drainage facilities.

D. Excavate shafts for drilled piers to indicated elevations.
   1. Remove loose material from bottom of excavation.
   2. Excavate bottom of drilled piers to level plane within 1:12 tolerance.
   3. Remove water from excavated shafts before concreting.
   4. Excavate rock sockets of dimensions indicated.

E. Notify and allow testing and inspecting agency to test and inspect bottom of excavation.
   1. Where unsuitable bearing stratum is encountered, make adjustments to drilled piers as determined by Geotechnical Engineer.
   2. Do not excavate shafts deeper than elevations indicated unless approved by Geotechnical Engineer.
   3. Payment for additional authorized excavation will be according to Contract provisions for changes in the Work specified in Section 01 2610.

F. End-Bearing Drilled Piers: Probe with auger to depth below bearing elevation, equal to diameter of the bearing area of drilled pier.
   1. Determine whether voids, clay seams, or solution channels exist.
   2. Test first three drilled piers and one of every six drilled piers thereafter.
   3. Fill augur-probe holes with grout.
G. Excavate shafts for closely spaced drilled piers and for drilled piers occurring in fragile or sand strata only after adjacent drilled piers are filled with concrete and allowed to set.

H. Slurry Displacement Method: Stabilize excavation with slurry maintained minimum of 60 inches above ground-water level and above unstable soil strata to prevent caving or sloughing of shaft.
   1. Maintain slurry properties before concreting.
   2. Excavate and complete concreting of drilled pier on same day if possible, or redrill, clean, and test slurry in excavation before concreting.
   3. Clean bottom of each shaft before concreting.

I. Temporary Casings: Install watertight steel casings of sufficient length and thickness to prevent water seepage into shaft; to withstand compressive, displacement, and withdrawal stresses; and to maintain stability of shaft walls.
   1. Remove temporary casings, maintained in plumb position, during concrete placement and before initial set of concrete.

J. Tolerances: Construct drilled piers to remain within ACI 336.1 tolerances.
   1. Where location or out-of-plumb tolerances are exceeded, provide corrective construction.
      a. Submit design and construction proposals to Owner for review before proceeding.

3.03 PERMANENT STEEL CASINGS FOR DRY METHOD INSTALLATION

A. Install steel casings of appropriate wall thickness as determined by Contractor in order to satisfactorily perform Work, and of diameter not less than diameter of drilled pier.
   1. Install casings as excavation proceeds, to maintain sidewall stability.
   2. Fabricate bottom edge of lowest casing section with cutting shoe capable of penetrating rock and achieving water seal.
   3. Connect casing sections by continuous penetration welds to form watertight, continuous casing.
   4. Remove and replace or repair casings that have been damaged during installation and that could impair strength or efficiency of drilled pier.
   5. Fill annular void between casing and shaft wall with grout.

3.04 STEEL REINFORCEMENT


B. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with concrete.

C. Fabricate and install reinforcing cages symmetrically about axis of shafts in single unit.

D. Accurately position, support, and secure reinforcement against displacement during concreting.
   1. Maintain minimum cover over reinforcement.
E. Use templates to set anchor bolts, leveling plates, and other accessories furnished in work of other Sections.
   1. Provide blocking and holding devices to maintain required position during final concrete placement.

F. Protect exposed ends of extended reinforcement, dowels, or anchor bolts from mechanical damage and exposure to weather.

3.05 CONCRETE PLACEMENT

A. Place concrete in continuous operation and without segregation immediately after inspection and approval of shaft by Owner's independent testing and inspecting agency.
   1. Construct construction joint when concrete placement is delayed more than one hour.
      a. Level top surface of concrete. Before placing remainder of concrete, clean surface laitance, roughen, and slush concrete with commercial bonding agent or with sand-cement grout mixed at ratio of 1:1.

B. Dry Method:
   1. Applicable Only to Piers Greater Than 30 inches in Diameter:
      a. Place concrete to fall vertically down center of drilled pier without striking sides of shaft or steel reinforcement.
      b. Where concrete cannot be directed down shaft without striking reinforcement, place concrete with chutes, tremies, or pumps.
      c. Vibrate top 60 inches of concrete.

C. Slurry Displacement Method: Place concrete in slurry-filled shafts by tremie methods or pumping.
   1. Control placement operations to ensure that tremie or pump pipe is embedded no fewer than 60 inches into concrete and that flow of concrete is continuous from bottom to top of drilled pier.

D. Coordinate withdrawal of temporary casings with concrete placement to maintain at least 60 inch head of concrete above bottom of casing.
   1. Vibrate top 60 inches of concrete after withdrawal of temporary casing.

E. Screed concrete at cutoff elevation level and apply scoured, rough finish.
   1. Where cutoff elevation is above ground elevation, form top section above grade and extend shaft to required elevation.

F. Protect concrete work, according to ACI 301, from frost, freezing, or low temperatures that could cause physical damage or reduced strength.
   1. Do not use frozen materials or materials containing ice or snow.
   2. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
   3. Do not use calcium chloride, salt, or other mineral-containing antifreeze agents or chemical accelerators.

G. Should hot-weather conditions exist that would seriously impair quality and strength of concrete, place concrete according to ACI 301 to maintain delivered temperature of concrete at no more than 90 degrees F.
   1. Place concrete immediately on delivery.
2. Keep exposed concrete surfaces and formed shaft extensions moist by fog sprays, wet burlap, or other effective means for minimum of seven days.

3.06 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage qualified special inspector to perform following special inspections:
   1. Drilled piers.
   2. Excavation.
   3. Concrete.
   4. Steel reinforcement welding.

B. Testing Agency: Owner will engage qualified testing agency to perform tests and inspections.

C. Drilled-Pier Tests and Inspections:
   1. For each drilled pier, before concrete placement.
   2. Soil Testing: Bottom elevations, bearing capacities, and lengths of drilled piers indicated have been estimated from available soil data.
      a. Actual elevations and drilled-pier lengths and bearing capacities will be determined by testing and inspecting agency.
   3. Final evaluations and approval of data will be determined by Geotechnical Engineer.
      a. Bearing Stratum Tests: Testing agency will take undisturbed core samples from drilled-pier bottoms and test each sample for compression, moisture content, and density, and will report results and evaluations.

D. Concrete Tests and Inspections: ASTM C 172 except modified for slump to comply with ASTM C 94.
   1. Slump: ASTM C 143; one test at point of placement for each compressive-strength test but no fewer than one test for each concrete load.
   2. Concrete Temperature: ASTM C 1064; 1 test hourly when air temperature is 40 degrees F and below and 80 degrees F and above, and 1 test for each set of compressive-strength specimens.
   3. Compression Test Specimens: ASTM C 31; one set of four standard cylinders for each compressive-strength test unless otherwise indicated.
      a. Mold and store cylinders for laboratory-cured test specimens unless field-cured test specimens are required.
   4. Compressive-Strength Tests: ASTM C 39; one set for each drilled pier but not more than one set for each truck load.
      a. One specimen will be tested at 7 days, 2 specimens will be tested at 28 days, and 1 specimen will be retained in reserve for later testing when required.
   5. Where frequency of testing will provide fewer than five strength tests for given class of concrete, testing will be conducted from at least five randomly selected batches or from each batch when fewer than five are used.
   6. Where strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
   7. Strength of each concrete mixture will be satisfactory when every average of three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
8. Report test results in writing to Owner, Engineer, concrete manufacturer, and Contractor within 48 hours of testing.
   a. List Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7 and 28 day tests in reports of compressive-strength tests.

9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Owner but will not be used as sole basis for approval or rejection of concrete.

10. Additional Tests: Testing and inspecting agency will make additional tests of concrete where test results indicate that slump, compressive strengths, or other requirements have not been met, as directed by Engineer.
    a. Continuous coring of drilled piers may be required, at Contractor's expense, where temporary casings have not been withdrawn within specified time limits or when observations of placement operations indicate deficient concrete quality, presence of voids, segregation, or other possible defects.

11. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

12. Correct deficiencies in Work that test reports and inspections indicate do not comply with Contract Documents.

E. Excavation, concrete, or drilled pier will be considered defective when it does not pass tests and inspections.

F. Prepare test and inspection reports for each drilled pier as follows:
   1. Actual top and bottom elevations.
   2. Actual drilled-pier diameter at top, bottom, and bell.
   3. Top of rock elevation.
   4. Description of soil materials.
   5. Description, location, and dimensions of obstructions.
   6. Final top centerline location and deviations from requirements.
   7. Variation of shaft from plumb.
   8. Shaft excavating method.
   9. Design and tested bearing capacity of bottom.
   10. Depth of rock socket.
   11. Levelness of bottom and adequacy of cleanout.
   12. Properties of slurry and slurry test results at time of slurry placement and at time of concrete placement.
   13. Ground-water conditions and water-infiltration rate, depth, and pumping.
   14. Description, purpose, length, wall thickness, diameter, tip, and top and bottom elevations of temporary or permanent casings.
      a. Include anchorage and sealing methods used and condition and weather tightness of splices.
   15. Description of soil or water movement, sidewall stability, loss of ground, and means of control.
   16. Bell dimensions and variations from original design.
   17. Date and time of starting and completing excavation.
   18. Inspection report.
21. Concrete placing method, including elevation of consolidation and delays.
23. Locations of construction joints.
24. Concrete volume.
25. Concrete testing results.
26. Remarks, unusual conditions encountered, and deviations from requirements.

3.07 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Project Site.
   1. Comply with requirements specified in Section 01 7419.

END OF SECTION 31 6329
SECTION 32 01 26

PAVEMENT REPAIR

PART 1 - GENERAL

1.01 SUMMARY

A. Provisions of Division 01 apply to this section.

B. Section Includes:
   1. Bituminous Surfacing Repair: Areas removed for utility trenches, heaved by tree roots, cracked areas, protruding areas where pavement meets hard surfaces, depressed areas, holes and areas around new structures, and raveled bituminous pavement.
   2. Concrete Pavement Repair: Areas heaved by tree roots, cracked areas, holes and trenches, and areas around new structures.

C. Related Sections:
   1. Section 32 0000: Earthwork.
   2. Section 32 1613: Site Concrete Work.
   3. Section 32 1236: Seal for Bituminous Surfacing.

1.02 SUBMITTALS

A. Shop Drawings: Indicating areas to be repaired.

B. Product Data: Manufacturer's technical data for materials and products.

1.03 QUALITY ASSURANCE


PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials specified in Section 32 1613: Site Concrete Work.

B. Materials specified in Section 32 1236: Seal for Bituminous Surfacing.

2.02 BITUMINOUS MATERIALS

A. Provide materials and products of the class, grade or type indicated, conforming to relevant provisions of Section 203 - Bituminous Materials of the latest Standard Specifications for Public Works Construction.

2.03 HEADERS AND STAKES

A. Headers: Redwood, Construction Heart Grade, size 2 x 6, unless otherwise indicated on Drawings.
B. Stakes: 2 x 4 redwood or 2 x 3 Douglas fir, Construction Grade.

C. Nails: Common, galvanized, 12d minimum.

2.04 SLURRY

A. Cement-sand slurry; minimum two sack of cement per cubic yard of mixture.

PART 3 - EXECUTION

3.01 PAVEMENT REMOVAL

A. Remove bituminous and concrete pavement in accordance with applicable provisions of Section 300 - Earthwork of SSPWC.

B. Pavement Heaved By Roots: Remove pavement to limits of distortion and expose roots. Trim roots to provide at least 12 inches clearance to pavement.

C. Remove protruding bituminous surfaces flush with the surrounding grade using a suitable tool or equipment so that adjacent finishes are not blackened.

D. Remove raveled and depressed bituminous pavement to limits indicated or required.

E. Saw cut existing improvements, trim holes and trenches in bituminous and concrete pavement to permit mechanical hand tampers to compact the fill.

F. Remove broken concrete by saw cutting. If the required cut line is within 30 inches of a score or joint line or edge, cut and remove to the score, joint line, or edge.

3.02 EXCAVATING, BACKFILLING AND COMPACTING

A. Conform to requirements in Section 31 00 00: Earthwork, as required.

B. Where subgrade or base is deemed to be unstable or otherwise unsuitable, excavate such materials to firm earth, and replace with a required material. Install and compact fill materials in accordance with the requirements of related Specification sections.

3.03 HEADERS

A. Install headers along edge of bituminous surfacing abutting turf, earth, or planting area, unless indicated otherwise.

B. Install headers so the bottom surface has continuous bearing on solid grade. Where excavation for headers is undercut, thoroughly tamp soil under the header. Compact backfill on both sides of header to the density of the adjacent undisturbed grade.

C. Fasten headers in place with redwood or Douglas fir stakes of length necessary to extend into solid earth a minimum of 12 inches.
   1. Stakes shall be of sound material, neatly pointed, driven vertically, and securely nailed to headers.
2. Space stakes, not to exceed 4 feet on centers with top of stakes set one inch below top of header. Provide minimum of 2-12d galvanized common nails through each stake.

D. Remove existing headers where new surfacing is installed adjacent to existing surfacing.

E. Install temporary headers at transverse joints of paving where continuous paving operations are not maintained.

F. Provide additional stakes and devices as required to fasten headers.

### 3.04 BASE COURSE

A. Unless otherwise indicated, base course shall be crushed aggregate base, fine grade, 3 inches thick or equal to thickness of the existing base, whichever is greater.

B. Fill grade and compact as specified in Section 31 00 00: Earthwork.

### 3.05 RESURFACING

A. Holes and Trenches: Remove loose dirt and backfill with cement-sand slurry allowing for surfacing one inch thicker than existing. Unless otherwise indicated on Drawings, resurface flush with existing adjoining pavement installing same type of materials and section provided in existing improvements.

B. Other Areas: Other surface improvements damaged or removed shall be cut to neat even line and excavated one inch below bottom of existing pavement. Resurface by following original grades and installing same type of materials provided in existing improvements.

C. Where bituminous surfacing abuts concrete, masonry, and walks or paving, tamp joint smooth, if necessary, as described above to obtain uniformly even joint, true to line and grade. Tamp and smooth materials before asphalt cools.

### 3.06 REPAIRING AND RESEALING EXISTING SURFACES

A. Preparation of Surfaces: Prior to filling cracks, clean existing bituminous surfacing of loose and foreign materials and coat with a film of asphalt emulsion.

B. Repair of Existing Surfacing:
   1. Fill cracks 1/2 inch wide and less with RS-1 emulsion and silica sand or other required material. Cracks larger than 1/2 inch wide shall be filled with Type C2 Asphalt Concrete as specified. Cracks shall be filled to level of adjacent surfacing.
   2. Where low areas, holes, or depressions occur in existing surfacing, repair with emulsified asphalt. Install material; strike off emulsified asphalt with straightedge flush with adjoining surfacing. Finish with steel trowel, and after dehydration, compact by rolling or tamping.

C. Testing: Flood test entire area in presence of Project Inspector. Entire area tested shall be free of standing water or puddles.
D. Surface Seal: After surface has been repaired and tested, install seal coat over entire area indicated. Surface seal shall be as specified in Section 32 12 36: Seal For Bituminous Surfacing.

3.07 FINISHING

A. Portland cement concrete paving shall have medium broom finish on surfaces sloped less than 6 percent and slip resistant (heavy broom finish) on all surfaces sloped greater than 6 percent CBC Section 1133B.7.1.

3.08 CLEANING

A. Remove stains on Project Site and adjacent properties caused by or attributed to Work of this section.

B. Remove and legally dispose of rubbish, debris, and waste materials off Project Site.

3.09 PROTECTION

A. Protect Work until Substantial Completion.

END OF SECTION 32 0126
SECTION 32 1216
ASPHALT PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aggregate base course.

B. Single course bituminous concrete paving.

C. Double course bituminous concrete paving.

D. Surface sealer.

1.02 RELATED REQUIREMENTS


B. Section 31 2200 - Grading: Preparation of site for paving and base.

C. Section 31 2323 - Fill: Compacted subgrade for paving.

D. Section 32 1313 - Concrete Paving: Concrete curbs.

E. Section 33 0513 - Manholes and Structures: Manholes, including frames; gutter drainage grilles, covers, and frames for placement by this section.

F. 2015 Standard Specifications For Public Works Construction (SSPWC) "Greenbook"

G. 2012 Standard Plans For Public Works Construction (SPPWC)

H. 2006 LA County Additions and Amendments to SSPWC "Graybook"

1.03 REFERENCE STANDARDS

A. AI MS-2 - Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types; The Asphalt Institute; 1997.


1.04 PERFORMANCE REQUIREMENTS

A. Design normal duty asphaltic concrete section at 3 inches and aggregate base course at 4 inches, designated in Geotechnical Report. Design heavy duty asphaltic concrete section at 4 inches and aggregate base course at 5 inches.
1.05 QUALITY ASSURANCE

A. Perform Work in accordance with Caltrans or Authority Having Jurisdiction.
B. Mixing Plant: Conform to Caltrans or Authority Having Jurisdiction.
C. Obtain materials from same source throughout.

1.06 REGULATORY REQUIREMENTS

A. Conform to applicable code for paving work on public property.

1.07 FIELD CONDITIONS

A. Do not place asphalt when ambient air or base surface temperature is less than 40 degrees F (4 degrees C), or surface is wet or frozen.
B. Place bitumen mixture when temperature is not more than 15 F degrees (8 C degrees) below bitumen supplier's bill of lading and not more than maximum specified temperature.

PART 2 - PRODUCTS

A. Aggregate for Base Course: In accordance with Caltrans specifications Section 26 for Class II aggregate base or Greenbook Section 200-2 for untreated base materials.
B. Aggregate for Binder Course: In accordance with Caltrans specifications for Grade PG 64-10 Binder.
C. Aggregate for Wearing Course: In accordance with Caltrans or Authority Having Jurisdiction standards.
D. Fine Aggregate: In accordance with Caltrans or Authority Having Jurisdiction standards.
E. Mineral Filler: Finely ground particles of limestone, hydrated lime or other mineral dust, free of foreign matter, conforming to Caltrans specifications.
F. Primer: In accordance with SSPWC 203-2.4.
G. Tack Coat: In accordance with Caltrans specifications.

2.02 ASPHALT PAVING MIXES AND MIX DESIGN

A. Use dry material to avoid foaming. Mix uniformly.
B. Mix design shall conform to Caltrans standards.
C. Submit proposed mix design of each class of mix for review prior to beginning of work.

2.03 SOURCE QUALITY CONTROL

A. Test mix design and samples in accordance with AI MS-2.
PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that compacted subgrade is dry and ready to support paving and imposed loads.
B. Verify gradients and elevations of base are correct.

3.02 BASE COURSE

A. See Section 32 2323.

3.03 PREPARATION - PRIMER

A. Apply primer in accordance with Greenbook 302-5.3.

3.04 PREPARATION - TACK COAT

A. Apply tack coat in accordance with Caltrans Specifications Section 39.
B. Apply tack coat to asphalt concrete base course or sand asphalt base course. Apply emulsified asphalt tack coat between each lift or layer of full depth asphalt concrete and sand asphalt bases and on surface of bases where asphalt concrete paving will be constructed.
C. Apply tack coat to surfaces of previously constructed asphalt concrete base courses or Portland cement concrete surfaces abutting or projecting into asphalt concrete pavement.
D. Coat surfaces of curbs and gutters, and manhole, catch basin, and other structure frames with oil to prevent bond with asphalt pavement. Do not tack coat these surfaces.

3.05 PLACING ASPHALT PAVEMENT - SINGLE COURSE

A. Install Work in accordance with Caltrans or Authority having Jurisdiction standards.
B. Place asphalt within 24 hours of applying primer or tack coat.
C. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
D. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

3.06 PLACING ASPHALT PAVEMENT - DOUBLE COURSE

A. Place asphalt binder course within 24 hours of applying primer or tack coat.
B. Place wearing course within two hours of placing and compacting binder course.
C. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
D. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

3.07 SEAL COAT

A. Apply seal coat to surface course and asphalt curbs in accordance with AI MS-19.

3.08 TOLERANCES

A. Flatness: Maximum variation of 1/8 inch (3 mm) measured with 10 foot (3 m) straight edge.

B. Variation from True Elevation: Within 1/8 inch (3 mm).

3.09 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for general requirements for quality control.

B. Provide field inspection and testing. Take samples and perform tests in accordance with AI MS-2.

3.10 PROTECTION

A. Immediately after placement, protect pavement from mechanical injury for 7 days or until surface temperature is less than 140 degrees F (60 degrees C).

3.11 SCHEDULE

A. Pavement at Heavy Duty Asphaltic Concrete Paving Areas: Single course of 3 inch (76 mm) compacted thickness, sand seal coat.

END OF SECTION 32 1213
SECTION 32 1236

SEAL FOR BITUMINOUS SURFACING

PART 1 - GENERAL

1.01 SUMMARY

A. Provisions of Division 01 apply to this section.

B. Section Includes:
   1. Surface sealer over bituminous surfacing.

C. Related Sections:
   1. Section 32 01 26: Pavement Repair

1.02 SUBMITTALS

A. Product Data: Manufacturer's product information and application procedures for bituminous surfacing.

1.03 QUALITY ASSURANCE


B. Agitate bulk materials during transport.

1.04 MAINTENANCE

A. Extra Materials: Provide 10 gallons in unopened containers.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Provide one of following surface seals:

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guard-Top</td>
<td>Vulcan Materials Co.</td>
</tr>
<tr>
<td>OverKote</td>
<td>Diversified Asphalt Product</td>
</tr>
<tr>
<td>Park Top</td>
<td>Western Colloid Products</td>
</tr>
<tr>
<td>Super Drive Top.</td>
<td>SAF-T-Seal. Inc.</td>
</tr>
</tbody>
</table>

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

A. Thoroughly wash surfaces with water to remove dirt, debris, excessive oil and grease, or other foreign matter.
3.02 APPLICATION

A. Install seal coat in strict accordance with manufacturer’s written directions and recommendations.

B. Where existing bituminous surfacing is indicated to be patched and sealed, install 2 coats of surface seal after patching.

3.03 PROTECTION OF SURFACES

A. Protect sealed and unsealed surfaces from damage and traffic during performance of Work and until surface seal has thoroughly set and cured. Do not permit pedestrian and vehicular traffic for at least 24 hours after completion of installation.

B. Protect Work until Substantial Completion.

3.04 TESTING

A. Owner reserves right to obtain samples, perform tests to ensure compliance with Specifications, and to review weight slips and invoices of materials delivered to Project Site.

3.05 CLEAN UP

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

END OF SECTION 32 1236
SECTION 32 1313

CONCRETE PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete sidewalks, gutters, median barriers, and parking areas.

1.02 RELATED REQUIREMENTS


B. Section 03 1000 - Concrete Forming and Accessories.

C. Section 31 2200 - Grading: Preparation of site for paving and base.

D. Section 31 2323 - Fill: Compacted subbase for paving.

E. Section 32 1123 - Aggregate Base Courses

F. Section 32 1216 - Asphalt Paving: Asphalt wearing course.

G. Section 33 0513 - Manholes and Structures: Manholes, including frames; gutter drainage grilles, covers, and frames for placement by this section.

H. 2015 Standard Specifications For Public Works Construction (SSPWC) "Greenbook"

I. 2012 Standard Plans For Public Works Construction (SPPWC)

J. 2006 LA County Additions and Amendments to SSPWC "Graybook"

1.03 REFERENCE STANDARDS

A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; 1991 (Reapproved 2002).

B. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2010.

C. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 2000.

D. ACI 305R - Hot Weather Concreting; American Concrete Institute International; 2010.

E. ACI 306R - Cold Weather Concreting; American Concrete Institute International; 2010.
F. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2014.


1.04 SUBMITTALS

A. Product Data: Provide data on joint filler, admixtures, curing compound, and mix design.

PART 2 - PRODUCTS

2.01 PAVING ASSEMBLIES

A. Comply with applicable requirements of Greenbook.

B. Concrete Sidewalks: 4,000 psi (27.6 MPa) 28 day concrete, 7 inches (100 mm) thick, buff color Portland cement.

2.02 FORM MATERIALS

A. Form Materials: Conform to ACI 301.

B. Joint Filler: Preformed; non-extruding bituminous type (ASTM D1751) or sponge rubber or cork (ASTM D1752).

1. Thickness: 1/2 inch (12 mm).

2.03 REINFORCEMENT

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 - 60,000 psi (420 MPa) yield strength; deformed billet steel bars; unfinished.
B. Steel Welded Wire Reinforcement: Plain type, ASTM A1064/A1064M; in flat sheets; unfinished.

C. Dowels: ASTM A615/A615M, Grade 40 - 40,000 psi (280 MPa) yield strength; deformed billet steel bars; unfinished finish.

2.04 CONCRETE MATERIALS

A. Obtain cementitious materials from same source throughout.

B. Concrete Materials: Provide in accordance with Greenbook standards.

2.05 ACCESSORIES

A. Curing Compound: ASTM C309, Type 1-D, Class B.

2.06 CONCRETE MIX DESIGN

A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.

B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
   1. For trial mixtures method, employ independent testing agency acceptable to Engineer for preparing and reporting proposed mix designs.

C. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.

D. Concrete Properties:
   1. Compressive strength, when tested in accordance with ASTM C39/C39M at 28 days; 4,000 psi (27.6 MPa).
   2. Fly Ash Content: Greenbook 201-1.2.5.
   3. Calcined Pozzolan Content: Greenbook 201-1.2.5.
   4. Silica Fume Content: Greenbook 201-1.2.5.
   5. Cement Content: Minimum 520 lb per cubic yard (309 kg per cubic meter).
   6. Water-Cement Ratio: Maximum 50 percent by weight.
   7. Total Air Content: 5 percent, determined in accordance with ASTM C173/C173M.
   8. Maximum Slump: 4 inches (100 mm).

2.07 MIXING

A. Transit Mixers: Comply with ASTM C94/C94M.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify compacted subgrade is acceptable and ready to support paving and imposed loads.

B. Verify gradients and elevations of base are correct.
3.02 SUBBASE

A. See Section 32 1123 for construction of base course for work of this Section.

3.03 PREPARATION

A. Moisten base to minimize absorption of water from fresh concrete.

B. Coat surfaces of manhole and catch basin frames with oil to prevent bond with concrete pavement.

C. Notify Engineer minimum 24 hours prior to commencement of concreting operations.

3.04 FORMING

A. Place and secure forms to correct location, dimension, profile, and gradient.

B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.

C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.05 REINFORCEMENT

A. Place reinforcement as indicated.

B. Interrupt reinforcement at 2 inches (50 mm) from concrete surfaces and expansion joints.

3.06 COLD AND HOT WEATHER CONCRETING

A. Follow recommendations of ACI 305R when concreting during hot weather.

B. Follow recommendations of ACI 306R when concreting during cold weather.

C. Do not place concrete when base surface temperature is less than 35 degrees F (1 degrees C), or surface is wet or frozen.

3.07 PLACING CONCRETE

A. Place concrete in accordance with ACI 304R.

B. Do not place concrete when base surface is wet.

C. Ensure reinforcement, inserts, embedded parts, formed joints are not disturbed during concrete placement.

D. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.
3.08 JOINTS

A. Align curb, gutter, and sidewalk joints.

B. Place 1/4 inch (6 mm) wide expansion joints at 10 foot (3 m) intervals and to separate paving from vertical surfaces and other components and in pattern indicated.
   1. Form joints with joint filler extending from bottom of pavement to within 1/4 inch (6 mm) of finished surface.

3.09 FINISHING

A. Area Paving: Light broom, texture perpendicular to pavement direction.

B. Sidewalk Paving: Light broom, texture perpendicular to direction of travel with troweled and radiused edge 1/2 inch (12 mm) radius.

C. Curbs and Gutters: Light broom, texture parallel to pavement direction.

D. Place curing compound on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.

3.10 JOINT SEALING

A. See Greenbook 201-3.

3.11 TOLERANCES

A. Maximum Variation of Surface Flatness: 1/8 inch (3 mm) in 10 ft (3 m).

B. Maximum Variation From True Position: 1/8 inch (3 mm).

3.12 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000.
   1. Provide free access to concrete operations at project site and cooperate with appointed firm.
   2. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
   3. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.

B. Compressive Strength Tests: ASTM C39/C39M; for each test, mold and cure four concrete test cylinders. Obtain test samples for every 100 cu yd (76 cu m) or less of each class of concrete placed.
   1. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
   2. Perform one slump test for each set of test cylinders taken.

C. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.
3.13 PROTECTION

A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.

B. Do not permit pedestrian traffic over pavement for 7 days minimum after finishing.

END OF SECTION
SECTION 32 1723

PAVEMENT MARKINGS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Parking restriping.
      a. Includes markings and accessibility symbols, for accessible spaces as indicated.
   2. Fire lane “No Parking.”
   3. Curb marking and red curbs.

B. Related Sections:
   1. Section 09 9100: Painting
   2. Section 32 1216: Asphalt Paving
   3. Section 32 1313: Concrete Paving

1.02 REFERENCES


1.03 SUBMITTALS

A. Product Data: Manufacturer’s product data on traffic paint products and material.

B. Shop Drawings: Indicating location, extent, color, and texture of markings.

C. Samples: Color samples of paint products.

1.04 PROJECT CONDITIONS

A. Do not install markings when adverse weather conditions are forecasted.

1.05 REGULATORY REQUIREMENTS

A. Accessible Parking Spaces Serving Particular Building or Facility:
   1. When serving more than one accessible entrance, locate on shortest accessible route to entrance or multiple accessible entrances per CBC Section 11B-208.3.1
   2. Provide minimum number of required accessible parking spaces in accordance with CBC Section 11B-208.2.4
   3. Provide accessible parking spaces and access aisles comply with CBC Section 11B-502
      a. Dimension parking spaces to centerline of marked lines as follows:
         1) Mark parking spaces and access aisles according to CBC Figures 11B-502.2, 11B-502.3 and 11B-502.3.3
         2) Provide surfaces complying with CBC Section 11B-11B-302 and at
4. Parking Space Dimensions:
   a. Parking Spaces: 9 feet by 18 feet minimum.
   b. Van Accessible Spaces: 12 feet by 18 feet minimum, with adjacent access aisle of 5 feet by 18 feet minimum.
   c. Place access aisles on either side of parking spaces, except locate on passenger side for van parking spaces.

5. Parking Space and Access Aisle Markings:
   a. Mark access aisles with blue painted borderline around their perimeter.
   b. Mark area within blue borderlines with hatched lines maximum of 36 inches on center with color contrasting to that of aisle surface.
      1) White on asphalt paving.
      2) Blue on concrete paving.
   c. Access aisle markings may extend beyond minimum required length per CBC Section 11B-502.3.3.
   d. Mark access aisles so as not to overlap vehicular way per CBC Section 11B-502.3.4.
   e. Provide vertical clearance of 8 feet-2 inches minimum for accessible parking spaces, access aisles, and vehicular routes serving them per CBC Section 11B-502.5.

PART 2 – PRODUCTS

2.01 MATERIALS

   A. Paint: Water emulsion-based Dura-Strip paint as manufactured by TMT-Pathway, or approved equal.

PART 3 – EXECUTION

3.01 PAVEMENT MARKINGS

   A. Application of Paint:
      1. Prior to application of paint, allow pavement to properly cure.
         a. Clean and prepare in accordance with paint manufacturer’s written recommendations.
      2. Provide mechanical equipment to install paint in a uniform, straight or curved pattern, without holidays and other defects.
      3. Do not permit traffic until paint has completely cured.
      4. Install 2 coats in thickness recommended by manufacturer.

   B. Marking Width and Color: Unless indicated otherwise, marking width and color are as follows:

      | Width | Color          |
      |-------|----------------|
      | 4 inches | Parking stall lines |
      |   4 inches | General     | White     |
      |   4 inches | Accessible   | Blue      |
      | 4 inches  | Traffic markings | Yellow    |
      | 4 inches  | Stripping:    |           |
      |   4 inches | General       | Yellow    |
      |   4 inches | Accessible    | Blue      |
      | 2 inches  | International Symbol of Accessibility | White on blue background |

PAVEMENT MARKINGS
32 1723 - 2
3.02 PROTECTION

A. Protect Work until Substantial Completion.

3.03 CLEANUP

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

END OF SECTION 32 1723
SECTION 32 1726
TACTILE WARNING SURFACING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Cast In Place Detectable/Tactile Warning Surface Tiles (truncated domes) where indicated.

B. Related Sections:
   1. Section 32 1313: Concrete Paving
   2. Section 32 1723: Pavement Markings.

1.02 REFERENCES


B. ASTM International (ASTM):
   2. ASTM C 293 – Standard Test Method for Flexural Strength of Concrete (Using Simple Beam With Center-Point Loading)

C. Federal Standard (FS):
1.03 QUALITY ASSURANCE

A. Provide cast in place detectable/tactile warning surface tiles and accessories as produced by single manufacturer with minimum of three years experience in manufacturing of cast in place detectable/tactile warning surface tiles.

B. Installer's Qualifications: Engage experienced installer certified in writing by detectable/tactile warning surface tile manufacturer as qualified for installation, who has successfully completed tile installations similar in material, design, and extent to that indicated for Project.
   1. Manufacturer's supervisor shall be present at initial pour.

1.04 SUBMITTALS

A. Product Data: Manufacturer's literature describing products, installation procedures and routine maintenance.

B. Shop Drawings: For products specified showing fabrication details, composite structural system, tile surface profile, and sound on cane contact amplification feature.
   1. Include plans of tile placement including joints, and material to be used as well as outlining installation materials and procedure
   2. Tile pattern shall be designed and shown between existing expansion joints with tile rib dimension used for cut size of panels.

C. Samples for Verification Purposes: Minimum of three samples, as Project Site mock-ups, of full cast in place detectable/tactile warning surface tiles of kind proposed for use.

D. Material Test Reports: From qualified accredited independent testing laboratory indicating that materials proposed for use are in compliance with requirements and meet properties indicated.
   1. Test reports shall be conducted on cast in place detectable/tactile warning surface tiles as certified by qualified independent testing laboratory.
   2. Do not include manufacturer's MSDS sheets with this submittal.

E. Maintenance Instructions: Copies of manufacturer's specified maintenance practices for cast in place detectable/tactile warning surface tiles

1.05 PROJECT CONDITIONS

A. Environmental Conditions and Protection: Maintain minimum temperature of 40 degrees F in spaces to receive tiles for at least 24 hours prior to installations, during installation, and for not less than 24 hours after installation.
   1. Store tile material in spaces where they will be installed for at least 24 hours before beginning installation.
   2. Subsequently, maintain minimum temperature of 40 degrees F in areas where Work is completed.

B. Use of water for Work, cleaning, or dust control, shall be contained and controlled and shall not be allowed to come into contact with public.
   1. Provide barricades or screens to protect public.
C. Disposal of liquids or other materials of possible contamination shall be made in accordance with federal state and local laws and ordinances.

D. Cleaning materials shall have code acceptable low VOC solvent content and low flammability if used on Site.

E. Contractor shall coordinate phasing and flagging personnel operations as specified in Division 01.

1.06 DELIVERY, STORAGE AND HANDLING

A. Tiles shall be suitably packaged or crated to prevent damage in shipment or handling.
   1. Finished surfaces shall be protected by sturdy wrappings, and tile type shall be identified by part number.

B. Tiles shall be delivered to location at Project Site for storage prior to installation.

1.07 REGULATORY REQUIREMENTS

A. Tactile Warning Surfacing:
   1. Provide tactile warning surfaces which comply with CBC Section 11B-705.1
   2. Surfacing Color: 33538 “Yellow” conforming to FS 595B.
      a. Except for locations at curb ramps, islands, or cut-through medians where color used shall contrast visually with that of adjacent walking surfaces.
      b. Either light-on-dark, or dark-on-light in accordance with CBC Section 11B-705.1.1.3 and 11B-705.1.1.5.
   3. Surfacing shall differ from adjoining surfaces in resiliency or sound-on-cane contact in accordance with CBC Section 11B-705.1.1.4.

1.08 WARRANTY

A. Provide manufacturer’s minimum 5 year warranty in writing for period of five years from date of final completion complying with DSA Bulletin 10/31/02, revised 04/09/08.
   1. Warranty includes defective work, breakage, deformation, fading and chalking of finishes, and loosening of tiles.

PART 2 – PRODUCTS

2.01 MANUFACTURERS/PRODUCTS

A. Provide detectable warning surface tile by one of following:
   1. Engineered Plastics, Inc. (Armor-Tile)
   2. ADA Solutions, Inc.
   3. Armorcast Products

B. Basis-of-Design Product: Vitrified Polymer Composite (VPC) Cast in Place Detectable/Tactile Warning Surface Tiles specified are based on Armor-Tile as manufactured by Engineered Plastics Inc.
   1. Existing engineered and field tested products which are subject to compliance with requirements, may be incorporated in Work and shall meet or exceed specified test criteria and characteristics.
2.02 MATERIALS

A. Tiles: Made of homogeneous vitrified polymer composite (VPC) material with ultraviolet stabilized coating, to minimize color wear
   1. Provide with slip-resistant surface, incorporating “truncated domes” of same material.
   2. Nominal thickness of detectable warning tile shall be 1/8 inch, exclusive of height of truncated domes.
   3. Provide tiles complying with applicable requirements of CBC, Chapter 11B.

B. Vitrified Polymer Composite (VPC) cast in place detectable/tactile warning surface tiles shall be epoxy polymer composition with ultra violet coating employing aluminum oxide particles in truncated domes, conforming to following:
   1. Compressive Strength, ASTM D 695: Not to be less than 18,000 psi.
   2. Tensile Strength, ASTM D 638: Not to be less than 10,000 psi.
   3. Flexural Strength, ASTM C 293 or D 790: Not to be less than 24,000 psi.
   4. Water Absorption, ASTM D 570: Not to exceed 0.35 percent.
   5. Slip Resistance: 0.9 minimum for the combined wet/dry static co-efficient of friction when tested by ASTM C 1028
   6. Chemical Stain Resistance, ASTM D 543 or D 1038: To withstand without discoloration or staining -1 percent hydrochloric acid, urine, calcium chloride, stamp pad ink, gum and red aerosol paint.
   8. Accelerated Weathering, ASTM G 155: For 3000 hours shall exhibit following result-Delta E, <4.5: No deterioration, fading or chalking of surface of tile.
   9. Accelerated Aging and Freeze Thaw Test, ASTM D 1037 or C1026: Show no evidence of cracking, delamination, warpage, checking, blistering, color change, loosening of tiles, or other defects.
   10. Salt and Spray Performance of Tile, ASTM B 117: Not to show deterioration or other defects after 200 hours of exposure.

C. Pattern/Dimension: Pattern and dimensions of detectable warning surface tile shall incorporate an “in-line” dome pattern of truncated domes 0.2 inch in height, 0.9 inch diameter at base and 0.45 inch diameter at top of dome.
   1. Domes should be spaced no greater than 2.35 inches from center to center.
   2. Field area of detectable warning surface should consist of raised points no greater than 0.045 inches, to create a slip-resistant surface for wheelchair safety.

D. Color: Unless otherwise indicated, detectable warning surface tiles shall be Federal Color No. 33538 “Yellow”
   1. Color shall be integral with detectable warning device tiles and shall not be surface applied.
   2. Paints or other surface coatings shall not be used.

E. Sealants: Sealant shall be gray epoxy, two-component sealant, as manufactured by Sika, Bostik or approved equal and complying with requirements of Section 07 9200.
   1. Sealant: As supplied by manufacturer.
PART 3 – EXECUTION

3.01 INSTALLATION

A. During concrete pouring and tile installation procedures, ensure adequate safety guidelines are in place and are in accordance with applicable industry and government standards.

B. Prior to placement of cast in place detectable/tactile warning surface tiles, review manufacturer's shop drawings and layout drawing prepared by installation contractor to resolve issues related to pattern repeat, tile cuts, expansion joints, control joints, curves, end returns and surface interferences.
   1. Refer discrepancies to Architect.

C. Physical characteristics of concrete shall be consistent with Section 321313 specifications while maintaining a slump range of 4-7 to permit solid placement of cast in place detectable/tactile warning surface tiles.
   1. Overly wet mix will cause tiles to float, therefore suitable weights such as concrete blocks or sandbags (25 lb) shall be placed on each tile.

D. Concrete pouring and finishing operations require typical mason's tools, however, 4' long level with electronic slope readout, 25 lb. weights, and large non-marring rubber mallet are specific to installation of cast in place detectable/tactile warning surface tiles.
   1. Vibrating mechanism may be employed.
      a. Fix vibrating unit to soft wood base at least 1 foot square

E. Concrete shall be poured and finished true and smooth to required dimensions and slope prior to tile placement.
   1. Immediately after pouring concrete, use electronic level to check that required slope is achieved
   2. Place tile square and true to curb edge in accordance with approved shop drawings.
   3. Tiles shall be tamped or vibrated into fresh concrete to ensure that field level of tile is flush to adjacent concrete surface.
      a. Do not attempt to accomplish embedment process by stepping on tiles as this may cause uneven setting which can result in air voids under tile surface
   4. Shop drawings indicate that tile field level (base of truncated dome) is flush to adjacent surfaces to permit proper water drainage and eliminate tripping hazards between adjacent finishes.
      a. Tolerance for elevation differences between tile and adjacent surface is 1/16 inch.

F. Immediately after tile placement, tile elevation is to be checked to adjacent concrete.
   1. Tile elevation shall be set consistent with shop drawings to permit water drainage to curb as design dictates.
   2. Ensure field surface of tile is flush with surrounding concrete and back of curb so that no ponding of possible on tile at back side of curb

G. While concrete is workable, use 3/8 inch edging tool to create finished edge of concrete.
1. Use steel trowel to finish concrete around tile perimeter, flush to field level of Tile.

H. During and after tile installation and concrete curing stage, do not allow walking, leaning, or external forces placed on tile to rock tile, causing void between underside of tile and concrete.

I. Following tile placement, review installation tolerances to shop drawings and adjust tile before concrete sets.
   1. Suitable weights of 25 lb. shall be placed on each tile and additional weights at tile to tile assemblies as necessary to ensure solid contact of tile underside to concrete.

J. Following curing of concrete, remove protective plastic wrap from tile face by cutting plastic with sharp knife tight to concrete/tile interface.
   1. Where concrete bleeding occurs between tiles, soft brass wire brush will clean residue without damage to tile surface.

K. Individual tiles may be bolted together with 1/4 inch bolts or equivalent hardware to help ensure adjacent tiles are flush to each other during installation process.
   1. Place tape or sealant on underside of bolted edge to prevent concrete from rising up between tiles during installation
      a. Replace protective plastic wrap peeled back to facilitate bolting or cutting by taping to ensure tile surface remains free of concrete during installation process
   2. Replace sound-amplifying plates on underside of tile dislodged during handling or cutting and secure with construction adhesive
      a. Air gap created between plates and bottom of tile is important in preserving sound on canr audible properties of tiles.
   3. Applications of sealant shall be level to adjacent surface and straight line formed to tile edge.
      a. Mask off tile faces with duct tape to ensure clean definition of sealant to adjacent surfaces.

3.03 CLEANING AND PROTECTING

A. Protect panels against damage during construction period to comply with tactile tile manufacturer's specification.

B. Protect tiles against damage from rolling loads following installation by covering with plywood or hardwood.

C. Clean tactile tiles not more than four days prior to date scheduled for inspection intended to establish date of substantial completion in each area of project.
   1. Clean tactile tile by method specified by tile manufacturer.

D. Comply with manufacturer's maintenance manual for cleaning and maintaining tile Surface.
   1. Perform recommended annual inspections for safety and tile integrity
E. Remove and legally dispose of rubbish, debris, and waste materials off Project Site.

F. Protect Work until Substantial Completion.

END OF SECTION 32 1726
PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Provide all labor, materials, transportation, and services necessary to furnish and install Irrigation Systems as shown on the Drawings and described herein.

B. It is the intent of the Drawings and Specifications to provide an irrigation system ready for the Owner's use. Any items not specifically shown in the Drawings or called for in the Specification, but normally required to conform to such intent, are to be considered as part of the work.

C. Maintain entire irrigation system for a period of one hundred twenty (120) days upon completion of all punch list items.

D. Supply accurate as-builts for the District upon completion of project (See Section 1.04 B).

1.02 RELATED WORK

A. Planting - Section 32 9000

1.03 QUALITY ASSURANCE AND REQUIREMENTS

A. Permits and Fees: It shall be the responsibility of the Contractor to apply for and arrange for all County, Water District and Utility Services and permits required for the completed school project. Upon request, the School District will pay associated fees for said services and permits. The Contractor is responsible for all costs of temporary services.

B. The Contractor shall possess all insurance, licenses, and permits required to perform the work of this contract, including a C-27 State Contractors License.

C. Manufacturer's Directions: Manufacturer's directions and detailed drawings shall be followed in all cases where the manufacturers of articles used in this contract furnish directions covering points not shown in the Drawings and Specifications.

C. Ordinances and Regulations: All local, municipal and state laws, and rules and regulations governing or relating to any portion of this work are hereby incorporated into and made a part of these Specifications, and their provisions shall be carried out by the Contractor. Anything contained in these Specifications shall not be construed to conflict with any of the above rules and regulations or requirements of the same. However, when these Specifications and Drawings call for or describe materials, workmanship, or construction of a better quality, higher standard, or larger size than is required by the above rules and regulations, the provisions of these Specifications and Drawings
shall take precedence.
E. Superintendent:
   1. A Superintendent satisfactory to the Owner's Representative shall be present on the site at all times during progress of the work.
   2. The Superintendent shall not be changed except with the consent of the Owner's Representative.
   3. The Superintendent shall be authorized to represent the Contractor.

F. Explanation of Drawings:
   1. Due to the scale of Drawings, it is not possible to indicate all offsets, fittings, sleeves, etc., which may be required. The Contractor shall carefully investigate the structural and finished conditions affecting all of his work and plan his work accordingly, furnishing such fittings, etc., as may be required to meet such conditions. Drawings are generally diagrammatic and indicative of the work to be installed. The work shall be installed in such a manner as to avoid conflicts between irrigation systems, planting, and architectural features.
   2. The word "Landscape Architect" as used herein shall refer to the Owner's Authorized Representative.
   3. All work called for on the Drawings by notes or details shall be furnished and installed whether or not specifically mentioned in the Specifications.
   4. The Contractor shall not willingly install the irrigation system as shown on the Drawings when it is obvious in the field that obstructions, grade differences or discrepancies in area dimensions exist that might not have been considered in engineering. Such obstructions or differences should be brought to the attention of the Landscape Architect. In the event this notification is not performed, the Irrigation Contractor shall assume full responsibility for any revision necessary.
   5. Work of this Section that is allied with the work of other trades shall be coordinated as necessary.

G. Applicable Standards: Current published standards, Specifications, tests or recommended methods of trade, industry or Governmental organizations apply to work of this Section where cited by abbreviations noted below:

- Underwriters Laboratories (UL)
- National Sanitation Foundation (NSF)
- American National Standard Institute (ANSI)
- American Standards Association (ASA)

1.04 SUBMITTALS

A. Material List: (Coordinate and submit simultaneously with Planting Submittal, Section 32 9000, Part 1.04)
   1. The Contractor shall furnish the articles, equipment, materials, or processes specified by name in the Drawings and Specifications. No substitution will be allowed without prior written approval by the Owner's Authorized Representative.
   2. Complete material(s) list, five (5) copies, shall be submitted to the Landscape Architect for his approval prior to performing any work. Material list shall include the manufacturer, model number, and description of all materials and equipment to be used. Although
manufacturer and other information may be different, the following is a guide to proper submittal format:

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Manufacturer</th>
<th>Model No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Backflow Preventer</td>
<td>Wilkins</td>
<td>975XL</td>
</tr>
<tr>
<td>2. Automatic</td>
<td>Calsense</td>
<td>ET2000e</td>
</tr>
<tr>
<td>3. Gate Valve</td>
<td>Nibco</td>
<td>T-113</td>
</tr>
</tbody>
</table>

Irrigation submittal must be specific and complete. All items must be listed and should include solvent / primer, wire, wire connectors, valve boxes, etc.

**NOTE:** Copies of manufacturer's literature (catalog cuts) are required as part of submittal information for Inspector and School District use.

3. The Contractor may submit substitutions for equipment and materials listed on the Irrigation Drawings by following procedures as outlined in Part 1.05 of these Irrigation Specifications.

4. Equipment or materials installed or furnished without prior approval of the Landscape Architect may be rejected, and the Contractor required to remove such materials from the site at his own expense.

5. Approval of any item, alternate or substitute indicates only that the product or products apparently meet the requirements of the Drawings and Specifications on the basis of the information or samples submitted.

6. Manufacturer's warranties shall not relieve the Contractor of his liability under the guarantee. Such warranties shall only supplement the guarantee.

**B. Record and As-Built Drawings:**

1. The Contractor shall provide and keep up to date a complete "as-built" record set of blueline ozalid prints which shall be corrected daily and show every change from the original Drawings and Specifications and the exact "as-built" locations, sizes, and kinds of equipment. Prints for the purpose of "as-builts" may be obtained from the Landscape Architect at cost. This set of Drawings shall be kept on the site and shall be used only as a record set.

2. These Drawings shall also serve as work progress sheets and shall be basis for measurement and payment for work completed. These Drawings shall be available at all times for site reviews and shall be kept in a location designated by the Landscape Architect. Should the record blueline as-built progress sheets not be available for review or not up to date at the time of any site reviews (refer to Section 1.08), it will be assumed no work has been completed and the Contractor will be assessed the cost of that site visit at the current billing rate of the Landscape Architect. No other inspections shall take place prior to payment of that assessment.

3. The Contractor shall make neat and legible notations on the as-built progress sheets daily as the work proceeds; showing the work as
actually installed. For example, should a piece of equipment be installed in a location that does not match the plan, the Contractor must indicate that equipment has been relocated in a graphic manner so as to match the original symbols as indicated in the Irrigation legend. The relocated equipment and dimensions will then be transferred to the original as-built plan at the proper time.

4. Before the date of the final site review, the Contractor shall transfer all information from the "as-built" prints to a sepia Mylar or similar Mylar material procured from the Landscape Architect. All work shall be in waterproof India ink and applied to the Mylar by a technical pen made expressly for use on Mylar material. Such pen shall be similar to those manufactured by Rapidograph, Kueffel & Esser, or Faber Castell. The dimensions shall be made so as to be easily readable even on the final controller chart (See Section 1.04C). The original Mylar "as-built" plan shall be submitted to the Landscape Architect for approval prior to the making of controller chart.

5. The Contractor shall dimension from two permanent points of reference, building corners, sidewalks, or road intersections, etc., the location of the following items:
   a. Connection to existing water lines.
   b. Connection to existing electrical power.
   c. Gate/ball valves.
   d. Routing and/or directional turns of sprinkler pressure lines (dimension maximum 10-foot along routing).
   e. Sprinkler control valves.
   f. Routing of control wiring.
   g. Quick coupling valves.
   h. Pressure relief valves.
   i. Other related equipment as directed by the Architect.

6. On or before the date of the final site review, the Contractor shall deliver the corrected and completed sepias to the Landscape Architect. Delivery of the sepias will not relieve the Contractor of the responsibility of furnishing required information that may be omitted from the prints.

D. Controller Charts:
   1. The Landscape Architect shall approve as-built drawings before controller charts are prepared.
   2. Provide one controller chart for each controller supplied.
   3. The chart shall show the area controlled by the automatic controller and shall be the maximum size that the controller door will allow.
   4. The chart is to be a reduced drawing of the actual as-built system and of a maximum size that will fit inside controller housing. It shall be double sided if required for readability.
   5. The chart shall be a blackline print. Different colors shall be used to indicate the Lateral Lines area of coverage for each station, using pastel or transparent colors.
   6. When completed and approved, the chart shall be hermetically sealed between two pieces of plastic, each piece being a minimum of 20 mils thick.
   7. These charts shall be completed and approved prior to final acceptance of the irrigation system.

D. Operation and Maintenance Manuals:
1. Prepare and deliver to the Landscape Architect within ten (10) calendar days prior to completion of construction, two hard cover binders with three rings containing the following information:
   a. Index sheet stating Contractor's address and telephone number and a list of all equipment used with the name and addresses of local manufacturer's representative.
   b. Catalog and part sheets on every material and all equipment installed under this contract.
   c. Guarantee statement. (See Section 1.09.)
   d. Complete operating and maintenance instruction on all major equipment (controllers, booster pump system, etc.).

2. In addition to the above-mentioned maintenance manuals, provide the Owner's maintenance personnel with instructions for operation of major equipment and show evidence in writing to the Architect at the conclusion of the project that this service has been rendered.

E. Equipment to be furnished:
   1. Supply as part of this contract the following tools:
      a. Two keys for opening valve boxes.
      b. One 36-inch soil probe, Oakfield Model B.
      c. Two keys for each automatic controller.
      d. Total of (6) quick-coupler keys for each system, (recycled water and domestic water) with matching hose swivels and globe valve. Grand total of (12) keys.

   2. The above mentioned equipment shall be turned over to the Owner at the conclusion of the project. Before final acceptance can occur, evidence that the Owner has received material must be shown to the Landscape Architect. Refer to plans for any other turn over items the Contractor is responsible for providing the School District.

1.05 SUBSTITUTIONS

A. If the Irrigation Contractor wishes to substitute any equipment or materials for those equipment or materials listed on the Irrigation Drawings and Specifications, he may do so by providing the following information to the Landscape Architect for written approval:
   1. Provide a statement indicating the reason for making the substitution. Use a separate sheet of paper for each item to be substituted.
   2. Provide descriptive catalog literature, performance charts and flow charts for each item to be substituted illustrating that the alternate item meets or exceeds the Specifications of original item.
   3. Provide the amount of cost savings if the substituted item is approved.

B. Contractor shall be responsible for the total performance of such substitution to equal or surpass the original in every respect.

C. If the substitution proves to be unsatisfactory in the opinion of the Architect, Contractor shall remove such work and replace it with originally specified item (including installation) as part of the work of this section.

D. The Landscape Architect shall have the sole responsibility for accepting or rejecting any substituted item as an approved equal to equipment and materials listed on the Irrigation Drawings and Specifications.
1.06 PRODUCT DELIVERY

A. Delivery: Deliver materials in manufacturer's original unopened containers, with each container identified with manufacturer's name, brand or type. Deliver pipe in a manner that allows sections to lay flat along its full length.

B. Storage:
   1. Store materials at a location directed by the Owner's Representative.
   2. Store pipe flat along its entire length.
   3. Store materials in an orderly manner. Avoid interference with other construction activities.

C. Protection:
   1. Protect all materials to prevent intrusion of dirt and moisture.
   2. Protect PVC pipe from sunlight.
   3. Protect the installed work and materials of other trades.

1.07 PROJECT CONDITIONS

A. Contractor shall acquaint himself with all site conditions and exercise extreme care in excavating and working near existing utilities. Call Underground Service Alert (Dial: 811) two days prior to any excavation.

B. Should Contractor find any utilities during his inspections or excavations that are not shown on the plans, Contractor shall promptly notify Landscape Architect and Superintendent for instructions as to further action. Failure to do so will make Contractor liable for any damage thereto arising from his operations subsequent to discovery of such utilities not shown on plans.

1.08 INSPECTIONS

A. All observations herein specified shall be made by the Landscape Architect. The Contractor shall request observations at least 48 hours in advance. Coordinate trips with Landscape Planting - Section 32 90 00. Site visits will be required (at a minimum) on the following parts of the work:
   1. Pre-construction Conference.
   2. Pressure supply line routing, installation and testing. Play-field dimension verification, track layout and irrigation head layout.
   3. Irrigation coverage test and or plant material location as required.
   4. Site review to release to maintenance.
   5. Final site review and acceptance.
      a. The Contractor shall operate each system in its entirety for the Landscape Architect at time of final observation. Any system deemed not acceptable by the Landscape Architect or not in compliance with these Specifications and Drawings, shall be reworked to the complete satisfaction of the Architect.
      b. The Contractor shall show evidence to the Landscape Architect that the Owner has received all accessories, charts, record drawings, and equipment as required (See Section 1.04) before final observation can occur.
B. Contractor shall be responsible for scheduling any other inspections required by other agencies, and coordinate Landscape Architect's involvement as necessary.

C. When observations have been conducted by someone other than the Landscape Architect, show evidence in writing of when and by whom these observations were made. Contractor shall send Landscape Architect copies of all meeting / inspection documentation.

D. No site observations will commence without as-built drawings. In the event the Contractor calls for a site visit without as-built drawings, without completing previously noted corrections, or without preparing the system for said visit, he shall be responsible for reimbursing the Landscape Architect at his current billing rates per hour, portal to portal, (plus transportation costs) for inconvenience. No further site visits will be scheduled until this charge has been paid and received.

E. If in the Landscape Architect's opinion the work scheduled for inspections is not ready; the Contractor shall reimburse the Landscape Architect for his time, prior to any further inspections.

1.09 GUARANTEE

A. The guarantee for the sprinkler irrigation system shall be made in accordance with the following form. The general conditions and supplementary conditions of these Specifications shall be filed with the Owner or his representative prior to acceptance of the irrigation system. The standard one, (1) year guarantee shall include:
1. Filling and repairing depressions and replacing plantings due to settlement of irrigation trenches for one year following acceptance of Project.

B. A copy of the guarantee form shall be included in the operations and maintenance manual.

C. The guarantee form shall be re-typed onto the Contractor's letterhead and contain the following information:

D. GUARANTEE FOR SPRINKLER IRRIGATION SYSTEM

We hereby guarantee that sprinkler irrigation system we have furnished and installed is free from defects in materials and workmanship, and the work has been completed in accordance with the Drawings and Specifications; ordinary wear and tear and unusual abuse or neglect expected.

We agree to repair or replace any defects in material or workmanship that may develop during the period of one year from the date of acceptance and also to such defects at no additional cost to the Owner. We shall make such repairs or replacements within a reasonable time, as determined by the Owner, after receipt of written notice from Owner, we authorize the Owner to proceed to have said repairs or replacements made at our expense and we will pay the costs and charges therefore upon demand.
PART 2.00 PRODUCTS

2.01 MATERIALS

A. General: Use only new materials of brands and types noted on Drawings, specified herein, or approved equals.

2.02 PIPE AND FITTINGS

A. Pressure Mainline-Piping and Fittings: Sizes 2 inch, 2 ½ inch and 3 inch shall be PVC class 315 solvent weld type, unless otherwise noted on drawing. Solvent weld type PVC fittings shall be Schedule 80 PVC or (as a Contractor option) ductile iron fittings as manufactured by Leemco with joint restraints may be used per manufacturer’s recommendation.

B. Pressure Mainline Piping and Fittings: Sizes 1 ½ inch and smaller shall be Schedule 80 PVC.

C. Non-pressure lines (buried lateral): Shall be PVC Class 200/Sch 40. See Irrigation Plan.

D. Copper Pipe Fittings:
   1. Pipe: Type K, hard tempered.
2. Fittings: Wrought copper, solder joint type.
3. Joints shall be soldered with silver solder, 45% silver, 15% copper, 16% zinc, 24% cadmium and solidus at 1125° F, liquidus at 1145° F.

E. Brass Pipe Fittings:
1. Brass pipe shall be 58% red brass, (ASTM B43), Schedule 40 screwed pipe.
2. Fittings shall be medium brass, screwed 125-pound class.

F. Galvanized pipe and fittings:
1. Pipe shall be galvanized steel, (ASTM A53), Schedule 40 galvanized, mild steel screwed pipe.
2. Fittings: Screwed beaded malleable iron, or #125 cast iron; flanged.
3. Unions (2 inches and smaller): Ground joint pattern.
4. Unions (Larger than 2 inches): Flanged type, packed with 1/16-inch asbestos fiber gaskets.

G. All PVC pipe and fittings shall conform to specific requirements as follows:

1. PVC (Solvent Weld)
   a. Pipe: Manufactured from virgin polyvinyl chloride compound in accordance with ASTM D 1785, cell classification 12454B, hydrostatic design stress rating not less than 2000 PSI.
   b. Fittings (solvent weld or thread): Standard weight, schedule 40, side gated, injection molded PVC complying with ASTM D 2466, cell classification 13454B, including threads when required.

2. PVC nipples shall be schedule 80 with molded threads.

3. All PVC pipe must bear the following markings:
   a. Manufacturer's name
   b. Nominal pipe sizes
   c. Schedule or class
   d. Pressure rating in AST
   e. NSF approval
   f. Date of extrusion

4. Solvent cement and primer for PVC solvent-weld pipe and fittings shall be of type and installation method prescribed by the pipe manufacturer.

5. Lettering shall be facing up on all underground PVC. The Inspector will verify this.

H. Lettering shall be facing up on all underground PVC. The Inspector will verify.

2.03 ELECTRICAL (HIGH VOLTAGE)

A. All high voltage electrical materials and service required for automatic controller
and other equipment noted on drawing for irrigation system will be provided by General Contractor.

B. All connections between electrical services and equipment shall be in rigid galvanized electrical conduit, with conduit and wiring size as required.

### 2.04 ELECTRICAL LOW VOLTAGE

A. Connections between controller and remote control valves shall be made with direct burial copper AWGUF, 600 Volt wire, insulation thickness 3/64 inch, utilizing low density high molecular weight polyethylene insulation.

B. Splices, where permitted, shall be waterproofed using Rainbird, Pen-Tite Connectors or fusible heat shrinking tubing, and housed in a box. 1 Box for other irrigation use may be utilized for this purpose. Make only one splice with each connector sealing pack.

C. In no case shall wire size be less than #14 "UF" 600 Volt underground wiring. Common wire to be white in color and sized to accommodate maximum simultaneous operation for each controller, (minimum #12). All other wires a different color.

D. Low voltage wire shall be laid on the north side of east/west pipe runs or the east side of north/south pipe runs. The Inspector will verify.

E. Connections between controller and flow meter shall be made with than #14 "UF" 600 Volt underground wiring.

### 2.05 AUTOMATIC CONTROLLER

A. Type: Refer to plan. Fully automatic operation, capable of operating the number of stations indicated on Drawings.

1. Solid-state type controller in a weatherproof housing with locking hinged cover.
2. Fuse and chassis ground all controller components.
3. The controller shall be mounted on utility room wall. Bottom of controller to be positioned on wall (or approved by School District) ±42 inches above floor. Valves to be connected in sequence as shown on drawing. Controller shall operate on a minimum of 117-Volt power input. The 117-Volt duplex box shall be provided with an on/off switch and 117-Volt receptacle. Metal conduit shall run from the 117-Volt supply to the controller housing. All power within the housing shall be properly phased. A pre-wired terminal strip shall be provided clearly indicating the proper points of connection of all appropriate wiring.

### 2.06 VALVES

A. Gate valves, remote control valves, quick couplers, manual control valves, and hose bibs shall be of the type and manufacturer stated on Drawings.

B. Gate valves 2 ½ inches and smaller (unless otherwise noted on Drawings): ASTM B62 brass body, 150 pound saturated steam rated; with screwed joints; non-rising stem; screwed bonnet, solid disc. Provide with hand-wheel.

C. Gate valves 3 inch and larger (use ductile iron flanged) gate valves shall be of the type and manufacturer stated on Drawings.
D. Quick coupling valves for potable water system refer to irrigation legend.
E. Master valve shall be of the type and manufacturer stated on Drawings.
F. Anti-drain Valves shall be those manufactured by Valcon Automatic Irrigation Equipment Co., or equal.
G. Pressure regulating valves shall be the type and manufacture stated on Drawings.
H. Pressure relief valve shall be of the type and manufacturer stated on Drawings.

2.07 VALVE BOXES
A. Valve boxes shall be fabricated from a durable plastic material resistant to weather, sunlight and chemical action of soils. Valve box shall have no holes to permit Africanized honeybees to enter. All valve boxes shall be heat branded with valve designation, or "GV" for gate valve, "QC" for quick coupler, and controller and station number.
B. Valve box extensions shall be by the same manufacturer as the valve box.
C. Gate valve boxes shall be round plastic boxes with flex lock covers, RAINBIRD VB SERIES or approved equal.
D. Remote control valve boxes shall be rectangular plastic boxes, RAINBIRD VB SERIES or approved equal, with hinged covers with flex lock.

2.08 SPRINKLER HEADS
A. All sprinkler heads shall be of the same size, type, and deliver the same rate of precipitation with the diameter (or radius) of throw, pressure, and discharge as shown on the Drawings and/or as specified herein.
B. Spray heads shall have a screw adjustment.
C. Riser units shall be fabricated in accordance with the installation details.
D. Riser nipples for all sprinkler heads shall be the same size as the riser opening in the sprinkler body.
E. All sprinkler heads of the same type shall be by the same manufacturer.

2.09 DRIP IRRIGATION EQUIPMENT
A. All drip irrigation equipment shall be as shown on the Drawings and/or as specified herein.

PART 3.00 EXECUTION

3.01 WATER SUPPLY
A. The General Contractor will provide new meters. Water meters shall be installed per Engineer’s plan.
B. Sprinkler irrigation system shall be connected to water supply points of connection as indicated on the Drawings.

C. Connections shall be made at approximate locations as shown on Drawings. Contractor is responsible for minor changes caused by actual site conditions.

### 3.02 Pipe

**A. General:**
1. All irrigation pipe and fittings shall be installed in complete accord with manufacturer instructions for same.
2. Line Clearance: All lines shall have a minimum clearance of 6 inches from each other and from lines of other trades. Parallel lines shall not be installed directly over one another.
3. Contractor shall notify Landscape Architect subsequent to mainline installation for approval (See Section 1.08).
4. All mainline shall be installed with coated tracer wire. Install atop all mainline.

**B. Underground Pipe:**
1. **Trenching:**
   a. Excavate trenches to required depths. Follow approved layout for each system.
   b. Trench bottom shall be flat to ensure piping is supported continuously on an even grade.
   c. Where lines occur under paved areas, consider dimension to be below the sub-grade.
   d. Provide minimum coverage as follows:
      1) Pressure supply lines (2 ½ inch and smaller): 18 inches.
      2) Pressure supply lines domestic (3 inch and larger): 24 inches.
      3) Non-pressure lines: 12 inches.
      4) Control wire: 18/24 inches.
   e. Contractor shall notify Landscape Architect prior to backfilling for Pressure Test (See Section 1.08).
   f. Trenching depth needs to be to the top of the pipe. Example: 2 inch PVC to be set at 12 inches deep needs a 14 inch deep trench.
   g. Flood all trenches when back-filling.
   h. Mark all sleeving that goes under sidewalks, etc., with arrow chiseled on sidewalks or curb as applicable.
   i. Thrust blocks shall be installed on all mainline piping 2 inch and larger. Refer to “Green-book” Standards.

2. **Back-filling:**
   a. Buried pipe in trenches shall be center loaded only until all required tests are performed. Trenches shall be carefully backfilled with the excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand, or other approved materials, free from large clods of earth or stones. Backfill shall
be mechanically compacted in landscaped areas to a dry density equal to adjacent undisturbed soil in planting areas. Backfill will conform to adjacent grades without dips, sunken areas, humps or other surface irregularities.

b. A fine granular material backfill will be initially placed on all lines. No foreign matter larger than 1/2” in size will be permitted in the initial backfill.

c. Flooding of trenches will be permitted only with approval of the Landscape Architect or District’s Representative.

d. If settlement occurs and subsequent adjustments in pipe, valves, sprinkler heads, lawn or planting, or other construction are necessary, the Contractor shall make all required adjustments without cost to the Owner.

3. Trenching and Backfill under Paving:
   a. Trenches located under areas where paving, asphaltic concrete or concrete to be installed shall be backfilled with sand (a layer 6 inches below the pipe and 3 inches above the pipe), and compacted in layers to 95% compaction using manual or mechanical tamping devices. Trenches for piping shall be compacted to equal the compaction of the existing adjacent undisturbed soil and shall be left in a firm unyielding condition. All trenches shall be left flush with the adjoining grade. The Sprinkler Irrigation Contractor shall set in place, cap, and pressure test all piping under paving prior to the paving work.

C. Copper Pipe and Fittings:
   1. Install in accordance with manufacturer’s latest printed instructions.

D. Brass Pipe and Fittings:
   1. Cut brass piping by power hacksaw, circular cutting machine using an abrasive wheel, or hand hacksaw. Cut no piping with metallic wheel cutter of any description. Ream and remove rough edges or burrs so smooth and unobstructed flow is obtained.
   2. Carefully and smoothly place on male thread only. Tighten screwed joints with tongs or wrenches. Caulking is not permitted.

E. Galvanized Pipe and Fittings:
   1. Do not bend or spring pipe. Make all offsets or changes in direction with fittings. Cut threads with sharp, clean dies to conform to ASA Specification B2. Assemble pipes free from dirt and scale. Ream and deburr. Make up joints by applying oil base compound to male threads only. Remove excessive compound after makeup.

F. Assemblies:
   1. Routing of sprinkler irrigation lines as indicated on the Drawings is diagrammatic. Install lines (and various assemblies) in such a manner as to conform with the details per plans.
   2. Install NO multiple assemblies in plastic lines. Provide each assembly with its own outlet.
   3. Install all assemblies specified herein in accordance with respective details. In the absence of detail Drawings or Specifications pertaining to specific items required to complete work, perform such work in
accordance with best standard practice, with prior approval from the Landscape Architect.

4. PVC pipe and fittings shall be thoroughly cleaned of dirt, dust and moisture before installation. Installation and solvent welding methods shall be as recommended by the pipe and fitting manufacturer.

5. On PVC to metal connections, the Contractor shall work the metal connections first. Teflon tape or approved equal shall be used on all threaded PVC to PVC, and on all threaded PVC to metal joints. Light wrench pressure is all that is required. Where threaded PVC connections are required, use threaded PVC adapters into which the pipe may be welded. Use SCH 80 PVC adaptors.

G. Sleevings:
   1. All sleeves set in place under paving shall extend 12 inches minimum beyond such paving and be capped hand tight. No in-line fittings, including couplings will be permitted under surfaces to be paved, except where the length of the line under the paving is 20 feet, or where shown on the Drawings, i.e., parking lots, etc.

3.03 ELECTRICAL SUPPLY

A. 117-Volt electrical service for automatic controllers shall be provided for by General Contractor to point shown on plans.

B. Electrical wiring from electrical source to Controller and from Controller to Pump Start Panel shall be in galvanized conduit.

C. Provide grounding rods for irrigation electrical. Provide one for each clock station.

3.04 PILOT WIRES

A. For multiple controller installations, all valve pilot wiring should be color coded so that a different color wire is used for each controller. All ground wires shall be white, marked with identifying color strip for each controller used.

B. Encase all wire under paving in schedule 40 PVC pipe "sleeve."

3.05 LOW VOLTAGE ELECTRICAL

A. Control Wiring:
   1. Wiring:
      a. Install control wires with sprinkler mains and laterals in common trenches wherever possible. Lay under pipeline. Provide expansion curl every 100 feet on runs of more than 100 feet in length. Provide looped slack at valves and changes in direction of 90 degree, and snake wires in trench to allow for contraction of wires. Tie wires in bundles at 10-foot intervals to under side of pipe.
      b. Run five extra control wires from panel continuously from valve to valve throughout system similar to common wire for use if a wire fails. Wire shall be different color than all other wires and marked in control box as an extra wire.
   2. Splices:
      a. Control wire splices at remote control valves to be crimped and
sealed with Spears D.S. 400 Pre-Filled Dri-splices. Line splices will be allowed only on runs of more than 500 feet. Line splices to be waterproofed and sealed with Spears D.S. 400 Pre-Filled Dri-splices. Line splices are to be vaulted and noted on as-builts.

3.06 AUTOMATIC CONTROLLER

A. Automatic controller(s) shall be Calsense ET2000e (size and type shown on the Drawings).

B. Final location of automatic controller(s) shall be approved by the Owner’s Authorized Representative.

C. Unless otherwise noted on the Drawings, the 120-Volt electrical power to each automatic controller location is to be furnished by others. The final electrical hook-up shall be the responsibility of the Contractor.

D. Install controllers per manufacturer’s instructions. Remote control valves shall be connected to controllers in numerical sequence as indicated on Drawings.

E. Remote control unit must be provided for each irrigation controller.

3.07 VALVES

A. Gate valves, quick couplers, pressure reducing valves, master valves, etc:
   1. Install per detail and where indicated on plans.

B. Remote Control Valve:
   1. Install each control valve in separate valve box where shown and as detailed. Group boxes together where practical. Place no closer than 12 inches to buildings and walls. Provide 4 inch minimum clearance between valve and valve box lid. Place in planters and/or turf areas.

C. Anti-Drain Valves:
   1. Install per manufacturer’s recommendations where indicated on plans or where needed.

3.08 VALVE BOXES

A. All buried valves and equipment shall be installed with a proper box. All valve boxes shall have no holes in lids

B. Set valve boxes over valve so all parts of valve can be reached for service.

C. Fill area under box with a minimum of 3 cubic feet of pea gravel before box is installed.

D. Valve boxes shall be flush with turf grades and 2 inches above finish grades in planter areas.

E. Identification tags shall be attached to each remote control valve, showing number that corresponds with controller sequence. Tags shall be manufactured
of polyurethane Behr Desopaid, yellow in color with black letters 2 3/4 inch X 2 1/4 inch or equal. Valve box lids shall be heat branded with valve controller designation. "GV" for gate valve, "QC" for quick coupler, etc.

F. Maintain 4-inch minimum clearance between bottom of valve box lid and top of valve stem.

3.09 IRRIGATION HEADS

A. Install all irrigation heads as designated on the Drawings and in accordance with their respective detail.

B. Spacing of heads shall not exceed the maximum indicated on the Drawings. In no case shall the spacing exceed the maximum recommended by the manufacturer.

3.10 FIELD QUALITY CONTROL

A. Adjustment of the System:
   1. The Contractor shall adjust all sprinkler heads and valves for optimum performance and to prevent as much as possible any over-spray onto walks and roadways. No spray is permitted on buildings.
   2. If it is determined that adjustments in the irrigation equipment will provide proper and more adequate coverage, the Contractor shall make such adjustments prior to planting. Adjustments may include changes in nozzle sizes or degrees of arc, as required.
   3. All sprinkler heads shall be set perpendicular to finished grades unless otherwise designated on the plans and at height and distance from walks, buildings, etc, as noted.

B. The Contractor is responsible for protecting all existing landscaping. Any existing landscaping removed shall be properly replaced, unless approved in writing by Landscape Architect.

C. Testing of Irrigation System:
   1. Test all pressure lines under hydrostatic pressure of 150 PSI, and prove watertight.
   2. Testing of pressure main lines shall occur prior to installation of remote control valves, quick couplers or any other equipment that might prevent a proper test from being performed.
   3. All piping under paved areas shall be tested under hydrostatic pressure of 150 PSI, and proved watertight, prior to paving.
   4. Sustain pressure in lines for not less than 2 hours. If leaks develop, replace joints and repeat test until entire system is proven watertight.
   5. All hydrostatic tests shall be made only in the presence of the Landscape Architect, or other duly authorized representative of the Owner. (Refer to Section 1.08). No pipe shall be completely backfilled until it has been inspected, tested and approved in writing.
   6. Furnish necessary force pump and all other test equipment.
   7. When the sprinkler irrigation system is completed, perform a coverage test in the presence of the Landscape Architect, to determine if the water coverage for planting areas is complete and adequate. Furnish all
materials and perform all work required to correct any inadequacies of
coverage due to deviations from plans, or where the system has been
willfully installed as indicated on the Drawings when it is obviously
inadequate, without bringing this to the attention of the Landscape
Architect. This test shall be accomplished before any ground cover is
planted. Refer to Section 1.08
8. Upon completion of each phase of work, entire system shall be tested
and adjusted to meet site requirements.
9. Low voltage wiring under paving shall be tested for continuity, prior to
paving.

3.11 CLEANUP
A. Clean up shall be performed as each portion of the work progresses. Refuse
and excess dirt shall be removed from the site, all walks and paving shall be
broomed or washed down, and any damage sustained to the work of others shall
be repaired and work returned to its original condition.

3.12 OPERATING INSTRUCTIONS
A. The Contractor shall be required to train Owner's maintenance personnel in
proper operation of all major equipment. Provide written evidence of the person
or persons so trained to the Landscape Architect.

3.13 MAINTENANCE
A. An inspection of valves, hose bibs and other pressurized above ground
connections shall be performed on a minimum weekly basis throughout
maintenance period.
B. Inspection of irrigation heads to correct alignment, clear laterals, adjust spray
patterns, clean screens, and repair damaged heads shall be performed before
commencement of maintenance period and prior to final acceptance (end of
maintenance period).
C. Contractor shall be responsible for interrupting irrigation program to eliminate
watering during a rainstorm.
D. Contractor shall, on a weekly basis, inspect system for damage. Any problems
shall be brought to the attention of the Owner and rectified immediately.

END OF SECTION
SECTION 32 9000
PLANTING

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The work includes all services, labor, materials, transportation and equipment necessary to perform the work indicated on the Drawings.

B. It is the intent of the Drawings and Specifications to provide planting with plants in vigorous growth, ready for Owner’s use. Any items not specifically shown in the Drawings or called for in the Specifications, but normally required to conform to such intent, are to be considered as part of the work.

C. Maintain entire landscape for one hundred and twenty (120) days, upon completion of all punch-list items.

1.02 RELATED WORK

A. Irrigation: Section 32 8000.

1.03 QUALITY ASSURANCE AND REQUIREMENTS

A. The term “Landscape Architect” herein refers to the Owner’s authorized representative.

B. Requirements of Regulatory Agencies:
   1. Comply with Federal, State and local laws and regulations pertaining to all work included in this section.

C. Qualifications:
   1. Pest Control Applicator: Trained and State licensed for application of weed control chemicals.
   2. The Contractor shall possess all insurance, licenses and permits required to perform the work of this contract including a C-27 State Contractor's License.

D. Tests:
   1. Imported and On-site Soils: Soil structure and infiltration rate of existing site soil to be included. Contact Soil & Plant Laboratory, Inc. to coordinate soil sample analysis, telephone (714) 282-8777, Fax (714) 282-8575.
   2. Contractor is responsible for soil testing fees.

E. Applicable Standards:

1.04 SUBMITTALS
A. Materials (s) List: (Coordinate and submit simultaneously with Landscape Irrigation Submittal, Section 02811, Part 1.04)
   1. The Contractor shall furnish the plant material, articles, planting appurtenances, products, materials, or processes specified by name in the Drawings and Specifications. No substitution will be allowed without prior written approval by the Owner's Authorized Representative.
   2. Complete materials (s) list, (5) copies, shall be submitted to the Landscape Architect for his/her approval prior to performing any work. Materials (s) list shall include representative photographs of trees and written specifications of all tree and shrub species. Contractor shall also list supplier for which material is supplied.
      NOTE: Copies of manufacturer’s literature (catalog cuts) are required as part of submittal information for Inspector and School District Use.
   3. The Contractor may submit substitutions for plant material and material listed on the Planting Drawings by following procedures as outlined in Part 1.05 of these Landscape Planting Specifications.

B. Submit to Landscape Architect, (2) copies of test results reflecting specification conformance (Section 2.01) for approval/review prior to placing imported soils, backfill mix and fertilizer on the project site. This should be coordinated and submitted simultaneously with Landscape Planting and Landscape Irrigation Submittal.

C. Certificates of Inspection required by law for transportation shall accompany invoice for each shipment of plants. File copies of certificates with Landscape Architect after acceptance of material. Inspection Certificates by Federal or State Governments at place of growth do not preclude rejection of plants at project site.

D. Submit to Landscape Architect, (2) copies of written guarantee prior to final acceptance (See Section 1.09.)

F. Submit Owner’s Representative/Inspector (2) copies of purchase/delivery receipt for fertilizers delivered to site.

G. Submit to Owner’s Representative/Inspector (2) copies of MSDS statements for all pesticides used on project.

H. Submit to Owner’s Representative/Inspector (2) copies of seed tags for all seeds used on project.

1.05 SUBSTITUTIONS

A. Substitutions will not be permitted without the Landscape Architect’s written approval.

B. If a specified plant species or variety is not obtainable or if size is not up to industry standards, Contractor may submit a proposal to provide the nearest equivalent size or variety to the Architect for his consideration.

C. If approval is granted for substitution, adjustment in Contract will be made in accordance with the Contract Conditions.
1.06 PRODUCT DELIVERY

A. Delivery: Deliver all materials in manufacturer's original unopened containers. Containers shall be clearly labeled with weight, analysis and manufacturer's name and brand applicable.

B. Storage:
   1. Secure Owner’s permission to store plant materials on the project site.
   2. Store fertilizers above ground and protect from moisture absorption with approved covering.

C. Protection:
   1. Protect all plants from damage by sun, wind, rain and freezing at all times prior to planting. Maintain watering of plants on a regular schedule.
   2. Store fertilizers above ground and protect from moisture absorption with approved covering.
   3. Protect the installed work and materials of other trades.

1.07 PROJECT CONDITIONS

A. Verify all dimensions and planting area conditions prior to proceeding with work.

B. Notify the Landscape Architect immediately if any discrepancies exist between the Drawings, the Specifications and actual site conditions.

C. Do not perform work in any area that is unsuitable for successful plant material establishment until all such conditions have been corrected and approved by the Landscape Architect.

D. Examine surfaces for conditions that will adversely affect execution permanence and quality of work.

1.08 INSPECTIONS

A. All observations herein specified shall be made by the Landscape Architect. The Contractor shall request observations at least forty-eight (48) hours in advance. Coordinate trips with Landscape Irrigation System, Section 02811. Site visits will be required on the following parts of the work:
   1. Pre-Construction Meeting.
   2. Review of trees and shrubs spotted for planting, prior to excavating holes; and finish grading, prior to planting lawn and ground cover.
   3. Pre-Maintenance: When planting, irrigation and all other indicated or specified work has been completed.
   4. Final Observation: At completion of maintenance period.

B. Contractor shall personally accompany the Landscape Architect on each of the above-required inspections.

C. If, in the Landscape Architect’s opinion, the work scheduled for inspection is not ready, the Contractor shall reimburse the Landscape Architect for his time.
D. Contractor shall be responsible for scheduling any other inspections required by any other agencies and coordinating Landscape Architect's involvement as necessary.

1.09 GUARANTEE

A. The Guarantee for all items specified in this Section shall be made in accordance with the following form. The General Conditions and Supplementary Conditions of these Specifications shall be filed with the Owner or his representative prior to final acceptance. The Guarantee Form shall be retyped onto the Contractor’s letterhead and contain the following information:

GUARANTEE FOR LANDSCAPE MATERIALS

We hereby guaranteed that all landscaping materials we have furnished and installed are free from defects in materials and workmanship, pests, diseases, and the work has been completed in accordance with the Drawings and Specifications.

We agree to repair or replace any defects in material or workmanship, which may develop during the period of one year from the date of acceptance, and also to such defects at no additional cost to the Owner. We shall make such repairs or replacements within a reasonable time, as determined by the Owner, after receipt of written notice from Owner, we authorize the Owner to proceed to have said repairs or replacements made at our expense and we will pay the costs and charges therefore upon demand. We guarantee to make replacements immediately as project site conditions will permit.

PROJECT:
__________________________________________________________

CONTRACTOR:
_____________________________________________________

ADDRESS:
__________________________________________________________

PHONE NO:  BY:
_____________________________________________________

DATE OF ACCEPTANCE:  BY:
_________________________________________

B. The Guarantee to the Owner shall be that all trees, shrubs and plant materials will maintain vigorous and healthy growth for the following specified guarantee periods:

1. Less than 15-gallon size: Ninety (90) days.
2. 15- gallon or larger: one (1) year.

C. The Guarantee for each period shall begin on date of final acceptance of work by the Owner (after successful completion of the specified maintenance period)

D. We guarantee to replace all dead and dying plants and all plants not reflecting vigorous growth.
E. Plants that are to be replaced shall be of the same variety and size (minimum) originally planted. If landscape has matured since original installation, replacement plant size shall match in size to originally installed plants of similar size plus added growth during maturity. Included will be all materials pertaining to installation of replacement plants, including:

1. Soil preparation, planting and fertilization, staking or guying involved in replacement, shall conform to original specifications, including guarantees.

PART 2.00 – PRODUCTS

2.01 SOIL MATERIALS

A. Topsoil:
   1. On-site Soil: Use existing on-site soil
   2. Use only topsoil materials, which have been approved, by the soil laboratory.

B. Existing Soil to be amended: Inspect existing soil and provide all amendments needed to conform to recommendations by soil laboratory. (See Section 1.03 D)

2.02 Fertilizers and Soil Conditioners:

A. Soil Conditioners:
   1. Material shall be fine textured, with 80% minimum passing a No. 8 screen, and 95% minimum passing a No. 4 screen.
   2. Salinity: Not to exceed 3.5 millionths per centimeter at 25 degrees Celsius, as measured by saturation extract conductivity.
   3. Organic Amendment: Provide one of the following:
      a. Nitrolized/mineralized Redwood sawdust (0.5% actual Nitrogen).
      b. Nitrolized/mineralized Fir sawdust (0.8% actual nitrogen).
      c. Nitrolized/mineralized Fir bark (1-% actual nitrogen).
   2. Agricultural Gypsum: Standard commercial quality manufactured for use as a soil amendment as per soils report obtained upon completion of rough grading.

B. Fertilizer: Available from Gro-Power, Inc., Phone # (909) 393-3744; Fax (909) 393-2773.
   1. Gro-Power Plus (5-3-1)
   2. Gro-Power Controlled Release (12-8-8)
   3. Gro-Power Hi Nitrogen (14-4-9)
   4. Gro-Power planting tablets (12-8-8)

2.03 PLANT MATERIALS

A. Turf: Per plans to match existing.

B. Species and Size: Provide as indicated on “Plant Legend” within Drawings.
C. Tag all plant materials with name and size in accordance with American Association of Nurserymen’s “Standards of Practice”.

D. All plants shall be healthy, well developed representations of their species and/or varieties, free from disfigurements, pests, diseases, and with well-developed branch and root systems.
   1. Container stock shall have grown in containers for at least 6 months, but not over 2 years.
   2. Plants shall have been grown under environmental conditions comparable to those of the project site, except as otherwise specifically approved by Architect.
   3. Plants in containers shall not be root-bound.
   4. Remove rejected plants from the site immediately and replace with acceptable materials.

2.04 MISCELLANEOUS MATERIALS

A. Tree Staking:
   1. Lodge pole Pine (pointed on one end): Stain entire length with green shingle stain. Provide 2-inch diameter by 10-foot long for 24-inch box, 36-inch box and larger, 15- and 5-gallon trees. (Refer to tree planting details.)
   2. Tree Ties: For galvanized pipe use rubber or plastic hose protected 10 gauge galvanized wire as approved by Landscape Architect. For lodge pole pine double stakes use ‘cinch ties’ or equal.

B. Herbicides: Commercial quality pre/post-emergent type as approved by a licensed Pest Control Advisor for use with species of plants specified on the Planting Plans. Contractor must provide name and license number of Pest Control Advisor prior to applying herbicide.

C. Tree-guying:
   1. Duck bill tree support systems.
   2. Model 40-DTS for 3-inch caliper and smaller trees.
   4. Guy Wire Flags: ½ inch diameter x 5 foot long white plastic tubing.

D. Root Barriers: Will be by Deep-Root Manufacturer and installed per Plan. Use Deep-Root Manufacturer and installed per Plan. Use Deep Root UB 24-2 panels. (Refer to tree planting details.)

E. Concrete Mow Curbs (if called for on Drawings):
   1. Refer to detail.

PART 3.00 – EXECUTION

3.01 GRADING
A. Remove and dispose of soil in planting areas that contain deleterious substances such as oil, plaster, concrete, wood, gasoline, paint, or solvents. Remove soil per soils engineer recommendations.

B. Control all airborne dust caused by grading operations using water tankers and sprinklers.

C. Do not work soil when moisture content is so great that excessive compaction will occur, not when soil is so dry that dust will form or clods will not break up. Water shall be applied if necessary to provide ideal moisture content for filling and for planting as herein specified.

D. Preliminary grading shall be done in such a manner as to anticipate the finish grading. Excess soil shall be removed or redistributed before the application of fertilizer and mulch. Where soil is to be replaced by plants and mulch, allowance shall be made so that when finish grading has begun, there shall be no deficiency in the specified depth of mulched-planted beds.

E. Contractor shall check the site for week growth prior to grading or disturbance of the soil in planting areas. These areas shall receive an application of contact herbicide per manufacturer’s recommendations.

F. Finish grading shall consist of bringing all ground areas to uniform slopes, meeting grades of installed curbs, paving, etc. and drainage at a 2% slope unless otherwise indicated on the Drawings. Ground shall be 2 inches below walks, curbs and headers in ground cover and shrub areas and 1 inch below it in lawn areas. Accurate flow lines shall be set by instrument to catch basins or other points of drainage flow. Mounding of finish grade shall be done as directed by the Landscape Architect/Owner’s representative.

G. Prior to beginning finish grading, loosen soil in planting areas to a depth of 8 inches.

H. Allow for addition of soil conditioners in establishing finish grades.

I. Make minor grade adjustments as directed by Landscape Architect

J. Warp grades as necessary to prevent accumulation of water at locations where designed drainage meets an obstruction.

K. Finish grade all planting areas to a smooth and even condition. Make sure that no water pockets or irregularities remain.

L. Remove all foreign materials. Remove clods and rocks larger than 1 1/4 –inch diameter in any direction from soils within 3 inches of the finish grades to required elevations so that after conditioning and planting grade is ½ inch below tops of curbs and walks. Slope to drain toward adjacent drainage swales or catch basins.

3.02 SOIL CONDITIONING (on-site soil)

A. Plant Areas (graded 3:1 or flatter): Grade to finish elevation, allowing for amendments, then incorporate the amendments uniformly into the top 6-inches for each 1,000 sq. ft. of area. The amendments shall be per soil report obtained by
the Landscape Contractor upon completion of grading. (See Section 1.03D.) For bidding purposes use:
1. Organic Amendment: 6 cubic yards
3. Gypsum: 100 lbs.
4. Soil Sulfur: 10 lbs.

B. Remove all rock and unbroken clods larger than 1-1 ½ inches in any dimension brought to the surface.

3.03 PLANTING

A. Locate trees and shrubs by scaling dimensions from Planting Drawings. Do not prune any plant material prior to delivery without specific approval by Architect.

B. Spot containers and obtain Landscape Architect’s approval prior to excavating pits. (See section 1.08.)

C. Pit Excavations:
1. All sides cut vertical.
2. Diameter: Double the container or root ball size for 15 gallon and smaller plants. One and one-half times the diameter of containers 24-inch box and larger.
3. Depth for plant material 24-inch box and smaller: 6 inches deeper than container or root ball.
4. Depth for plant material 36-inch box and larger: Same depth as container or root ball +1 inch.
5. If planter pits are excavated using a power auger, break vertical sides with a balling bar or spade.

D. Do not install plant materials that have cracked or broken balls of earth when removed from container.

E. Plant material in a manner that after settlement, the crown of the plant bears the same relation to finish grade that it did to the surface in its original container.

F. Backfill tree and shrub pits with prepared mix per soil report obtained from the Soil Laboratory upon completion of rough grading. For bidding purposes use:
1. Approved Soil: 6 parts by volume.
2. Organic Amendment: 4 parts by volume.
Add for each cubic yard: (For bidding purposes only. Refer to soils analysis recommendations – Section 1.03 D.)
   b. Iron sulfate: 2 lbs.

G. All plants, which settle deeper than specified above shall be raised to the correct level. After the plant has been placed, additional backfill shall be added to the hole to cover approximately ½ of the height of the root ball. At this stage, water shall be added to the top of the partly filled hole to thoroughly saturate the root ball and adjacent soil.
1. After the water has completely drained, planting tablets shall be placed as indicated below:
   3 tablets per 1-gallon container
8 tablets per 5-gallon container
15 tablets per 15-gallon container
16 tablets per 20- to 24- inch box

2. Larger Sizes: For each “1/2” caliper measured 14 inches above soil level, use 3 to 4 tablets.
3. The remainder of the hole shall then be backfilled.
4. Planting tablets shall be set with each plant on the top of the rootball while the plants are still in their containers so the required number of tablets to be used in each hole can be easily verified.

H. Form a shallow basin around edge of plant pit.
I. Grade area around plants to finish grade.

3.04 MISCELLANEOUS ITEMS

A. Tree Staking:
   1. Lodge Pole Stakes: Install per detail.

B. Tree Guying, Root Barriers, and Erosion Control Fabric: Refer to details/manufacturer’s recommendations.

C. Concrete Mow Curbs: Refer to detail.

D. Herbicides: Apply only under licensed pest control applicators recommendations and per manufacturer’s directions.

3.05 MAINTENANCE PERIOD

A. Maintenance period shall begin when all work indicated on Drawings and Specifications have been completed, inspected and approved by the Landscape Architect. (Refer to Article 1.08 of this Section).

B. Tree Pruning:
   1. Prune trees selectively to provide the following characteristics:
      a. To allow development of permanent scaffold branches that are smaller in diameter than the trunk or branch to which they are attached, and which have a vertical spacing of 19- to 24- inches, with radial orientation and do not overlay one another.
      b. Eliminate narrow v-shaped branch forks, which lack strength.
      c. As necessary to maintain growth within space limitations.
      d. As necessary to maintain a natural appearance, and to balance the crown with roots.
   2. Stripping of lower branches (“raising-up”) of young trees is not permitted. Retain lower branches in a “tipped back” or pinched condition, with as much foliage as possible to promote trunk growth (tapered trunk). Lower branches may be cut flush with the branch collar only after the tree is able to stand erect without staking or other support.
   3. Perform primary pruning of deciduous trees during the dormant season. Prune damaged trees or those that constitute health or safety hazards promptly, without regard to season.
   4. Make all pruning cuts of lateral branches or buds just above collar. “Stubbing” is not permitted.
C. Shrub Pruning:
1. Objectives of shrub pruning are as specified for trees.
2. Do not clip shrubs into balled or boxed forms except where required by the design and so identified on the Plant Legend.

D. Plant Supports:
1. Inspect stakes and guys to prevent girdling of trunks or branches. Make adjustments as necessary to prevent rubbing or injury of bark.
2. Remove stakes and guys as soon as plants no longer require their support.

E. Insect and Disease Control: Maintain effective controls using approved materials and application techniques.

F. Pest Control:
1. Provide all measures necessary to exterminate gophers and moles immediately when their presence is discovered.
2. Repair and restore surfaces to original condition.

G. Fertilizer: Provide applications of Gro-Power Plus at the rate of 20 lbs. Per 1,000 square feet or at the rate recommended by the soil report at the following periods:
1. Thirty (30) calendar days following beginning date of the maintenance period.
2. Sixty (60) calendar days following beginning date of the maintenance period and every thirty (30) calendar days thereafter until maintenance period if complete.

H. Plant Replacement: Refer to Section 1.09.

I. Groundcover:
1. Apply specified pre-emergent herbicide to all broadleaf groundcover areas. Apply in accord with manufacturer’s instructions.
2. Edge groundcover to keep in bounds; trim top growth as necessary to maintain an overall uniform appearance.
3. Remove accumulated trash weekly.

J. Lawns:
1. Mow all turf areas to a minimum height of 1 inches, max 1 ½ inches. Refer to turf company’s recommended mow heights for specific varieties listed in plant legend.
2. Mow at least once every 7 days during spring and fall seasons, and as necessary during other seasons, cutting no more than 1/3 blade height per mowing.
3. Trim edges at least twice monthly or as necessary to maintain a neat appearance. Remove clippings from walks by vacuum.
4. Water lawns at such intervals as weather conditions require replenishing soil moisture below root zone. Always irrigate at night.
5. Control weed growth when necessary using selective herbicides. In areas of Crabgrass infestation apply specified pre-emergent herbicides.
A. Final approval and acceptance of the work will be given when the following conditions, as determined by the Landscape Architect, are met:

1. At the completion of the one-hundred twenty (120) day maintenance period and when 90% coverage for hydroseed ground cover and 100% coverage for turf is obtained.

2. After final inspection and acceptance by the Landscape Architect.

3. The Landscape Architect reserves the option to extend the maintenance period beyond the one-hundred twenty (120) days specified if he determines that further maintenance is necessary to comply with requirements set by the contract documents.

4. Approval and acceptance will be given in writing.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Monolithic concrete manholes with transition to lid frame, covers, anchorage, and accessories.

B. Modular precast concrete manhole sections with tongue-and-groove joints with masonry transition to lid frame, covers, anchorage, and accessories.

1.02 REFERENCE STANDARDS

A. ACI 530/530.1/ERTA - Building Code Requirements and Specification for Masonry Structures and Related Commentaries; American Concrete Institute International; 2011.


H. 2015 Standard Specifications For Public Works Construction (SSPWC) "Greenbook"

I. 2012 Standard Plans For Public Works Construction (SPPWC)

J. 2006 LA County Additions and Amendments to SSPWC "Graybook"

K. Manufacturer’s specifications and details for Contech Stormwater Solutions, StormFilter Manhole.

1.03 SUBMITTALS

A. Shop Drawings: Indicate manhole locations, elevations, piping sizes and elevations of penetrations.

B. Manufacturer's Qualification Statement.
1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years’ experience.

1.05 FIELD CONDITIONS

A. Cold and Hot Weather Requirements: Comply with requirements of ACI 530/530.1/ERTA or applicable building code, whichever is more stringent.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cast-in-place Concrete: Nonreinforced cast in place concrete barrel.
   1. Concrete: 4000 psi concrete (Type II cement, 0.50 max. water/cement) conforming to ASTM C94.
   2. Forms: Steel sheet accurately shaped and fabricated of sufficient strength to form dense watertight walls to true dimensions.

B. Mortar and Grout: Mortar for finishing and sealing shall be Class "C." Honeycombing less than 2 inches deep shall be repaired using Class "D" mortar.

C. Reinforcement: Formed steel wire, galvanized finish, wire diameter as indicated on drawings.

D. Inverts: Shape inverts for smooth flow across structure floor as indicated on Construction Drawings. Use concrete and mortar to obtain proper grade and contour. Finish surface with fine textured wood float.

E. Waterproofing membranes: Tremproof 250 GC fluid applied coating (or approved equal).

2.02 COMPONENTS

A. Lid and Frame: ASTM A48/A48M, Class 35B Cast iron construction, machined flat bearing surface, removable lid, closed or open lid design as indicated on drawing; sealing gasket; lid molded with identifying name.
   1. Manufacturer:
      b. Deeter Foundry, Inc.
      d. Neenah Foundry.
      e. U.S. Foundry & Manufacturing.

2.03 CONFIGURATION

A. Shaft Construction: Concentric with concentric cone top section; lipped male/female dry joints; sleeved to receive pipe sections.

B. Shape: Cylindrical.

C. Clear Inside Dimensions: 48 inch (1,200 mm) diameter.
D. Design Depth: As indicated.
E. Pipe Entry: Provide openings as indicated.
F. Steps: As indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify items provided by other sections of Work are properly sized and located.
B. Verify that built-in items are in proper location, and ready for roughing into Work.
C. Verify excavation for manholes is correct.

3.02 PREPARATION

A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.

3.03 MANHOLES

A. Place concrete base pad, trowel top surface level.
B. Place manhole sections plumb and level, trim to correct elevations, anchor to base pad.
C. Form and place manhole cylinder plumb and level, to correct dimensions and elevations. As work progresses, build in fabricated metal items.
D. Cut and fit for pipe.
E. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour as required.
F. Set cover frames and covers level without tipping, to correct elevations.
G. Coordinate with other sections of work to provide correct size, shape, and location.
H. Contech Diversion Weir System to be installed per manufacturer's recommendations.

3.04 MASONRY WORK

A. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
B. Lay masonry units in running bond. Course one unit and one mortar joint to equal 8 inches (200 mm).
C. Form flush mortar joints.
D. Lay masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

E. Install joint reinforcement 16 inches (400 mm) on center.

F. Place joint reinforcement in first and second horizontal joints above base pad and below lid frame opening.

END OF SECTION 33 0513
SECTION 33 1116
SITE WATER UTILITY DISTRIBUTION PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe and fittings for site water lines including domestic water lines and fire water lines.

B. Valves, and Fire hydrants.

1.02 RELATED REQUIREMENTS

A. Section 31 2316 - Excavation: Excavating of trenches.

B. Section 31 2323 - Fill: Bedding and backfilling.

C. Section 33 0513 - Manholes and Structures.

1.03 REFERENCES


B. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; American Water Works Association; 2010 (ANSI/AWWA C105/A21.5).


F. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service; American Water Works Association; 2009 (ANSI/AWWA C509).


H. AWWA C511-89 – Reduced-Pressure Principle Backflow-Prevention Assembly; American Water Works Association; 1990.

I. AWWA C606 - Grooved and Shouldered Joints; American Water Works Association; 2011.

J. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution; American Water Works Association; 2007 (ANSI/AWWA C900/C900a).
1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

A. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

C. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with utility company requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store valves in shipping containers with labeling in place.

PART 2 - PRODUCTS

2.01 WATER PIPE

A. Ductile Iron Pipe: AWWA C151:
   2. Joints: AWWA C111, rubber gasket with rods.

B. PVC Pipe: AWWA C900 Class 200:
   1. Fittings: AWWA C111, cast iron.

C. Trace Wire: Magnetic detectable conductor, brightly colored plastic covering, imprinted with "Water Service " in large letters.

2.02 VALVES

A. Valves: Manufacturer's name and pressure rating marked on valve body.
B. Gate Valves 3 Inches (75 mm) and Over:
   1. AWWA C509, iron body, bronze trim, non-rising stem with square nut, single
      wedge, resilient seat, flanged ends, control rod, post indicator, valve key, and
      extension box.
   2. Product: Mueller 2360 Series, Clow F-6100 Series, U.S. Pipe Metroseal 250 or
      approved equal.

C. Ball Valves Up To 2 Inches (50 mm):
   1. Brass body, Teflon coated brass ball, rubber seats and stem seals, Tee stem
      pre-drilled for control rod, AWWA inlet end, compression outlet with electrical
      ground connector, with control rod, valve key, and extension box.
   2. Manufacturer: Ford, Jones, or Mueller.

D. Check Valves, Post Indicator Valves, and Backflow Preventers:
   1. Per Water Company Requirements.
   2. Double Check Detector Assemblies (DCDA) shall conform to AWWA C510-89.
      a. DCDA shall conform to LA County DHS Approved Backflow Prevention
         Devices.

2.03 HYDRANTS

A. Hydrants: AWWA C502, UL 246, dry barrel type.
   1. Product: Jones 3700 or approved equal.

A. Hydrant Extensions: Fabricate in multiples of 6 inches (150 mm) with rod and
   coupling to increase barrel length.

A. Hose and Streamer Connection: Match sizes with utility company, two hose nozzles,
   one pumper nozzle.

A. Finish: Primer and two coats of enamel in color required by utility company.

2.04 BEDDING AND COVER MATERIALS

A. Bedding: As specified in Section 31 2323.

B. Cover: As specified in Section 31 2323.

2.05 ACCESSORIES

A. Thrust Blocking: NFPA 24 A.10.8.2; Factor of Safety 1.5, Water Pressure 200 psi,
   and soil bearing 1,0000 pounds per square foot.

B. Backflow Preventer: Per Water Company and Fire Department Requirements.
   1. Zurn Wilkins Model 975XL Reduced Pressure Principle Assembly or approved
      equal.

C. Fire Department Connection (FDC):
   1. FDC shall have sign to indicate type of system, address served by the FDC,
      and pumping if greater than 150 psi (1.03 MPa). Lettering shall be minimum 1
      inch (25 mm), color contrasting to background.
PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that building service connection and municipal utility water main size, location, and invert are as indicated.

3.02 PREPARATION

A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
B. Remove scale and dirt on inside and outside before assembly.
C. Prepare pipe connections to equipment with flanges or unions.

3.03 TRENCHING

A. See the section on trenching for additional requirements.
B. Hand trim excavation for accurate placement of pipe to elevations indicated.
C. Form and place concrete for pipe thrust restraints at each change of pipe direction. Place concrete to permit full access to pipe and pipe accessories.
D. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.04 INSTALLATION - PIPE

A. Group piping with other site piping work whenever practical.
B. Establish elevations of buried piping to ensure not less than 3 ft (1 m) of cover.
C. Install grooved and shouldered pipe joints to AWWA C606.
D. Route pipe in straight line.
E. Install pipe to allow for expansion and contraction without stressing pipe or joints.
F. Slope water pipe and position drains at low points.
G. Install trace wire 12 inches (300 mm) above top of pipe; reading "Water Line Below" in large blue letters.

3.04 INSTALLATION – VALVES AND HYDRANTS

A. Set valves on solid bearing.
B. Center and plumb valve box over valve. Set box cover flush with finished grade.
C. Set hydrants plumb; locate pumper nozzle perpendicular to and facing roadway.
3.05 SERVICE CONNECTIONS

A. Provide water service to utility company requirements.

3.06 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with Greenbook standard.

B. Pressure test water piping in accordance with Water Department standards.

C. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

END OF SECTION