

SPECIFICATIONS ■

Site and Shell Submittal- Issue for Construction – SI 06

April 18, 2016

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(08/17/15 Structural Steel Skin Elevator Bid)
(09/24/15 Site and Shell Submittal)
(10/12/15 Addendum "D")
(11/11/15 SI 01)
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SECTION 01 5639

TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.

1.2 DEFINITIONS

- A. Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings.

1.3 SUBMITTALS

- A. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.
- B. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.
- C. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.
- D. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.

1.4 QUALITY ASSURANCE

- A. Arborist Qualifications: Certified Arborist as certified by ISA, licensed arborist in jurisdiction where Project is located, current member of ASCA, or registered Consulting Arborist as designated by ASCA.
- B. Pre-installation Conference: Conduct conference at Project site.

1.5 PROJECT CONDITIONS

- A. The following practices are prohibited within protection zones:
 1. Storage of construction materials, debris, or excavated material.
 2. Parking vehicles or equipment.
 3. Foot traffic.
 4. Erection of sheds or structures.
 5. Impoundment of water.
 6. Excavation or other digging unless otherwise indicated.
 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

- B. Do not direct vehicle or equipment exhaust toward protection zones.
- C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Organic Mulch: Ground or shredded bark or Wood and bark chips, free from deleterious materials.
- B. Protection-Zone Fencing: Fencing fixed in position and meeting one of the following requirements:
 - 1. Chain-Link Protection-Zone Fencing: Galvanized-steel fencing fabricated from minimum 2-inch opening, 0.148-inch- diameter wire chain-link fabric; with pipe posts, minimum 2-3/8-inch- OD line posts, and 2-7/8-inch- OD corner and pull posts; with 1-5/8-inch- OD top rails and 0.177-inch- diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system. Refer to Arborist report prepared by Arbor Resources, dated June 26, 2015.
 - 2. Height of Fencing: 6 feet.
- C. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.
- C. Protection Zones: Mulch areas inside protection zones and other areas indicated with 4 inches average thickness of organic mulch. Do not place mulch within 6 inches of tree trunks. Refer to Arborist report prepared by Arbor Resources, dated June 26, 2015.

3.2 PROTECTION ZONES

- A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones in a manner that will prevent people from easily entering protected area except by entrance gates.
 - 1. Chain-Link Fencing: Install to comply with ASTM F 567 and with manufacturer's written instructions.
 - 2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.
 - 3. Access Gates: Install where indicated and/or as required by Contractor.

- B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect.
- C. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.
- D. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.

3.3 EXCAVATION

- A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Section 31 2000 "Earth Moving."
- B. Trenching near Trees: Where utility trenches are required within protection zones, hand excavate under or around tree roots or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning. Notify project arborist when roots two inches and greater in diameter are encountered.
- C. Do not allow exposed roots to dry out before placing permanent backfill.

3.4 ROOT PRUNING

- A. Prune roots that are affected by temporary and permanent construction. Prune roots as follows:
 - 1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
 - 2. Temporarily support and protect roots from damage until they are permanently covered with soil.
 - 3. Cover exposed roots with burlap and water regularly.
 - 4. Backfill as soon as possible according to requirements in Section 31 2000 "Earth Moving."
- B. Root Pruning at Edge of Protection Zone: Prune roots by cleanly cutting all roots to the depth of the required excavation.
- C. Root Pruning within Protection Zone: Clear and excavate by hand to the depth of the required excavation to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.
- D. Refer to most recent arborist report and any supplemental related information prepared by Arbor Resources. Request most recent documentation if not already provided.

3.5 CROWN PRUNING

- A. Prune branches that are affected by temporary and permanent construction. Prune branches as follows:
 - 1. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by arborist.

2. Pruning Standards: Prune trees according to ANSI A300 (Part 1) and the following:
3. Cut branches with sharp pruning instruments; do not break or chop.
4. Do not apply pruning paint to wounds.

B. Chip removed branches and spread over existing trees to remain.

3.6 REGRADING

- A. Minor Fill within Protection Zone: Where existing grade is 2 inches or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.

3.7 FIELD QUALITY CONTROL

- A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.8 REPAIR AND REPLACEMENT

- A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.
1. Have arborist perform the root cutting, branch pruning, and damage repair of trees and shrubs.
 2. Treat damaged trunks, limbs, and roots according to arborist's written instructions.
 3. Perform repairs within 24 hours.
 4. Replace vegetation that cannot be repaired and restored to full-growth status, as determined by Architect.

3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove excess excavated material, displaced trees, trash and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 01 7323

BRACING AND ANCHORING

PART 1 – GENERAL

1.1 CONDITIONS AND REQUIREMENTS

- A. Refer to the General Conditions, Supplementary Conditions, and Division 1 General Requirements.

1.2 DESCRIPTION

- A. This section provide guidelines and limitations for supporting all mechanical, electrical, plumbing or architectural items from the building structure, and for seismic bracing for all such items.
- B. Design and install all support and bracing systems except as noted. Provide for attachment to portions of the building structure capable of bearing the loads imposed. Design systems not to overstress the building structure.

1.3 QUALITY ASSURANCE

- A. Design and install all support systems to comply with the seismic zone 4 requirements of the California Building Code (CBC) Chapter 16.
- B. For seismic bracing design use the services of a civil or structural engineer licensed in California.
- C. For seismic bracing for mechanical, electrical and plumbing systems, refer to the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA), "Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems" for guidelines.

1.4 SUBMITTALS

- A. Submit shop drawings for all substructures and attachment methods.
- B. Submit proposed alternative methods of attachment for review and approval by the Architect, prior to deviating from the requirements given below.
- C. For all seismic bracing systems, submit structural calculations and details prepared and signed by the Contractor's licensed engineer which include all resultant forces applied to the building structure. Do not overstress building structure. Calculations will be reviewed only for compliance with design criteria.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Furnish all substructures and fasteners required to comply with the limitations given below. Use materials as specified in the various sections and as appropriate to the use.

- B. Channel framing systems: As required to properly support equipment or assemblies is provided.
- C. All exterior materials: Hot dipped galvanized or stainless steel.

PART 3 – EXECUTION

3.1 GUIDELINES AND LIMITATIONS

- A. The General Contractor shall coordinate the load requirements from all subcontractors so that no combination of loads exceeds the limitations given below.
- B. Steel Structure:
 - 1. Make no attachments to metal decking without written approval from the Architect. If requested, inserts shall be provided where concrete fill occurs or stiffeners welded where roof insulation occurs. Submit supported weights and details as required for such approval.
 - 2. Hang no more than 20 lbs per metal deck rib in any span.
 - 3. Hang all loads greater than 40 lbs concentric with centerline of supporting beam/girder.
 - 4. Attach no loads greater than the following without specific approval of Architect/Engineer:
 - a. Floor beams and girders: 500 lbs points load. 1000 lbs total for a single span.
 - b. Roof beams and girders: 250 lbs points load. 500 lbs total for a single span.

3.2 SEISMIC BRACING

- A. Seismic forces shall be calculated using a value for I (importance factor) of no less than 1.0.

END OF SECTION

SECTION 01 7419

CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section specifies the administrative and procedural requirements for diversion of non-hazardous construction and demolition waste from landfill.

1.2 SYSTEM DESCRIPTION

- A. Performance Requirement: It is a requirement of this Project that a minimum of 95 percent of non-hazardous construction and demolition debris be diverted from landfill.

1.3 DEFINITIONS

- A. Construction Waste: Building improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building improvement materials resulting from selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.
- G. Recyclable Materials:
 - 1. Products and materials that can be recycled may include, but are not limited to, the following:
 - a. Metals (ferrous and non-ferrous), including banding, metal studs, ductwork, aluminum cans, and piping.
 - b. Gypsum board.
 - c. Paper.
 - d. Cardboard.
 - e. Wood products, including crates and pallets.
 - f. Carpet.
 - g. Plastics.
 - h. Copper wiring.
 - i. Mechanical and electrical products and equipment.
 - 2. Final determination of actual recyclable materials will be based on the local recycling facility capability.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Achieve end-of-Project rates for recycling of 95% percent by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling of materials including the following:

1. Demolition Waste:

- a. Asphalt paving.
- b. Concrete.
- c. Concrete reinforcing steel.
- d. Brick.
- e. Concrete masonry units.
- f. Wood studs.
- g. Wood joists.
- h. Plywood and oriented strand board.
- i. Wood paneling.
- j. Wood trim.
- k. Structural and miscellaneous steel.
- l. Rough hardware.
- m. Roofing.
- n. Insulation.
- o. Doors and frames.
- p. Door hardware.
- q. Windows.
- r. Glazing.
- s. Metal studs.
- t. Gypsum board.
- u. Acoustical tile and panels.
- v. Carpet.
- w. Carpet pad.
- x. Demountable partitions.
- y. Equipment.
- z. Cabinets.
- aa. Plumbing fixtures.
- bb. Piping.
- cc. Supports and hangers.
- dd. Valves.
- ee. Sprinklers.
- ff. Mechanical equipment.
- gg. Refrigerants.
- hh. Electrical conduit.
- ii. Copper wiring.
- jj. Lighting fixtures.
- kk. Lamps.
- ll. Ballasts.
- mm. Electrical devices.
- nn. Switchgear and panel boards.
- oo. Transformers.

2. Construction Waste:

- a. Masonry and CMU.
- b. Lumber.
- c. Wood sheet materials.
- d. Wood trim.

- e. Metals.
 - f. Roofing.
 - g. Insulation.
 - h. Carpet and pad.
 - i. Gypsum board.
 - j. Piping.
 - k. Electrical conduit.
 - l. Packaging: Regardless of recycle goal indicated in "General" Paragraph above, recycle 100 percent of the following uncontaminated packaging materials:
 - 1) Paper.
 - 2) Cardboard.
 - 3) Boxes.
 - 4) Plastic sheet and film.
 - 5) Polystyrene packaging.
 - 6) Wood crates.
 - 7) Plastic pails.
- B. The Contractor shall take a pro-active and responsible role in the management of construction waste, and shall require all subcontractors, vendors, and suppliers to participate in the effort.
- C. The Contractor shall establish a construction waste management program for this Project that includes, but is not limited to, the following;
- 1. Salvage for resale.
 - 2. Salvage and reuse.
 - 3. Recycling.
 - 4. Disposal.
- D. Only trash or waste materials that cannot be practically or economically reused or recycled shall be transported to the landfill.
- E. 100% of trees, stumps, rocks and associated vegetation and soils resulting primarily from land clearing shall be reused or recycled.

1.5 SUBMITTALS

- A. Waste Management Plan: Submit plan within 7 days of date established for the Notice to Proceed.
- B. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report including the following information:
- 1. Materials category.
 - 2. Generation point of waste.
 - 3. Total quantity of waste in tons.
 - 4. Quantity of waste salvaged, both estimated and actual in tons.
 - 5. Quantity of waste recycled, both estimated and actual in tons.
 - 6. Total quantity of waste recovered (salvaged plus recycled) in tons.
 - 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- C. Waste Reduction Calculations: Before request for Substantial Completion, submit copies of calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

- D. Records of Donations: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts and invoices.
- G. LEED Submittal: LEED Credit Form for Credit MR 2, completed by Contractor, tabulating total waste material, quantities diverted and means by which it is diverted, and statement that requirements for the credit have been met.
- H. Qualification Data: For waste management coordinator.

1.6 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Experienced firm, with a record of successful waste management coordination of projects with similar requirements, that employs a LEED-Accredited Professional, certified by the USGBC, as waste management coordinator.
- B. Waste Management Conference: Conduct conference at Project site to review methods and procedures related to waste management including, but not limited to, the following:
 1. Retain subparagraphs below if required. Revise to suit Project.
 2. Review and discuss waste management plan including responsibilities of waste management coordinator.
 3. Review requirements for documenting quantities of each type of waste and its disposition.
 4. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 5. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 6. Review waste management requirements for each trade.

1.7 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout Waste Management Plan.
- B. Identify the off-site Recycling Service and Hauler of each designated debris item, who have agreed to accept and divert that item from landfill, and the proposed quantities. Schedule each item and list off-site Recycling Service and Hauler company name, telephone number, address, and person contacted.
- C. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing, and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

- D. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
 2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
 3. If applicable, list local charitable organizations (such as the Habitat for Humanity) in "Salvaged Materials for Donation" Subparagraph below.
 4. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
 5. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 6. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 7. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.
- E. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Include the following:
1. Total quantity of waste.
 2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
 3. Total cost of disposal (with no waste management).
 4. Revenue from salvaged materials.
 5. Revenue from recycled materials.
 6. Savings in hauling and tipping fees by donating materials.
 7. Savings in hauling and tipping fees that are avoided.
 8. Handling and transportation costs. Include cost of collection containers for each type of waste.
 9. Net additional cost or net savings from waste management plan.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
1. Maintain log of each load, of each category item diverted from landfill. Log in separately debris sent to a Class III and/or Class II landfills and materials sent to recycling facilities. Include in log, type of load, load weight, name of hauling service; recycling service or landfill, and date accepted by recycling service or by landfill.
 2. Owner reserves the right to audit the log at any time, retain and make available, all weight tickets, copies of receipts and invoices.

- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.
- C. Material Handling:
 - 1. Separation Facilities:
 - a. Designate a specific on site area or areas to facilitate separation of materials for potential salvage or reuse, recycling, and return.
 - b. Keep waste bins and pile areas neat and clean. Clearly mark bins for each category of waste. Do not mix non-recyclable waste with materials designated for reuse or recycling.
 - 2. Do not permit designated materials to become contaminated or to contaminate site or surrounding areas.
- D. Training and Coordination: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
 - 1. Distribute Waste Management Plan to all on-site supervisors and each subcontractor.
 - 2. Provide on-site instruction of appropriate separation, handling, and recycling, salvage or reuse, and return methods to be used by all entities at the appropriate stages of the Project.
- E. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.

3.2 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 - 3. Store items in a secure area until installation.
 - 4. Protect items from damage during transport and storage.
 - 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- B. Salvaged Items for sale and donation not permitted on Project site.
- C. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area on-site.
 - 5. Protect items from damage during transport and storage.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.

- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to the Owner.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
 - 1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - 4. Store components off the ground and protect from the weather.
 - 5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

- A. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.
- B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
 - 1. Pulverize concrete to maximum 4-inch (100-mm) size.
- C. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
 - 1. Pulverize masonry to maximum 4-inch (100-mm) size.
 - 2. Clean and stack undamaged, whole masonry units on wood pallets.
- D. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- E. Metals: Separate metals by type.
 - 1. Structural Steel: Stack members according to size, type of member, and length.
 - 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- F. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- G. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.
- H. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
 - 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 - 2. Polystyrene Packaging: Separate and bag materials.
 - 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 - 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Wood Materials:
 - 1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
 - 2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
- C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

3.6 DISPOSAL OF WASTE

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

Waste Management Plan

Many of the materials generated from your project can be recycled. You are required to list materials that will be reused, recycled or disposed from your project.

The performance requirement is to reuse or recycle at least 75% of project waste.

Use **tons** to quantify total estimated waste and percentages for materials. Ask your hauler, recycler or site cleanup vendor to assist you with this plan. Receipts of all recycling and disposal must be submitted after project completion.

Project Name: _____

Location: _____

Type of Project: New Construction Demolition Renovation

Square Footage: _____

Type of Construction (wood frame, concrete, steel, etc.): _____

Total Project Value: \$ _____

Company Name: _____ Contact: _____

Address: _____ Phone: _____

Recycler #1: _____ Contact: _____

Address: _____ Phone: _____

Recycler #2: _____ Contact: _____

Address: _____ Phone: _____

Recycler #3: _____ Contact: _____

Address: _____ Phone: _____

Submit this form and the attached Waste Management table to:

KEMA Green
8276 Old Redwood Highway
Cotati, CA. 94931
Tel: 707. 792. 3332

Waste Management Plan

Project Name: _____

Total Estimated Waste Generated by Project: _____ tons
 (Ask your hauler, recycler or site cleanup vendor to assist you. Use receipts from your previous jobs for estimates)

Complete and return within 14-calendar days after receipt of Notice of Award of Bid, or prior to beginning demolition or construction, whichever occurs sooner.

Complete and return with receipts at 50% progress payment and at 100% status report.

Material Type	Estimated Reused/ Recycled	Estimated Disposed/ Landfilled	Actual Reused/ Recycled	Actual Disposed/ Landfilled	Vendor or Facility Used (Destination)
Asphalt & Concrete					
Bricks/Masonry/Tiles					
Building Materials (doors, windows, fixtures, etc.)					
Cardboard & other paper products					
Carpet/Carpet Padding/Foam					
Ceiling Tiles (acoustic)					
Drywall (new, unpainted)					
Electrical Components (light fixtures, cables, etc)					
Film Plastic & Styrofoam Blocks					
Landscape Debris (Plant & Tree Trimmings)					
Mechanical Debris (ducts, controls, plumbing fixtures, etc)					
Scrap Metal					
Unpainted Wood & Pallets					
Other (painted wood & drywall, roofing, etc.)					
Mixed C&D*					
Trash/Garbage					
TOTAL					

- * Mixed C&D is defined as a mixture of three or more materials (e.g. wood, drywall, roofing, insulation, etc) from construction or demolition sites that will be taken to a “qualified” facility for recycling.
- * Recycling rates for mixed C&D debris loads vary among the facilities listed on the attached sheet. For the purposes of calculating your Waste Management Table, assume that 70% by weight of the “mixed C&D debris” are reused/recycled and 30% are disposed/landfilled.

Did you have difficulties finding recycling vendors?

Yes

No

If the estimated amount reused/recycled is less than 75%, explain why:

If the actual amount reused/recycled is less than 75%, explain why:

Prepared by: _____

Date: _____

Signature: _____

Conversion Rates

The following conversion rates are estimates. The ranges vary widely, depending on how the materials are handled (compacted, loose, chipped, etc.). Use the conversion factors and receipts from previous projects to help you estimate the potential amount of materials and waste. Take into consideration the type and load of vehicles that will be used to haul the materials. Ask your hauler or recycler to assist you in estimating these numbers.

Material	Lbs/cy	Tons/cy
Asphalt	1,400 lbs/cy	0.7 tons/cy
Cardboard	100 lbs/cy	0.05 tons/cy
Concrete	2,600 lbs/cy (Sources range from 1,000 to 4,000)	1.3 tons/cy
Drywall	700 lbs/cy	0.35 tons/cy
Wood (chipped)	300 - 650 lbs/cy	0.15 - 0.3 tons/cy
Mixed C&D Debris	900 lbs/cy	0.45 tons/cy
Mixed Waste/Trash	100 - 350 lbs/cy	0.5 - 0.175 tons/cy

END OF SECTION

- E. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products were obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship." Certificates shall include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.

1.04 SUBMITTALS

- A. General: Submit additional LEED submittal requirements included in other sections of the Specifications.
- B. LEED submittals are in addition to other submittals. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated LEED requirements.
- C. Project Materials Cost Data: Provide official invoices indicating total cost, recycled content (including detail on the percentage of post-consumer and post-industrial material), and regionally manufactured and extracted locations for materials used for Project. Costs exclude labor, overhead, and profit. Include breakout of costs for the following categories of items:
 - 1. Furniture.
 - 2. Plumbing.
 - 3. Mechanical.
 - 4. Electrical.
 - 5. Specialty items such as elevators and equipment.
 - 6. Wood-based construction materials.
- D. LEED Action Plans: Provide preliminary submittals within 14 days of date established in the Notice to Proceed indicating how the following requirements will be met:
 - 1. Credit MR 2: Contractor-prepared Construction and Demolition Debris Recycling Plan required under Document 01505, Construction Waste Management. This Plan shall conform to the following LEED requirement: Develop and implement a waste management plan, quantifying material diversion goals. Recycle and/or salvage at least 75 percent of construction, demolition, and land clearing waste. Calculations may be done by weight or volume, but shall be consistent throughout the entire project.
 - 2. Credit MR 4: List of proposed materials with recycled content. Indicate cost, post-consumer recycled content, and pre-consumer recycled content for each product having recycled content.
 - 3. Credit MR 5: List of proposed regional materials. Identify each regional material, including its source, cost, and the fraction by weight that is considered regional.
 - 4. Credit MR 6: List of proposed certified wood products. Indicate each product containing certified wood, including its source and cost of certified wood products.
 - 5. Credit IEQ 3: Construction indoor air quality management plans in accordance with LEED Credit IEQ 3 requirements. Contact the LEED consultant for assistance.
- E. Material Status Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with LEED action plans for the following:
 - 1. Credit MR 2: Waste reduction progress reports complying with Section 01505 Construction Waste Management.
 - 2. Credit MR 4: Recycled content.
 - 3. Credit MR 5: Regional materials.
 - 4. Credit MR 6: Certified wood products.
- F. LEED Documentation Submittals:
 - 1. Credit EA 5: Product data and wiring diagrams for sensors and data collection system used to provide continuous metering of building energy-consumption performance over a minimum of one year of post-construction occupancy.

2. Credit MR 2: Comply with Contractor-prepared Construction and Demolition Debris Recycling Plan required under Document 01505, Construction Waste Management, and additional LEED requirements specified herein.
 - a. Submit certification from recycling services used.
 - b. Complete the LEED Credit Form, tabulating the total waste material, quantities diverted and the means by which diverted, and declaring that the credit requirements have been met.
3. Credit MR 4: Product Data and certification letter indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include official invoices indicating costs for each product having recycled content.
 - a. Complete the LEED Credit Form confirming that the credit requirements have been met and listing the recycled content products used. Include details demonstrating that the project incorporates the required percentage of recycled content materials and products and showing their cost (separate from labor cost) and percentage(s) of post-consumer and/or post-industrial content, and the total cost of all materials for the project. Mechanical and electrical components shall not be included in this calculation.
 - b. Recycled content of steel documentation shall include the industry average for each process available.
4. Credit MR 5: Product Data for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include official invoice indicating cost for each regional material and the fraction by weight that is considered regional.
5. Credit MR 6: Product Data indicating vendor, cost and Forest Stewardship Council (FSC) chain-of-custody certificates for each FSC-certified material and product used. Include official statement indicating cost for each certified wood product.
6. Credit IEQ 3:
 - a. Construction indoor air quality management plan. See Section 1.4 Submittals.
 - b. Product Data for air filter media used during construction.
 - c. Product Data for air filter media used during occupancy.
 - d. Construction Documentation: Six photographs at three different occasions (total of 18 photographs) during construction along with a brief description of the SMACNA approach employed, documenting implementation of the IAQ management measures, such as protection of ducts and on-site stored or installed absorptive materials.
 - e. Complete the LEED Credit Form confirming that a Construction IAQ Management Plan has been developed and implemented, and listing each air filter used during construction and at the end of construction. Include the Minimum Efficiency Reporting Value (MERV), manufacturer name, and model number.
7. Credit IEQ 4.1: Product Data and material safety data sheets (MSDSs) for adhesives and sealants used inside the weatherproofing system indicating VOC content of each product used.
8. Credit IEQ 4.2: Product Data and material safety data sheets (MSDSs) for paints and coatings used inside the weatherproofing system indicating that VOC emissions from paints and coatings shall not exceed the VOC and chemical component limits specified. Indicate VOC content in g/L calculated according to 40 CFR 59, Subpart D (EPA method 24) and chemical components.
9. Credit IEQ 4.3: Product Data for carpet products indicating that carpet systems meet or exceed the requirements of the Carpet and Rug Institute's Green Label Plus Indoor Air Quality Test Programs and product data for hard surface flooring to meet the testing and product requirements of FloorScore certification.
10. Credit IEQ 4.4: Product Data for composite wood materials indicating that they contain no added urea formaldehyde resins.
11. Credit IEQ 5: Complete the LEED Credit Form listing each air filter used prior to occupancy. Include the Minimum Efficiency Reporting Value (MERV), manufacturer name, and model number.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

- A. Provide products and procedures necessary to obtain LEED credits required in this Section. Although other Sections may specify some requirements that contribute to LEED credits, the Contractor shall determine additional materials and procedures necessary to obtain LEED credits indicated.

2.02 RECYCLED CONTENT OF MATERIALS

- A. Credit MR 4: Building materials shall have recycled content such that post-consumer recycled content plus one-half of pre-consumer recycled content for Project constitutes a minimum of 20 percent of cost of materials used for Project.
 - 1. Cost of post-consumer recycled content plus one-half of pre-consumer recycled content of an item shall be determined by dividing weight of post-consumer recycled content plus one-half of pre-consumer content in the item by total weight of the item and multiplying by cost of the item.
 - 2. Do not include plumbing, mechanical and electrical components, and specialty items such as elevators and equipment in the calculation.

2.03 REGIONAL MATERIALS

- A. Credit MR 5: Not less than 10 percent of building materials (by cost) shall be regional materials.

2.04 CERTIFIED WOOD

- A. Credit MR 6: Not less than 95% (by cost) of wood-based materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
 - 1. Wood-based materials include, but are not limited to, the following materials when made from wood, engineered wood products, or wood-based panel products:
 - a. Rough carpentry.
 - b. Miscellaneous carpentry.
 - c. Heavy timber construction.
 - d. Wood decking.
 - e. Metal-plate-connected wood trusses.
 - f. Structural glued-laminated timber.
 - g. Finish carpentry.
 - h. Architectural woodwork.
 - i. Wood paneling.
 - j. Wood veneer wall covering.
 - k. Wood flooring.
 - l. Wood lockers.
 - m. Wood cabinets.
 - n. Furniture.
 - o. Wood doors.

2.05 LOW-EMITTING MATERIALS

- A. Credit IEQ 4.1: For field applications that are inside the weatherproofing system use adhesives and sealants that comply with the following VOC requirements: VOC content of adhesives and sealants used shall be less than the current VOC content limits of South Coast Air Quality Management District (SCAQMD) Rule #1168, AND all sealants used as fillers must meet or exceed the requirements of the Bay Area Air Quality Management District Regulation 8, Rule 51. The LEED Consultant may provide examples of common adhesives and sealants, upon request.
 - 1. Wood Glues: 30 g/L.
 - 2. Metal-to-Metal Adhesives: 30 g/L.

3. Adhesives for Porous Materials (Except Wood): 50 g/L.
 4. Subfloor Adhesives: 50 g/L.
 5. Plastic Foam Adhesives: 50 g/L.
 6. Carpet Adhesives: 50 g/L.
 7. Carpet Pad Adhesives: 50 g/L.
 8. VCT and Asphalt Tile Adhesives: 50 g/L.
 9. Cove Base Adhesives: 50 g/L.
 10. Gypsum Board and Panel Adhesives: 50 g/L.
 11. Rubber Floor Adhesives: 60 g/L.
 12. Ceramic Tile Adhesives: 65 g/L.
 13. Multipurpose Construction Adhesives: 70 g/L.
 14. Fiberglass Adhesives: 80 g/L.
 15. Contact Adhesive: 80 g/L.
 16. Structural Glazing Adhesives: 100 g/L.
 17. Wood Flooring Adhesive: 100 g/L.
 18. Structural Wood Member Adhesive: 140 g/L.
 19. Single-Ply Roof Membrane Adhesive: 250 g/L.
 20. Special-Purpose Contact Adhesive (contact adhesive that is used to bond melamine-covered board, metal, unsupported vinyl, rubber, or wood veneer 1/16 inch or less in thickness to any surface): 250 g/L.
 21. Top and Trim Adhesive: 250 g/L.
 22. Plastic Cement Welding Compounds: 250 g/L.
 23. ABS Welding Compounds: 325 g/L.
 24. CPVC Welding Compounds: 490 g/L.
 25. PVC Welding Compounds: 510 g/L.
 26. Adhesive Primer for Plastic: 550 g/L.
 27. Sheet-Applied Rubber Lining Adhesive: 850 g/L.
 28. Aerosol Adhesive, General-Purpose Mist Spray: 65 percent by weight.
 29. Aerosol Adhesive, General-Purpose Web Spray: 55 percent by weight.
 30. Special-Purpose Aerosol Adhesive (All Types): 70 percent by weight.
 31. Other Adhesives: 50 g/L.
 32. Architectural Sealants: 250 g/L.
 33. Nonmembrane Roof Sealants: 300 g/L.
 34. Single-Ply Roof Membrane Sealants: 450 g/L.
 35. Other Sealants: 420 g/L.
 36. Sealant Primers for Nonporous Substrates: 250 g/L.
 37. Sealant Primers for Porous Substrates: 775 g/L.
 38. Modified Bituminous Sealant Primers: 500 g/L.
 39. Other Sealant Primers: 750 g/L.
- B. Credit IEQ 4.2: For field applications that are inside the weatherproofing system use paints and coatings that do not exceed the VOC and chemical component limits of Green Seal's Standard GS-11 requirements. Indicate VOC content in g/L calculated according to 40 CFR 59, Subpart D (EPA method 24) and chemical components.
1. Flat Primer and Coatings: VOC not more than 50 g/L.
 2. Non-Flat Primer and Coatings: VOC not more than 100 g/L.
 3. Dry-Fog Coatings: VOC not more than 150 g/L.
 4. Primers, Sealers, and Undercoaters: VOC not more than 100 g/L.
 5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
 6. Zinc-Rich Industrial Maintenance Primers: VOC not more than 340 g/L.
 7. Pretreatment Wash Primers: VOC not more than 420 g/L.
 8. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
 9. Clear Wood Finishes, Lacquers: VOC not more than 550 g/L.
 10. Floor Coatings: VOC not more than 100 g/L.
 11. Shellacs, Clear: VOC not more than 730 g/L.

12. Shellacs, Pigmented: VOC not more than 550 g/L.
 13. Stains: VOC not more than 250 g/L.
- C. Credit IEQ 4.3: Install carpet systems that meet or exceed the Carpet and Rug Institute's Green Label Plus Indoor Air Quality Test Program requirements and hard surface flooring to meet the testing and product requirements of FloorScore certification.
 - D. Credit IEQ 4.4: Use composite wood, agrifiber products, and adhesives that contain no added urea-formaldehyde resins.

PART 3- EXECUTION

3.01 MEASUREMENT AND VERIFICATION

- A. Credit EA 5: Implement measurement and verification plan consistent with Option D: Calibrated Simulation, Savings Estimation Method 2 in the EVO's "International Performance Measurement and Verification Protocol (IPMVP), Volume III: Concepts and Options for Determining Energy Savings in New Construction," and as further defined by the measurement and verification plan design team.
- B. If not already in place, install metering equipment to measure energy usage. Monitor, record, and trend log measurements.
- C. Evaluate energy performance and efficiency by comparing actual to predicted performance.
- D. Measurement and verification period shall cover at least one year of postconstruction occupancy.

3.02 CONSTRUCTION WASTE MANAGEMENT

- A. Credit MR 2: Comply with Contractor-prepared Construction and Demolition Debris Recycling Plan required under Document 01 7419, Construction Waste Management, and the additional requirements specified herein.

3.03 CONSTRUCTION INDOOR AIR QUALITY MANAGEMENT

- A. Credit IEQ 3: Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."
 1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period, install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
 2. Replace all air filters immediately prior to occupancy.

END OF SECTION

SECTION 01 8119
INDOOR AIR QUALITY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Construction procedures to promote adequate indoor air quality after construction.
- B. Testing indoor air quality after completion of construction.
- C. Testing air change effectiveness after completion of construction.

1.02 PROJECT GOALS

- A. Dust and Airborne Particulates: Prevent deposition of dust and other particulates in HVAC ducts and equipment.
 - 1. Cleaning of ductwork is not contemplated under this Contract.
 - 2. Contractor shall bear the cost of cleaning required due to failure to protect ducts and equipment from construction dust.
- B. Airborne Contaminants: Procedures and products have been specified to minimize indoor air pollutants.
 - 1. Furnish products meeting the specifications.
 - 2. Avoid construction practices that could result in contamination of installed products leading to indoor air pollution.
- C. Ventilation: Design and construct the HVAC system to achieve the minimum requirements for ventilation specified in ASHRAE 62.1-2007.
- D. Ventilation: Design and construct the HVAC system to achieve the minimum requirements for ventilation specified in ASHRAE 62.1-2007 with air change effectiveness of 0.9 or greater.

1.03 RELATED SECTIONS

- A. Section 01 8113 - LEED Requirements: LEED credits relating to indoor air quality.
- B. Section 01 4000 - Quality Requirements: Testing and inspection services.
- C. Section 01 9100 - Commissioning

1.04 DEFINITIONS

- A. Adsorptive Materials: Gypsum board, acoustical ceiling tile and panels, carpet and carpet tile, fabrics, fibrous insulation, and other similar products.
- B. Contaminants: Gases, vapors, regulated pollutants, airborne mold and mildew, and the like, as specified.
- C. Particulates: Dust, dirt, and other airborne solid matter.
- D. Wet Work: Concrete, plaster, coatings, and other products that emit water vapor or volatile organic compounds during installation, drying, or curing.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Indoor Air Quality Management Plan: Describe in detail measures to be taken to promote adequate indoor air quality upon completion; use SMACNA IAQ Guidelines for Occupied Buildings Under Construction as a guide.
 - 1. Submit not less than 60 days before enclosure of building.

2. Identify potential sources of odor and dust.
 3. Identify construction activities likely to produce odor or dust.
 4. Identify areas of project potentially affected, especially occupied areas.
 5. Evaluate potential problems by severity and describe methods of control.
 6. Describe construction ventilation to be provided, including type and duration of ventilation, use of permanent HVAC systems, types of filters and schedule for replacement of filters.
 7. Describe cleaning and dust control procedures.
- C. Detailed Photo Log: Provide photos with date and time stamp documenting moisture protection methods of at least 2 time periods.
- D. Interior Finishes Installation Schedule: Identify each interior finish that either generates odors, moisture, or vapors or is susceptible to adsorption of odors and vapors, and indicate air handling zone, sequence of application, and curing times.
- E. Duct and Terminal Unit Inspection Report.
- F. Air Contaminant Test Plan: Identify:
1. Testing agency qualifications.
 2. Locations and scheduling of air sampling.
 3. Test procedures, in detail.
 4. Test instruments and apparatus.
 5. Sampling methods.
- G. Air Contaminant Test Reports: Show:
1. Location where each sample was taken, and time.
 2. Test values for each air sample; average the values of each set of 3.
 3. HVAC operating conditions.
 4. Certification of test equipment calibration.
 5. Other conditions or discrepancies that might have influenced results.
- H. Ventilation Effectiveness Test Plan: Identify:
1. Testing agency qualifications.
 2. Description of test spaces, including locations of air sampling.
 3. Test procedures, in detail; state whether tracer gas decay or step-up will be used.
 4. Test instruments and apparatus; identify tracer gas to be used.
 5. Sampling methods.
- I. Ventilation Effectiveness Test Reports: Show:
1. Include preliminary tests of instruments and apparatus and of test spaces.
 2. Calculation of ventilation effectiveness, E.
 3. Location where each sample was taken, and time.
 4. Test values for each air sample.
 5. HVAC operating conditions.
 6. Other information specified in ASHRAE 129.
 7. Other conditions or discrepancies that might have influenced results.
- J. Filtration Media: Identify:
1. Location of permanently installed air handling units.
 2. Filter manufacturer.
 3. Filter identification model number.
 4. Filter MERV rating.
 5. Pre-occupancy replacement date.
 6. Replacement filter MERV rating (post-construction).

1.06 QUALITY ASSURANCE

- A. Testing and Inspection Agency Qualifications: Independent testing agency having minimum of 5 years experience in performing the types of testing specified.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Low VOC Materials: See other sections for specific requirements for materials with low VOC content.
- B. Low-Emitting Materials:
 - 1. Adhesives and sealants used for interior applications shall comply with the following VOC requirements: VOC content shall be less than the current VOC content limits of South Coast Air Quality Management District (SCAQMD) Rule #1168, AND all sealants used as fillers must meet or exceed the requirements of the Bay Area Air Quality Management District Regulation 8, Rule 51.
 - 2. Paints and coatings used for interior applications shall not exceed the VOC and chemical component limits of Green Seal's Standard GS-11 requirements. Indicate VOC content in grams per liter (g/l) calculated according to 40 CFR 59, Subpart D (EPA method 24) and chemical components.
 - 3. Carpet systems shall meet or exceed the Carpet and Rug Institute's Green Label Plus program requirements.
 - 4. Composite wood and agrifiber products (particleboard, medium density fiberboard, plywood, wheatboard, strawboard, panel substrates and door cores) shall contain no added urea-formaldehyde resins.
 - 5. Laminating adhesives used to fabricate on-site and shop-applied composite wood and agrifiber assemblies shall contain no added urea-formaldehyde resins.
 - 6. Building insulation binders shall be formaldehyde-free.

PART 3 EXECUTION

3.01 CONSTRUCTION PROCEDURES

- A. Prevent the absorption of moisture and humidity by adsorptive materials by:
 - 1. Sequencing the delivery of such materials so that they are not present in the building until wet work is completed and dry.
 - 2. Delivery and storage of such materials in fully sealed moisture-impermeable packaging.
 - 3. Provide sufficient ventilation for drying within reasonable time frame.
- B. Begin construction ventilation when building is substantially enclosed.
- C. If extremely dusty or dirty work must be conducted inside the building, shut down HVAC systems for the duration; remove dust and dirt completely before restarting systems.
- D. HVAC equipment and ductwork may NOT be used for ventilation during construction:
 - 1. Provide temporary ventilation equivalent to 1.5 air changes per hour, minimum.
 - 2. Exhaust directly to outside.
 - 3. Seal HVAC air inlets and outlets immediately after duct installation.
- E. Do not store construction materials or waste in mechanical or electrical rooms.
- F. Prior to use of return air ductwork without intake filters clean up and remove dust and debris generated by construction activities.
 - 1. Inspect duct intakes, return air grilles, and terminal units for dust.
 - 2. Clean plenum spaces, including top sides of lay-in ceilings, outsides of ducts, tops of pipes and conduit.
 - 3. Clean tops of doors and frames.
 - 4. Clean mechanical and electrical rooms, including tops of pipes, ducts, and conduit, equipment, and supports.
 - 5. Clean return plenums of air handling units.
 - 6. Remove intake filters last, after cleaning is complete.

- G. Do not perform dusty or dirty work after starting use of return air ducts without intake filters.
- H. Use other relevant recommendations of SMACNA IAQ Guideline for Occupied Buildings Under Construction for avoiding unnecessary contamination due to construction procedures.

3.02 VENTILATION EFFECTIVENESS TESTING

- A. Perform ventilation effectiveness testing before occupancy.
- B. Do not begin ventilation effectiveness testing until:
 - 1. HVAC testing, adjusting, and balancing has been satisfactorily completed.
 - 2. New HVAC filtration media have been installed.
- C. Test each air handler zone in accordance with ASHRAE 129.
- D. If calculated air change effectiveness for a particular zone is less than 0.9 due to inadequate balancing of the system, adjust, and retest at no cost to Owner.

END OF SECTION

SECTION 01 9113

GENERAL COMMISSIONING REQUIREMENTS

PART 1 – GENERAL

1.01 DESCRIPTION

- A. This section includes administrative and procedural requirements and a detailed description of the Commissioning process. This section supplements other Division 01 Commissioning Sections and applies to equipment listed in Systems to be Commissioned (1.10) of this Section.
- B. Commissioning is defined in the US Green Building Council LEED Reference Guide v3 and is a prerequisite for certification.
- C. Additionally, this specification includes requirements that are part of California energy code Title 24-2008, Part 6. Reference to this standard are found in the 2008 Nonresidential Compliance Manual, including sections:
 - 1. Chapter 2, Compliance and Enforcement, sections 2.21, 2.26, and 2.27.
 - 2. Chapter 13, Acceptance Requirements
 - 3. Appendix A, Compliance Forms
- D. The commissioning of irrigation systems is required as part of CALGreen requirements.
- E. Commissioning is intended to achieve the following objectives:
 - 1. Verify the Owner's Project Requirements (OPR) are developed and incorporated into the design.
 - 2. Verify the Basis of Design (BoD) reflects the OPR and is used in the design.
 - 3. Include commissioning requirements in the construction documents.
 - 4. Provide a review of the construction documents during the design phase.
 - 5. Verify the submittals for commissioned systems meet the requirements defined in the BoD, specifications, and construction documents.
 - 6. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and that they receive adequate operational checkout by installing contractors.
 - 7. Verify and document that performance of equipment and systems is proper for the application and meets the Owner's operational requirements.
 - 8. Verify that Operations and Maintenance (O&M) Manuals are complete.
 - 9. Verify that the Owner's operating personnel are trained in accordance with the specifications.

1.02 RELATED SECTIONS:

- A. Section 01 13 30 – Submittals
- B. Section 22 05 01 – Plumbing General Requirements
- C. Section 22 30 00 – Plumbing Equipment
- D. Section 23 05 00 – HVAC General Requirements
- E. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
- F. Section 26 09 23 – Lighting Control Devices

1.03 DEFINITIONS

- A. OPR: Owner's Project Requirements. A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.
- B. BoD: Basis of Design. A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- C. Commissioning (Cx): A systematic process which verifies that the building systems perform as intended. The Commissioning process coordinates system documentation, equipment startup, control system calibration, Test Adjust and Balance, Functional Performance Testing, Operations and Maintenance Documentation, and training. Commissioning also assists in the coordination process to assure design, construction, and post-construction (warranty period) integration proceeds with intentional sequencing and scheduling of Cx requirements.
- D. Components, Subsystems, Equipment, and Systems: Where these terms are used together or separately, they shall mean "as-built" components, subsystems, equipment, and systems.
- E. Commissioning Authority (CxA): An entity identified by the Owner that plans, schedules, and coordinates the Commissioning Team to implement the commissioning process.
- F. System Readiness Checklist / Prefunctional Checklist: A written set of checks and tests that document the equipment's readiness, to be completed prior to the equipment's Functional Performance Tests. Manufacturer's startup checklists are part of each contractor developed Startup Checklist. The Startup Checklist is prepared by the Contractor and reviewed by CxA. The Startup Checklists are completed by the Contractor and verified by the Commissioning Authority through site visits, inspections, and/or review of the completed Startup Checklist. These tests provide the contractors' assurance that the components and systems are ready for Functional Performance Testing.
- G. TAB (Test Adjust and Balance): TAB work is to be completed after all Startup Tests are reviewed and accepted and prior to Functional Performance Tests. CxA reviews the final TAB report for consistency to design requirements.
- H. Functional Performance Tests (FPTs): A documented test of the dynamic functioning and operation of equipment and systems with the goal of verifying that the OPR is met. Functional Performance Testing generally begins with verification of component calibration and proceeds through verification of equipment and systems integration.
 - 1. Test procedures are developed and results documented by the Commissioning Authority.
 - 2. Test procedures are executed by the Contractor.
 - 3. Testing occurs once all system components are installed, energized, programmed, balanced, and otherwise ready for operation under part- and full-load conditions. Testing includes each process in the Sequence of Operations, including startup, shutdown, capacity modulation, emergency and failure modes, alarms, and interlocks to other equipment.

1.04 COORDINATION

- A. The Commissioning Team includes:
 - 1. Owner (or owner's representative)
 - 2. Commissioning Authority (CxA) and Commissioning agents
 - 3. Architect and Design Engineers (A/E Team)
 - 4. Construction Manager (CM) / Project Manager (PM)
 - 5. General Contractor (GC)
 - 6. Sub-contractors (Subs)
 - 7. Building operator (Operator), Maintenance Superintendent

- B. Design Phase
 - 1. Owner's Project Requirements (OPR)
 - a. Before the design phase begins, the OPR shall be documented.
 - b. Energy-related expectations and requirements of the building shall be documented, including,
 - 1) Energy efficiency goals
 - 2) Ventilation requirements
 - 3) Project program, including facility functions and hours of operation, and need for after-hours operation
 - 4) Equipment and systems expectations
 - c. Receipt of a copy of the OPR signed by the owner or owner representative attesting that the OPR has been completed and approved by the owner may be required for Building Department Plan Review.
 - d. Owner is responsible to update OPR as necessary.
 - 2. Basis of Design (BoD)
 - a. As early as possible, and prior to the design phase of the project, engineers responsible for commissionable equipment develop a BoD.
 - b. BoD shall cover the following systems:
 - 1) HVAC systems and controls
 - 2) Lighting control systems
 - 3) Domestic water heating systems and controls
 - 4) Covered processes
 - c. BoD describes the building systems to be commissioned and outlines the design assumptions and how these systems design meets the OPR and why the systems were selected. (See Compliance Method 2013 Nonresidential Compliance Manual for additional information.)
 - d. BoD is updated throughout design and construction as necessary.
 - 3. CxA reviews the OPR and BoD for clarity and completeness.
 - 4. Design Review Kickoff
 - a. An in-person meeting is held between the project owner, design team representatives (including project architect, mechanical and electrical design engineers), commissioning coordinator and Design Reviewer.
 - b. Topics to be discussed include,
 - 1) Project coordination, including design reviewer involvement
 - 2) Project scheduling, including design review
 - 3) Project scope
 - 4) Review OPR and BoD
 - 5) Discuss design elements and assumptions
 - 6) Discuss HVAC systems selection
 - 7) Energy Efficiency Measures
 - 5. Construction Document Review
 - a. Design team provides the Design Reviewer with a set of drawing plans and specifications late in design as agreed upon in Design Review Kickoff meeting, typically around 50-90% CD completion.

- b. Design Reviewer provides review of Construction Documents. The review will focus on adherence to the OPR and BoD, compliance with Title 24, completeness and clarity of the documents, maintainability of the systems as designed, interaction of systems, adherence to LEED requirements, and commission-ability of the systems. In addition to the quality of the design, it is important that the design documents clearly relate appropriate level of detail for contractors to submit complete bids and reduce the number of RFI's during construction.

C. Construction Phase

- 1. Provide submittals for equipment listed in 1.10 of this Section for review by CxA. Acceptance is based on compliance to Contract Documents.
- 2. Provide other submittals for systems and equipment to be commissioned. Submittals, along with any contract document requirements are submitted to CxA for review at least 30 days prior to Startup. Submittals are evaluated for conformance to the OPR, BoD, and contract documents and its operational functionality. Included are:
 - a. Sequence of Operations
 - b. Single line diagrams
 - c. Manufacturer's Installation and Operations Manuals
 - d. Startup Checklists

3. Equipment Startup Checklists
 - a. Develop and utilize Startup Checklists
 - b. Coordinate equipment startup with manufacturers' and/or vendor testing, and other required testing.
 - c. Minimize duplication of work.
 - d. Notify CxA 10 days prior to Startup.
 - e. Provide completed Startup Checklist at least 10 days prior to Test Adjust and Balance work.
4. Provide a Point-to-Point check and calibration of all sensors, actuators, dampers, and automatic valves for review by CxA, at least 10 days prior to the start of Test Adjust and Balance work.
5. Test Adjust and Balance (TAB): TAB work shall begin by the appropriate contractor after completion and acceptance of completed Startup Checklists by the CxA. Notify CxA 10 days prior to the start of Test Adjust and Balance. Submit TAB report to the CxA within 5 days of completion.
6. Functional Performance Testing (FPT): Coordinate Functional Performance Tests. CxA is to witness and document testing. Completion and acceptance of Startup Checklists and TAB reports by CxA are required prior to scheduling Functional Performance Tests. Notify CxA 10 days prior to scheduling FPTs.
7. Operations and Maintenance Manuals (O&M): Submit final O&M Manuals for review by CxA at least 20 days prior to training. O&M documentation includes O&M Manuals, sequence of operations, single line drawings, suggested maintenance and preventative maintenance activities, and list of recommended spare parts.
8. Training of building users and operations personnel: Submit training agenda(s) to CxA for review and acceptance at least 10 days prior to scheduling training. Provide training to building users and operations personnel at the level necessary to impart the operational knowledge relevant to each group.

1.05 OWNER'S RESPONSIBILITIES

- A. Provide the OPR documentation to the CxA and Contractor for information and use. Update OPR as operational goals are modified during design.
- B. Assign operation and maintenance personnel and schedule them to participate in Commissioning team activities.
- C. Provide the BoD documentation, prepared by Design Team and approved by Owner, to the CxA for use in developing the Commissioning Plan, Operation and Maintenance training, and Systems Manual.

1.06 ARCHITECT AND ENGINEERS' RESPONSIBILITY

- A. Develop a Basis of Design (BoD) for all the energy related equipment and systems.
 1. BoD is a narrative demonstrating the design team's understanding of the OPR.
 2. BoD shall express how the construction documents will convey these requirements to the owner, constructors and operators.
 3. BoD includes general information about the project, as well as specific technical design information about the proposed equipment and systems.
 4. BoD includes assumptions about space use, redundancy, diversity, climatic design conditions, space zoning, occupancy, operations, and space environmental requirements. Load calculations, sequence of operations, temperature, light, hours of occupancy, and where and how controls are being employed to these systems are defined.

5. Include applicable codes, guidelines, regulations, and other reference that will be put into practice.
 6. The document is used during functional testing to confirm the design strategy and to help troubleshoot issues that may arise.
 7. Design Team shall update the BoD as needed, based on changes to the design.
- B. Communicate and provide clarification to CxA and contractors as to the operational intent for proper and efficient equipment functioning and integration of systems within the building.
- C. Respond to design review comments provided by CxA to clarify questions and discrepancies found during the Commissioning Design Review.
- D. Assist with resolution and clarification of equipment Sequence of Operations during design and construction.

1.07 CONTRACTOR'S RESPONSIBILITIES

- A. Each Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform Commissioning process activities including, but not limited to, the following:
1. Include the GC and Sub Contractor cost for commissioning in the total contract price.
 2. Integrate and coordinate Commissioning activities into the master schedule. Work with the CxA to ensure that Commissioning activities are properly shown.
 3. Submit equipment submittals and other required submittals for all commissionable equipment for review by CxA.
 4. Attend Commissioning team meetings held on a variable frequency basis.
 5. Furnish a copy of all construction documents, addenda, change orders, submittals and shop drawings related to commissioned equipment to the CxA.
 6. Ensure subs provide submittals necessary to document and verify equipment is started up and in operational condition to meet the OPR and all Commissioning requirements.
 7. Ensure that all Subs execute their commissioning responsibilities according to the Contract Documents and schedule.
 8. Review and accept Functional Performance Test procedures provided by the CxA.
 9. Execute Functional Performance Testing with CxA as witness.
 10. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
 11. Cooperate with the CxA for resolution of issues recorded in the Commissioning Issues Log.
 12. Provide manufacturers' manuals and other supporting documentation described in other sections necessary for the CxA to develop Functional Performance Testing and compile Systems Manual for Owner.
 13. Provide Training Agenda to CxA covering topics necessary to impart information to the building users, maintenance staff, and Owner.
 14. Provide and document training to building users, maintenance staff, and Owner.
 15. Attend pre-warranty review with CxA approximately 10 months after building turnover.
 16. Ensure that Subs execute seasonal or deferred functional testing, witnessed by the CxA, according to the specifications.

17. Ensure that Subs correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

1.08 CxA's RESPONSIBILITIES

- A. Organize and lead the Commissioning Team.
- B. Assure commissioning requirements are included in the general specifications division.
- C. Provide Commissioning Plan.
- D. Convene Commissioning Team meetings.
- E. Review Contractor submittals applicable to systems being commissioned for compliance with commissioning needs, concurrent with the A/E reviews, or as determined by the PM or GC.
- F. Review submittals required for verification of system performance, such as Sequence of Operations, single line diagrams, and manufacturers' Installation and Operations Manuals. Each submittal will be reviewed and stamped with comments. CxA will stamp submittals "No Exceptions Taken", "Implement Exceptions Noted", "Revise and Resubmit", "Rejected", or "Not Reviewed".
- G. Review and comment on Startup Checklist forms provided by contractor for equipment and systems included the commissioning scope, including controls contractor's point-to-point checks and calibration of sensors, dampers, and actuators.
- H. Review completed Startup Checklists and TAB documents/reports.
- I. With necessary assistance and review from installing contractor, write the Functional Performance Tests to be completed by the installing contractor and witnessed by CxA. Additional support may be required of Design Engineers.
- J. Verify the execution of Commissioning process activities using random sampling. The sampling rate may vary from 1 to 100 percent. Verification will include, but is not limited to, equipment submittals, Startup Checklists, Functional Performance Tests, training, operation and maintenance data, and test reports to verify compliance with the OPR. When test results do not meet the requirements, the CxA will report the failure in the Commissioning Issues Log.
- K. Prepare and maintain the Commissioning Issues Log.
- L. Prepare a Final Commissioning Report, including:
 1. Executive summary of process and results of Cx program
 2. History of system deficiencies and resolutions
 3. System performance test results and evaluations
 4. Summary of training process completed and scheduled
 5. Include the following documents:
 - a. Cx Plan
 - b. OPR
 - c. BoD
 - d. Startup Checklists
 - e. Executed Functional Performance Tests
 - f. Recommendations for end-of-warranty review activities

- M. Analyze any functional performance trend logs and monitoring data to verify performance.
- N. Prepare Systems Manual
 - 1. Document the operational aspects of the building, including:
 - a. Site information, facility description, history and current requirements
 - b. Site contact information
 - c. Instruction for basic operations and maintenance, basic troubleshooting, recommended maintenance requirements, and a site events log
 - d. Site equipment inventory and maintenance notes
 - e. Copy of all special inspection verifications required by enforcing agency or the Standards.
 - 2. Systems Operations Training
 - a. Provide copy of written training program and completed attendance forms, or receipt of form signed by the owner attesting that the training program and delivery of training has been completed.

1.09 COMMISSIONING PLAN

- A. The Commissioning Plan is an independent document issued by the CxA to the Commissioning Team. Where there is a conflict, the Specifications and Contract Documents take precedence over the Commissioning Plan.
- B. The Commissioning Plan provides guidance in the execution of the Commissioning process. The Commissioning Plan outlines the specific reviews, inspections and tests that shall be performed as part of the Commissioning process for the project and assigns roles and responsibilities. A preliminary copy shall be issued for use during the initial Commissioning Kick-off Meeting. After the Kick-off Meeting, the CxA shall update and reissue the Commissioning Plan as needed.

1.10 SYSTEMS TO BE COMMISSIONED

- A. The following systems shall be commissioned where applicable:
 - 1. HVAC
 - 2. Domestic Hot Water
 - 3. Lighting Controls
 - 4. Electrical
 - 5. Irrigation Controls

PART 2 – PRODUCTS

2.01 TEST EQUIPMENT

- A. Provide all testing equipment, tools, and instruments required by the Commissioning Process except data logging equipment. Data logging equipment is provided by the CxA.
- B. Provide CxA with a list of test equipment, serial numbers, and calibration certificates expected to be used in the testing process. Calibration certificates shall be dated within 12 months of when equipment is expected to be used, or as more restrictive specifications state elsewhere.
- C. List of equipment and approved options, means of control and control sequencing, and setpoints shall be provided to CxA by each subcontractor responsible for commissioned systems. Lists shall be submitted to General Contractor 45 days from Submittal

acceptance. General Contractor shall submit completed list to CxA within 10 days of receipt of lists.

PART 3 – EXECUTION

3.01 MEETINGS

- A. Commissioning Kick-off Meeting: A Commissioning scoping meeting shall be held within sixty (60) working days after the Notice to Proceed. Attendance is mandatory for the entire Commissioning Team.
- B. Other Meetings: The CxA shall schedule other meetings, generally in conjunction with regularly scheduled site meetings. Meetings shall cover coordination, deficiency resolution, and planning issues.

3.02 COMMISSIONING RELATED SUBMITTALS

- A. General Requirements
 - 1. Allow clear space on each drawing for review stamp.
 - 2. Identify Tag Numbers from construction drawings on all submittals.
 - 3. Commissioning submittal requests shall be integrated into the normal submittal process and protocol of the construction team.
 - 4. The CxA shall review and comment on submittals related to the commissioned equipment for conformance to the Contract Documents as it relates to the Commissioning process, to the functionality of the equipment, and to the adequacy for developing test procedures.
 - 5. CxA will stamp submittals "Comments Provided" or "No Comments Provided".
 - 6. If more than one resubmittal of the same item or its component is required, the Contractor will be billed for additional review time and materials at current billing rates of the CxA.
- B. Equipment Submittals: The CxA shall request that specific equipment submittals and other required documents outlined in the specifications be copied or routed to the CxA for review and comment. All equipment that is subject to Commissioning shall be required to be submitted to CxA.
 - 1. Manufacturer's standard documentation shall be modified to delete information which is not applicable and shall be supplemented to provide additional information where so required.
 - 2. Manufacturer's catalog sheets, brochures, diagrams, schedules, performance charts, illustrations, and other standard descriptive data shall:
 - a. Have each copy clearly marked to identify pertinent materials, products, models, finishes, etc.
 - b. Clearly show intended options and delete (or strike) options not provided.
 - c. Show dimensions and clearances required.
 - d. Show performance characteristics and capacities.
 - e. Show wiring diagrams and controls, and show necessary rough-in requirements for utility services and connections, where applicable.
 - f. Include Tag numbers as designated on contract drawings.
- C. The following Submittals are required to be provided within 30 days of the approved Equipment Submittal.
 - 1. SOO: Sequence of Operations. Narrative description of each control sequence for each piece of equipment controlled.

- a. Provide information on locations of components, how to energize switches and controls, how components interface with other components, equipment and systems, operation of controls including operational sequence, complete troubleshooting sequence, and failure and safeguards to indicate if equipment goes off-line.
- b. Submittal shall include all operating modes, interlocks, specified control responses, specific responses to abnormal or emergency conditions and verifications of the proper response of the Building Automation System controllers and sensors (where applicable).

2. SLD: Single Line Diagram. Drawings identifying equipment and its interconnected relationship to other equipment.
 - a. Provide a single line diagram showing equipment and its relationship to other equipment and systems. This diagram informs the reader of equipment connectivity. Include clear indication of interlocks and dependencies.
 - b. Diagrams showing all control points, sensor locations, point names, actuators, and controllers and, where necessary, points of access superimposed on diagrams of the physical equipment.
 - c. Logic diagrams showing the logic flow of the system.
3. IOM: Manufacturer's Installation and Operations Manuals.
 - a. Provide one copy of the manufacturer's IOM for each unique type of equipment. This manual shall be consistent with the specified approved model. Highlight or cross out sections to illustrate the options and control strategies that are being used for this project. Identify ID Tags on the cover page of each IOM, consistent with design drawings.
4. Control Drawings: Control drawings provided by the Controls Contractor include the following components.
 - a. A list of all control points, including analog inputs, analog outputs, digital inputs, and digital outputs. Include the values of all parameters for each system point. Include schedules, setpoints, and settings.
 - b. A complete control language program including all software routines employed in operating the control system. Also provide a program write-up, organized in the same manner as the control software. This narrative shall describe the logic flow of the software and the functions of each routine and sub-routine. It should explain individual math or logic operations that are not clear from reading the software listing.
5. Startup Checklists – Contractor developed Installation/Startup Checklists.
 - a. Subs will provide their Startup Checklists as submittals. The CxA will review the Startup Checklists and may request additional items be added.
 - b. Startup Checklists are required for all commissioned equipment, including each component, piece of equipment, system, and sub-system, with all interfaces, interlocks, etc.
 - c. Startup Checklists provide operating tests and checks to verify that all components, equipment, systems, subsystems, and interfaces between systems are installed, calibrated, and configured in accordance with the Contract Documents.
 - d. Typically manufactures startup procedures along with contract document requirements are sufficient. When using the manufacturer's standard written startup procedures, per manufacturer's installation manuals, include check boxes by each procedure and a signature block at the end.
 - e. Include forms used by the sub-contractor to document tests required in the specifications.
 - f. Each item to be tested shall have a different entry line with space provided for comments and to indicate whether the mode under test responded as required or not.
 - g. Separate checklists shall be prepared for each piece of equipment for each mode of operation, if appropriate.
 - h. Provide space for all necessary parties to sign off and date each checklist.
6. TAB: Test Adjust and Balance.
 - a. Submit a sample form of all checklists for each component, piece of equipment, sub-system, and system requiring testing, adjusting, and

balancing, including all interfaces, interlocks, etc. Submit within 30 days after equipment submittals have been accepted.

- b. Sample reports shall be developed for this specific project and include all required testing, adjusting, and balancing identified elsewhere in contract documents.
- c. Identify a detailed description of the testing, adjusting, and balancing procedures and processes.

7. Training Systems Operations

- a. Training material shall include:
 - 1) System and equipment overview (equipment function and with what other systems or equipment it interfaces)
 - 2) Review and demonstration of operation, servicing, and preventive maintenance
 - 3) Review Systems Manual
 - 4) Review record drawings on systems and equipment

- b. Written training program includes:
 - 1) Learning goals and objectives
 - 2) Training agenda, topics and length of instruction
 - 3) Instruction information and qualifications
 - 4) Location of training sessions
 - 5) Attendance forms
 - 6) Training materials
 - 7) Description on training will be archived for future use
- D. Warranty: Submit a single Warranty stating that the work is in accordance with Contract Documents and conforms to the contract document requirements.

3.03 ISSUES LOG

- A. A record of deficit responses is developed and maintained throughout the Commissioning process. The Issues Log is started during the design review stage and carried through the warranty phase.
- B. Items are generated by the CxA as a communication tool to inform the owner and commissioning team members of corrective actions that may be needed, or observed conditions that document commissioning events that have a bearing on the project.
- C. Each item is dated and assigned to a particular responsible party, who is charged with responding to the Issues Log in writing. The response shall indicate the action taken by the responsible party and reviewed by the CxA.
- D. Responses are to be provided within 10 days of the Issues Log being provided.
- E. The Issues Log becomes a document within the Commissioning Report and a record of the Commissioning process.

3.04 SITE INSPECTIONS

- A. Relevant subcontractors shall accompany the Commissioning Authority on up to 2 construction site visits prior to Functional Performance Testing.
- B. The Contractor shall correct deficiencies found during site visits within 7 days of receiving a Corrective Action Report (Commissioning Issues Logs). A written response shall be provided with an explanation describing the corrective measure.

3.05 INSTALLATION / STARTUP CHECKLISTS

- A. Undertake a full startup checkout of each piece of equipment. The startup testing shall be successfully completed prior to formal Functional Performance Testing of that system.
- B. The Startup Checklist shall be inclusive of the manufacturer's written startup procedures and any requirements identified in Construction Documents.
- C. The contractor shall complete a Startup Checklist for each piece of equipment listed in paragraph 1.10 of this section and submit it for review by the CxA.
 - 1. Each piece of equipment receives a full checkout by the Contractor. No sampling strategies are used.
 - 2. Startup Checklists (Pre-functional Checklists) are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., verification of installation requirements, fan belt tension, labels affixed, gages in place, sensor calibration, etc.).

3. This list of procedures does not constitute a recommendation of the full installation and startup procedures or release the installer from following all factory recommendations, the specifications, applicable codes and good practice.
4. Other startup record forms normally used should also be filled out and submitted at the same time as Startup Checklists. All documentation should be submitted to the CxA upon completion.

D. Execution of Startup Checklists

1. A minimum of 10 days prior to startup, the Subs and/or vendors schedule startup with the CM, GC and CxA. The Startup Checklists are directed and executed by the Sub or vendor. The CxA, A/E, and CM may observe the procedures for some or all of the primary equipment.
2. To document the process of startup, the site technician performing the task initials each line item in the Startup Checklist and checks off items as they are completed. Only individuals having direct knowledge of a line item being completed shall check or initial the forms. Each form is to be dated and signed by the person responsible for the Startup.
3. The Subs and/or vendors execute the Startup Checklists and submit a signed copy of the completed Startup Checklist to the CxA for review and acceptance.
4. Startup Checklists may contain tasks for multiple subcontractors. The primary subcontractor for any particular commissioned equipment is responsible for coordinating sign-off by others.
5. The subcontractors shall complete the documentation during the startup of the equipment and submit the completed documentation to the CxA prior to Functional Performance Testing.
6. Provide all manufacturers suggested maintenance to equipment until Final Completion.

3.06 TEST ADJUST AND BALANCE REQUIREMENTS

- A. Test Adjust and Balance (TAB) work is to start after all Startup Checklists are completed and accepted by CxA.
- B. Notify CxA 10 days prior to scheduled TAB work.
- C. Submit TAB report to CxA for review as soon as completed.
- D. Acceptance of TAB report is based on specified deviation from design values. Deviation of $\pm 10\%$ from design value will be used absent of specified values from design engineers.
- E. A sample set of readings will be taken during Functional Performance Tests to verify final TAB Report. Discrepancies of values greater than $\pm 10\%$ (unless specified elsewhere) for 10% of the sample will be cause to have the TAB Report rejected by CxA.

3.07 CALIFORNIA TITLE 24 ENERGY STANDARDS ACCEPTANCE TESTING

- A. Acceptance requirements ensure that equipment, controls and systems operate as required by California Title 24-2008 Part 6, Nonresidential Energy Standards. The activities specified in these requirements have three aspects:
- B. Visual inspection of the equipment and installation,
- C. Review of the certification requirements, and
- D. Functional tests of the systems and controls.
- E. Mechanical Acceptance Requirements are outlined in CEC Standard Section 125.
- F. Lighting Acceptance Requirements are outlined in CEC Standard Section 134.
- G. The Building Department shall not release a final Certificate of Occupancy until all required Certificates of Acceptance are submitted.
- H. Notify CxA 14 days prior to executing Acceptance Tests.
- I. CxA may witness tests and incorporate results as part of Functional Performance Tests to eliminate redundancy, but Title 24 Acceptance Tests are not the responsibility of the CxA.

3.08 FUNCTIONAL PERFORMANCE TESTING REQUIREMENTS

- A. Complete the following prior to Functional Performance Testing:
 - 1. Coordinate with the Commissioning Authority to be present during Functional Performance Testing.
 - 2. A minimum of 14-day notice to the CxA is required prior to scheduling the Functional Performance Testing.
 - 3. Completion and review by CxA of the Startup Checklists, Title 24 Acceptance Tests, and TAB Report.
 - 4. Correction of deficiencies identified during Startup Checklists. These will be identified through Commissioning Issues Logs provided by CxA.
 - 5. Provide CxA with access to the record documents. Finalize and make corrections to Record Documents as noted by the CxA prior to Functional Performance Testing.

6. List of any changes to equipment, SoO, and final set points.
- B. Perform Functional Performance Testing under the observation of the Commissioning Authority who shall record the results of the Functional Performance Test procedures.
- C. Perform all specified tests according to approved testing procedures and the following Control Signal Manipulation requirements:
 1. Verify and test performance using actual conditions whenever possible.
 2. Simulate conditions by imposing an artificial load when it is not practical to test under actual conditions and when written approval for simulated conditions is received from Commissioning Authority. Before simulating conditions, calibrate testing instruments. Set and document simulated conditions and methods of simulation. After test, return settings to normal operating conditions.
 3. Alter set points when simulating conditions is not practical and when written approval to do so is received from Commissioning Authority.
 4. Overwrite sensor values with a signal generator when actual or simulated conditions and altering set points are not practical. Do not use the sensor to act as the signal generator to simulate conditions or overwrite values.
- D. The Commissioning Authority shall review and recommend for acceptance Functional Performance Testing results.
- E. Deficiencies found during testing shall be corrected by the Contractor within 7 days of receiving an Issues Log from the CxA. Deficiencies shall be retested without cost to the owner until accepted by the Commissioning Authority. Where there is a dispute over a deficiency, the Engineer shall be the final authority.
- F. Deficiencies found during Functional Performance Testing due to inadequate startup are subject to additional services. Contractor will pay CxA on a time and materials basis for retesting.
- G. Resolution of minor deficits during Functional Performance Testing may be permissible and determined by the CxA at the point when the deficient are found.
- H. Problem Solving: The CxA may recommend solutions to problems found, however the burden of responsibility to solve, correct, and retest problems is with the contractor.
- I. All testing, retesting, and acceptance of Functional Performance Testing shall be completed prior to Substantial Completion.

3.09 OPERATIONS & MAINTENANCE DOCUMENTATION

- A. Provide a complete copy of the Operations and Maintenance document to the CxA. Follow the normal submittal procedure for this submittal. The CxA shall stamp and comment on the submittal, noting it as one of the following: "No Exceptions Taken", "Implement Exceptions Noted", "Revise and Resubmit", "Rejected", or "Not Reviewed".
- B. Description of Systems: Provide complete descriptions of the operating sequence for each system. Include detailed system description, with individual components described, and description of how components interface with others and to the complete system.
- C. Operating Division: Provide information on locations of components, how to energize switches and controls, how components interface with other components, operation of controls including operational sequence, complete troubleshooting sequence, and failure and safeguards to indicate if equipment goes off-line.

- D. List of Equipment Suppliers and Contractors: Provide list of equipment suppliers and contractors, including street addresses, website addresses, fax and toll-free telephone numbers.
- E. Provide the following equipment maintenance information where applicable:
1. Identify equipment name and tag number
 2. Locations (where several similar items are used, provide a list)
 3. Complete nameplate data
 4. Parts list
 5. Performance curves and data
 6. Wiring diagrams
 7. Lubrication charts
 8. Manufacturers' recommended operating and maintenance instructions, with all non-applicable information deleted
 9. List of spare parts recommended for normal service requirements
 10. Trouble shooting diagnostic instructions, where applicable

3.10 OPERATIONS & MAINTENANCE TRAINING

- A. Coordinate and schedule training for all commissioned systems.
- B. Provide written agenda for targeted audience for review by CxA. Agenda to be submitted prior to the completion of Functional Performance Testing.
- C. Submit training agenda, schedule and list of representatives to the Owner and CxA for review 2 weeks prior to training.
- D. Coordinate training of commissioned equipment with the CxA who shall oversee and review its content and adequacy.
- E. Coordinate training with the owner who may provide videotaping services.
- F. Separate training may be required for building users and owner's maintenance staff.
- G. Instruct Owner's operating personnel in proper starting sequences, operation, shutdown, and maintenance procedures, including normal and emergency procedures.
- H. Submit a written record of the seminar, complete with an attendance list (Training Log) to the CxA.
- I. In addition to these general requirements, specific training requirements for commissioned equipment may be specified in other Divisions.

3.11 PROJECT CLOSEOUT

- A. The Commissioning process shall be completed when the systems operate according to the Owner's Design Intent (OPR), Basis of Design, and the Contract Documents, as determined by the CxA.
- B. The Commissioning process may continue past Substantial Completion of the Project, until all non-compliance issues have been resolved. Any remaining deficits are reported to the Owner in the Final Commissioning Report.

3.12 COST OF RETESTING

- A. Costs for retesting beyond one retest shall be the responsibility of the Contractor if the CxA determines that the contractor is responsible for the deficiency. Where disputes occur, the Owner shall make the final determination.
- B. Additional costs incurred by the CxA for retesting systems which used Startup procedures not previously accepted or those completed inadequately during startup may be charged to the Contractor.
- C. Retesting shall not be considered a reason for a claim of delay or for a time extension by the contractor.

3.13 DEFERRED TESTING

- A. Equipment requiring seasonal testing to properly assure equipment operations, as determined by the CxA, shall require the Contractor to perform Functional Performance Testing at a later time. At no time shall the testing extend beyond the warranty period.
- B. Unforeseen Deferred Tests: Checks or tests not completed due to the required occupancy condition, or other conditions may be delayed upon approval of the Engineer.
- C. Warranty Review: CxA may require contractor to perform additional testing when results from the Warranty Review suggest components, systems, or system's integration are failing during the warranty period.

END OF SECTION 01 9113

SECTION 02 3200
GEOTECHNICAL REPORT

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. The Geotechnical Report, available as a copy from the Project Architect and/or Owner.

1.02 RELATED SECTIONS

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

1.03 REPORT PREPARATION

- A. Geotechnical investigation report prepared by:

TRC Solutions
1920 Old Middlefield Way
Mountain View, CA 94043

Report No.: 234269
Dated: July 13, 2015
- B. The report was obtained to be used by the Architect and Engineer for the purpose of designing site structures and improvements. The report remains the responsibility of the Geotechnical Engineer.

1.04 SITE WORK

- A. Report and log of borings is available for Contractors information, but is not a warranty of subsurface conditions.
- B. Perform site earthwork in accordance with the recommendations of the geotechnical report and the project specifications. In the event of a discrepancy or conflict between the two documents or discovered site conditions warranting additional consultation, the geotechnical consultant's recommendations will prevail. Owner will retain a testing agency to ensure conformance with the project specifications.

1.05 ADDITIONAL INVESTIGATION

- A. Contractor should visit the site and acquaint himself with site conditions.
- B. Before bidding, Contractor may make his own subsurface investigations to satisfy him/herself with site and subsurface conditions.

1.06 QUALITY ASSURANCE

- A. Geotechnical Engineer has been retained by the Owner to observe performance of Work under this contract.
- B. Make no deviations from the Contract Documents without specific, written approval of the Owner or his/her representative.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

- 3.01 Contractor shall assume that there will be variations in the soil and sub-soil conditions as indicated by the variations in the borings in this report.
- 3.02 Contractor may expect and is responsible for de-watering trenches and excavations.

END OF SECTION

SECTION 33 5100

NATURAL GAS DISTRIBUTION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes piping, valves, and specialties for natural gas distribution outside the building.
- B. This Section does not include final connection to utility's natural gas main.
- C. Related Sections include the following:
 - 1. Section 31 2316, Trench Excavation and Backfilling.

1.3 DEFINITIONS

- A. Gas Main: Utility's natural gas piping.
- B. Gas Distribution: Piping from gas main to individual service-meter assemblies.
- C. Point of Delivery: Piping outlet from service-meter assembly.
- D. Natural Gas Piping: Piping that conveys natural gas from point of delivery to natural gas utilization devices inside building.
- E. PE: Polyethylene plastic.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

- A. Minimum Working-Pressure Ratings: According to the following:
 - 1. Piping and Valves: 100 psi (690 kPa).
 - 2. Service Regulators: 100 psi (690 kPa).
 - 3. Service Regulators: 65 psi (450 kPa).
 - 4. Service Meters: 65 psi (450 kPa).
 - 5. Service Meters: 20 psi (138 kPa).
 - 6. Service Meters: 10 psi (69 kPa).
 - 7. Service Meters: 5 psi (34.5 kPa).

1.5 SUBMITTALS

- A. Product Data: Include identification materials and devices; and pressure ratings, rated capacities and settings for the following:
 - 1. PE valves.
 - 2. Earthquake valves.
 - 3. Piping specialties.

- B. Shop Drawings: Include pipe sizes, valves, regulators and specialties. Include details of service-meter assembly and underground piping. Indicate interface and spatial relationship between piping, adjacent utilities and proximate structures.
- C. Welding Certificates Copies of certificates for welding procedures and personnel.
- D. Test Reports: As specified in "Field Quality Control" Article.
- E. Maintenance Data: For service regulators, service meters and specialty valves to include in maintenance manuals specified in Division 1.

1.6 QUALITY ASSURANCE

- A. Distribution Components: Listing/approval stamp, label or other marking by testing agency acceptable to authorities having jurisdiction.
- B. Comply with requirements of utility supplying natural gas.
- C. Comply with standards of authorities having jurisdiction for natural gas piping systems. Include materials, installation and testing.
- D. Comply with NFPA 54, "National Fuel Gas Code", for gas piping materials and components; installations; and inspection, testing and purging.
- E. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications".
 - 1. Comply with ASME B31 Series, "Code for Pressure Piping".
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Handling Flammable Liquids: Remove and legally dispose of liquids from drips in existing gas piping. Handle liquids to avoid spillage and ignition. Notify gas supplier. Do not leave flammable liquids on premises overnight.
- B. Preparation for Transport: Prepare valves and specialties for shipping as follow:
 - 1. Ensure that units are dry and internally protected against rust and corrosion.
 - 2. Protect against damage to threaded ends, flange faces, and weld ends.
 - 3. Set valves in position for handling that avoids damage to seats and operating parts.
- C. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage and handling to prevent damage and entrance of dirt, debris and moisture.
- D. Store valves and specialties with end protectors in place, unless necessary for inspection; then reinstall for storage.
- E. Store valves and specialties indoors and maintain temperature higher than ambient dew-point temperature. Support off ground or pavement in watertight enclosures if outdoor storage is necessary.
- F. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor if stored inside.

- G. Protect flanges, fittings and piping specialties from moisture and dirt.
- H. Store plastic pipes and valves protected from direct sunlight. Support pipes to prevent sagging and bending.

1.8 PROJECT CONDITIONS

- A. Perform site survey, research public records and verify existing utility locations. Contact utility-locating service for area where Project is located.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Architect not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Architect's written permission.
- C. Comply with corrosion protection recommendations by Corrosion Consultant.

1.9 COORDINATION

- A. Coordinate connection to gas main with utility.
- B. Coordinate pipe materials, sizes, entry locations and pressure requirements with natural gas piping.
- C. Coordinate with other utility Work.
- D. Work Interruptions: Leave natural gas distribution piping in a safe condition if interruptions in Work occur while alterations or repairs are being made to existing gas piping.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Nonlubricated, Tapered Plug Valves:
 - a. Essex Brass Corp.
 - b. Grinnel Corp.; Mueller Co.; Gas Products Div.
 - c. Lyall: R.W. Lyall & Co., Inc.
 - d. McDonald: A.Y. McDonald Mfg. Co.
 - 2. Lubricated, Tapered Plug Valves:
 - a. Grinnel Corp.; Mueller Co.; Gas Products Div.
 - b. National Meter.
 - c. Nordstrom Valves, Inc.

3. Ball Valves:
 - a. Conbraco Industries, Inc.
 - b. Hammon Valve Corp.
 - c. Maxitrol Co.
 - d. Milwaukee Valve Co., Inc.
 - e. Nibco, Inc.
 - f. Stockham Valves & Fittings, Inc.
 - g. Watts Industries, Inc.; Water Products Div.
4. Lubricated Plug Valves:
 - a. Huber: J.M. Huber Corp.; Flow Control Div.
 - b. Milliken Valve Co., Inc.
 - c. Nordstrom Valves, Inc.
 - d. Olson Technologies, Inc.; Homestead Valve Div.
 - e. Walworth Co.
5. Nonlubricated Plug Valves:
 - a. Huber: J.M. Huber Corp.; Flow Control Div.
 - b. Keystone Valve USA, Inc.
 - c. Milliken Valve Co., Inc.
 - d. Olson Technologies, Inc.; Homestead Valve Div.
6. Plastic Valves:
 - a. Kerotest Manufacturing Corp.
 - b. Lyall: R.W. Lyall & Co., Inc.
 - c. Nordstrom Valves, Inc.
 - d. Perfection Corp.; Gas Products Div.
7. Earthquake Valves:
 - a. Pacific Seismic Products, Ltd.
 - b. Quake Defense, Inc.; Emergency Fail-Safe Systems.
 - c. Quakemaster Seismic Safety Systems.
 - d. SafeTQuake Corp.
 - e. Seismic Safety Produces, Inc.
 - f. Westcoast Seismic Protection Co., Ltd.
8. Service Regulators:
 - a. American Meter Co.
 - b. Equimeter, Inc.
 - c. Fisher Controls International, Inc.
 - d. National Meter.
 - e. Schlumberger Industries; Gas Div.

2.2 PIPING MATERIALS

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

2.3 PIPES

- A. Steel Pipe: ASTM A 53, Type E or S, Grade B; Schedule 40, black.
- B. PE Pipe: ASTM D 2513, SDR-13.5.

2.4 PIPE FITTINGS

- A. Malleable-Iron Fittings: ASME B16.3, Class 150, and standard pattern, with threads complying with ASME B1.20.1.

- B. Unions: ASME B16.39, Class 150, black malleable iron; female pattern; brass-to iron seat; ground joint.
- C. Steel Fittings: ASME B16.9, wrought-steel butt-welding type; and ASME B16.11, forged steel.
- D. Steel Flanges and Flanged Fittings: ASME B16.5.
- E. PE Fittings: ASME D 2683, socket type or ASTM D 3261 butt type with dimensions matching ASTM D 2513, SDR-13.5, PE pipe.
- F. Transition Fittings: Type, material and with end connections matching piping being joined.

2.5 JOINING MATERIALS

- A. Components, Tapes, Gaskets, and Bolts and Nuts: Suitable for natural gas and as recommended by piping manufacturer.

2.6 SHUTOFF VALVES

- A. Description: Manual-operation valves suitable for natural gas service and with 100-psi (690-kPa) minimum working-pressure rating.
 - 1. Threaded Valves, 1-Inch NPS (DN25) and Smaller: Include listing by agency acceptable to authorities having jurisdiction.
- B. Non-lubricated, Tapered Plug Valves: Cast-iron body, with brass tapered plug; Lever operation; and complying with ASME B16.33, MSS SP-78, UL 842, or AGA/IAS listing. Include lever.
 - 1. Option: Include locking device.
- C. Lubricated, Tapered Plug Valves: Cast-iron body, with lubricated, brass tapered plug; lever operation; and complying with ASME B16.33, MSS SP-78, UL 842, or AGA/IAS listing. Include lever.
 - 1. Option: Include locking device.
- D. Ball Valves: Bronze body, with chrome-plated brass ball; lever handle; and complying with ASME B16.33, MSS SP-110, UL 842, or AGA/IAS listing.
 - 1. Option: Include locking device.
- E. Lubricated Plug Valves: Cast-iron body, with lubricated, tapered or cylindrical plug; lever operation; and complying with ASME B16.38, MSS SP-78, UL 842, or AGA/IAS listing.
 - 1. Option: Include locking device.
- F. Non-lubricated Plug Valves: Cast-iron body, with eccentric plug with resilient coating; lever operation; and complying with ASME B16.38, MSS SP-108, UL 842, or AGA/IAS listing.
 - 1. Option: Include locking device.
- G. Plastic Valves: PE made for gas distribution, with nut or flat head for key operation, and complying with ASME B16.40, UL 842, or AGA/IAS listing.

- H. Valve Boxes: Cast-iron, two-selection box. Include top section with cover with "GAS" lettering, bottom section with base to fit over valve and barrel 5 inches (125 mm) in diameter, and adjustable cast-iron extension of length required for depth of bury. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head and stem of length required operating valve.

2.7 SERVICE REGULATORS

- A. Description: AGA/IAS-listed for service regulators, single stage, steel jacketed, and corrosion resistant. Include atmospheric vent, elevation compensator, with threaded ends for 2-inch NPS (DN50) and smaller, and flanged ends for 2-1/2 inch NPS (DN50) and larger.
- B. Regulator Vents: Factory- or field-installed, corrosion-resistant screen in opening.

2.8 EARTHQUAKE VALVES

- A. Description: All valves must meet California standards for earthquake actuated automatic gas shut off systems, standard no. 12-23-1, and ANSI Z21.70, 1981, mechanical-operation, automatic-shutoff earthquake valve. Include threaded ends for valves 2-inch NPS (DN50) and smaller, and flanged ends for valves 2-1/2-inch NPS (DN50) and larger.

2.9 PIPING SPECIALTIES

- A. Service Line Risers: PE pipe with coated, anode-less, steel pipe casing on riser section. Include inlet for heat-fusion connection to PE pipe and outlet for connection to shut-off valve.
- B. Strainers: Y-pattern, full size of connecting piping. Include ASTM A 666, Type 304 stainless-steel screens with 3/64-inch (1.2-mm) perforations, unless otherwise indicated.
 1. Pressure Rating: 125-psig (860-kPa) minimum steam or 175-psig (1207-kPa) WOG working pressure.
 2. 2-Inch NPS (DN50) and Smaller: Bronze body, with female threaded ends.
 3. 1-1/2-Inch NPS (DN65) and Larger: Cast-iron, with flanged ends.
 4. Screwed screen retainer with centered blow-down and pipe plug.

2.10 CONCRETE BASES

- A. Concrete Bases: Precast, reinforced, made of 3000-psi- (20.7-MPa-) minimum, 28-day compressive strength concrete; and 4 inches (100 mm) thick and 4 inches (100 mm) larger in dimension than supported item, unless otherwise indicated.

PART 3 – EXECUTION

3.1 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Division 2 Section 31 2316, Trench Excavation and Backfilling.

3.2 PREPARATION

- A. Close equipment shutoff valves before turning off gas to premises or piping section.

- B. Inspect natural gas piping according to NFPA 54 to determine that natural gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54, Part 1, "Prevention of Accidental Ignition" Paragraph.

3.3 PIPING APPLICATIONS

- A. Flanges, unions, transition and special fittings, and valves with pressure ratings same or higher than system pressure rating may be used, unless otherwise indicated.
- B. Aboveground Piping: Use the following:
 - 1. 2-Inch NPS (DN50) and Smaller: Steel pipe, butt-welding-type fittings, and welded joints. Joints for connection to threaded service regulators, service meters, and valves may be threaded.
 - 2. 2-Inch NPS (DN50) and Smaller: Steel pipe, malleable-iron fittings, and threaded joints.
 - 3. 1-1/2-Inch NPS (DN65) and Larger: Steel pipe, butt-welding-type fittings, and welded joints. Joints for connection to service regulators, service meters, and valves with flanged connections may be flanged. Joints for connection to service regulators, service meters, and valves with threaded connections 2-1/2- to 4-inch NPS (DN65 TO DN100) may be threaded.
- C. Underground Piping: Use PE pipe, PE fittings, and heat-fusion joints.

3.4 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. If specific valve types are not indicated, the following requirements may apply.
 - 1. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping gas mains.
 - 2. Underground: Use plastic valves.
 - 3. Aboveground, 2-Inch NPS (DN50) and Smaller: Non-lubricated, tapered plug valves.
 - 4. Aboveground, 2-Inch NPS (DN50) and Smaller: Lubricated, tapered plug valves.
 - 5. Aboveground, 2-Inch NPS (DN50) and Smaller: Ball valves.
 - 6. Aboveground, 2-1/2-Inch NPS (DN65) and Larger: Lubricated plug valves.
 - 7. Aboveground, 2-1/2-Inch NPS (DN65) and Larger: Non-lubricated plug valves.

3.5 JOINT CONSTRUCTION

- A. Install unions, in piping 2-inch NPS (DN50) and smaller, adjacent to each valve and at final connection to each piece of equipment having threaded pipe connection.
- B. Install flanges, in piping 2-1/2-inch NPS (DN65) and larger, adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.

3.6 PIPING INSTALLATION

- A. Install buried gas distribution piping at least 36 inches (900 mm).

- B. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where readily accessible to permit cleaning and emptying. Do not install where condensate would be subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use minimum length nipple of three pipe diameters, but not less than 3 inches (75 mm) long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- C. Install strainers on inset side of service regulators and earthquake valves.
- D. Terminate vent piping with turned-down, reducing-elbow fittings with corrosion resistant insect screens in large end.
- E. Install underground, plastic, gas distribution piping according to ASTM D 2774.
- F. Install continuous warning tape during backfilling of trench for gas piping. In areas to be paved, locate tape at top of subgrade. In all other areas, locate 8 inches below final finish grade.

3.7 VALVE INSTALLATION

- A. Install plastic shutoff valves on branch connections to existing underground gas distribution piping. Install valves with valve boxes.
- B. Install metal shutoff valves on aboveground, gas distribution piping.
- C. Install aboveground, metal shutoff valves in accessible locations, protected from physical damage. Include metal tag indicating piping systems supplied, attached to valve with metal chain.
- D. Install earthquake valves according to manufacturer's written instructions.

3.8 SERVICE-METER ASSEMBLY INSTALLATIONS

- A. Install service-meter assemblies aboveground, on precast concrete bases.
- B. Install metal shutoff valves and strainers upstream from service regulators. Shutoff valves are not required at second regulators of two regulators are installed in series.
- C. Install metal shutoff valves upstream from service meters. Install dielectric fittings downstream from service meters.
- D. Install service meters downstream from pressure regulators.
- E. Install pressure-relief or pressure-limiting devices so they can be readily operated to determine if device is free, tested to determine pressure, at which they operate, and examined for leakage if closed.
- F. Terminate service-regulator vents with turned-down, reducing elbow fittings with corrosion-resistant insect screens in large end.

3.9 CONNECTIONS

- A. Connect gas distribution piping to natural gas source and extend to service-meter assemblies and points indicated. Terminate piping with caps, plugs or flanges, as required for piping material. Connect to building natural gas piping if it is installed. Refer to Division 15 Section "Natural Gas Piping" for building natural gas piping.
- B. Connect to utility gas main according to utility's procedures and requirements.
- C. Connect to existing gas distribution main according to ASME B31.8.

3.10 ELECTRICAL BONDING AND GROUNDING

- A. Install aboveground, natural gas distribution piping upstream from equipment shutoff valves, electrically continuous, and bonded to grounding electrode according to NFPA 70.
- B. Do not use gas piping as grounding electrode.

3.11 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on or near each service regulator, meter and earthquake valve.
 - 1. Text: Distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to name of identified unit.
- B. Refer to Division 2 Section "Utility Materials" for equipment nameplates and signs.
- C. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tape during backfilling of trenches for piping.
- D. Refer to Division 2 Section 31 2000 "Earthwork" for warning tapes.

3.12 PAINTING

- A. Refer to Division 9 for field-painting requirements.
- B. Use materials and procedures in "Exterior Paint Schedule" Article's "Ferrous Metal" Paragraph and "Full-Gloss, Alkyd-Enamel Finish" Subparagraph in Division 9 Section "Painting". Include gray color, unless otherwise indicated.
- C. Paint exposed metal pipe, fittings, valves and supports.
- D. Paint exposed metal regulators, meters and supports, except units with factory applied paint or protective coating. Restore damaged finish to original condition.

3.13 FIELD QUALITY CONTROL

- A. Inspect, test and purge natural gas distribution according to NFPA 54, Part 4, "Inspection, Testing and Purging", and utility requirements.
- B. Repair leaks and defects with new materials and retest system until there are no leaks.
- C. Report test results in writing to Architect and authorities having jurisdiction.

D. Verify capacities and pressure rating of service regulators and meters and earthquake valves.

E. Verify correct pressure settings for service regulators.

3.14 ADJUSTING

A. Adjust controls and safety devices. Replace damaged and malfunctioning controls and safety devices.

END OF SECTION

SECTION 02 4100

SITE DEMOLITION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Identification of utilities in area of construction.
- B. Protection of existing trees and improvements that are to remain.
- C. Removal and legally dispose of items designated on plans or in specifications.
- D. Salvage/Removal/Storage of items designated on plans to be re-installed or as directed by the owner.

1.02 RELATED SECTIONS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Section 01 1000 - Summary of Work

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 3000.
- B. Shop Drawings: Indicate areas of demolition, location and construction of temporary work including utilities, curb cuts, driveways, parking, staging, storage, stockpiles, haul routes, and temporary control plans.

1.04 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01 7800.
- B. Accurately record actual locations and elevations of capped utilities and subsurface obstructions.

1.05 REGULATORY REQUIREMENTS

- A. Conform to applicable code for demolition work, safety of structure, and dust control.
- B. Obtain required permits from authorities.
- C. Notify affected utility companies and Owner before starting Work and comply with their requirements.
- D. Do not close or obstruct egress width to existing building(s) to remain and/or site exits.
- E. Do not disable or disrupt building fire or life safety systems without 3 day prior written notice to the Owner.

- F. Conform to applicable procedures when discovering hazardous or contaminated materials.
- G. Conform to requirements of storm water pollution prevention plan (SWPPP).

1.06 SEQUENCING

- A. Sequence work under the provisions of Division 1.

1.07 SCHEDULING

- A. Schedule work under the provisions of Division 1.
- B. Schedule Work to coincide with new construction.
- C. Describe demolition removal procedures and schedule.
- D. Perform work between the hours of 8:00 a.m. and 5:00 p.m., or per City of Pleasanton requirements. Notify Owner of any demolition work beyond the limits stated.

PART 2 - PRODUCTS

As noted on plans.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Provide, erect, and maintain temporary barriers at locations indicated, including perimeter construction and silt fencing of the project., temporary construction entrances and tree protection measures.
- B. Make provisions to prevent spread of dust, odors and noise to permit continued Owner occupancy, as specified in Division 1 and as approved by City.
- C. Protect existing facilities and equipment which are not to be demolished. See demolition plans for specific information.
- D. Arrange to have location of underground utilities marked on surface.

3.02 DEMOLITION REQUIREMENTS

- A. Conduct demolition to minimize interference with adjacent building areas.
- B. Cease operations immediately if existing structure(s) not to be demolished appear to be in danger. Notify the City and do not resume operations until directed.
- C. Maintain protected egress and access to the Work.

3.03 DEMOLITION

- A. Install soil erosion and sediment control measures as outlined on Soil Erosion Control plans and in Stormwater Pollution Prevention Plan (SWPPP) prior to commencing work.

- B. Disconnect, remove, cap and identify with appropriate markers (or markings) designated utilities within demolition areas.
- C. Demolish in an orderly and careful manner. Protect existing structures, pavement, fencing, landscaping and utilities that are to remain.
- D. Fill material shall meet the fill specifications and compaction specifications outlined in Section 31 2000 Site Earthwork.
- E. Remove demolished materials from site. Do not burn or bury materials on site.
- F. Remove demolished materials from site as Work progresses. Upon completion of Work, leave areas in clean condition satisfactory to the owner.
- G. Provide complete demolition work and leave site in clean and ready condition to receive new building and site construction improvements, satisfactory to the owner.
- H. Remove all roots and stumps from the area of demolition.
- I. Install temporary field inlets and grade site as needed to ensure positive drainage.
- J. Remove temporary work.

END OF SECTION

SECTION 02 4200

INERT SOLIDS RECYCLING

PART 1 -- GENERAL

1.01 SECTION INCLUDES

- A. Recycling of all inert solid material (asphalt concrete, Portland cement concrete and aggregate base material).

PART 2 -- PRODUCTS (not required)

PART 3 -- EXECUTION

3.01 RECYCLING PROCEDURE

- A. All asphalt concrete, Portland Cement Concrete and aggregate base material removed from the project site must be hauled to and deposited at a recognized inert solids recycling facility.
- B. It is the Contractor's responsibility to conform the above material to an acceptable size and composition in order to enable the acceptance of this material at a recognized inert solids recycling facility.
- C. Recognized inert solids recycling facilities include, but are not limited to:
 - 1. Republic Services of Livermore
<http://www.republicservices.com/businesses/construction-demolition>
 - 2. Waste Management Davis Street Transfer Station (San Leandro) -
<http://www.dsgardencenter.com/cdmrf.asp>
2615 Davis Street, San Leandro, CA 94577
 - 3. All recycling facilities are subject to the approval of the Project Manager.
- D. Documentation must be submitted for each load of inert solids, removed from the project site, on a daily basis. Failure to submit this documentation on a timely basis may delay progress payments. This documentation shall include the following:
 - 1. Project Title
 - 2. Date & Time
 - 3. Truck Number
 - 4. Type of Material
 - 5. Weight of Material
 - 6. Name of Recycling Facility
 - 7. Certification by Recycling Facility

PART 4 -- MEASUREMENT AND PAYMENT

4.01 DESCRIPTION

- A. Work for this bid item shall include all the work necessary to recycle all inert construction material (asphalt concrete, Portland cement concrete and aggregate base material).

- B. No separate payment shall be made for work required in this section. Payment will be included in payment for the related work. See Section 01 2900 for delineation of pay items.

END OF SECTION

SECTION 03 1000
CONCRETE FORMWORK

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Formwork for cast-in-place concrete and shotcrete.
- B. Products installed but not furnished under this section.
 - 1. Cast-in anchors, inserts, bolts, sleeves, reglets, and similar items furnished under other sections.
- C. Related Sections
 - 1. Section 03 3000 - Cast-In-Place Concrete: For finishes for formed concrete.
 - 2. Section 32 1313 - Site Concrete (Civil): For formwork curbs, gutters and valley gutters.
 - 3. Section 32 1314 - Site Concrete (Landscape): For formwork for exterior paving.

1.2 REFERENCES

- A. Standards listed below apply where designation is cited in this Section. Where the applicable year of adoption or revision is not listed below, the latest edition applies.
- B. ACI - American Concrete Institute's
 - 1. 301 - Specifications for Structural Concrete for Buildings.
 - 2. 347R - Guide to Formwork for Concrete.
- C. ASTM - American Society for Testing and Materials
 - 1. C578 - Specification for Rigid, Cellular Polystyrene Thermal Insulation.
 - 2. C920 -Elastomeric Joint Sealants.
 - 3. D1751 - Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.
 - 4. D1752 - Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- D. COE-Corps of Engineers
 - 1. CRD-C-572 - Waterstops.
- E. Product Standards:
 - 1. PS1 - Construction and Industrial Plywood.

1.3 DEFINITIONS

- A. Architectural Concrete: Concrete which is exposed to view as an interior or exterior surface, and either is specifically designated as Architectural Concrete or is specified to receive a special formed finish, shall conform to requirements for Architectural Concrete specified herein.

1.4 SUBMITTALS

- A. Submit the following in accordance with Section 01 3000.

- B. Product data for proprietary products, including forming accessories, waterstops and joint systems.
- C. Schedule showing Contractor's proposed location of construction joints not indicated on Drawings.
- D. Shop Drawings: For Architectural Concrete, show form construction including jointing, reveals, pattern of form ties and other items that affect appearance of exposed surface.
 - 1. Architect's review is for visual features only. Structural design of formwork is Contractor's responsibility.
- E. Samples: Only as requested by Architect.

1.5 QUALITY ASSURANCE

- A. Standards: Comply with provisions of the following specifications and standards, except where more stringent requirements are shown or specified:
 - 1. ACI 301 - "Specifications for Structural Concrete for Buildings."

PART 2 – PRODUCTS

2.1 FORM FACING MATERIALS

- A. Rough Form Finish Surfaces: Plywood, lumber, metal or other material of sufficient strength and stiffness to hold concrete properly in place; shall prevent leakage of mortar.
- B. Smooth Form Finish Surfaces: Plywood complying with U.S. Product Standard PS-1, B-B (Concrete Form), Class I, Exterior Grade or better, edge sealed, no mill oil.
- C. Special Architectural Finishes: 2-step MDO plywood made for forming. Simpson Timber Company's A-Matte, or equal.
- D. Forms for Cylindrical Columns: Metal, glass-fiber-reinforced plastic, or spiral wound fiber tubes that will produce smooth surfaces without joint indications. Capable of containing wet concrete without deformation.
- E. Pan-Type Forms: Glass fiber reinforced plastic or formed steel, stiffened to support weight of placed concrete without deformation.
- F. Foam Filler: Expanded polystyrene foam, ASTM C578, Type IX, 1.8 pounds per cubic foot density.
- G. Carton Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete.

2.2 FORM ACCESSORIES

- A. Form Ties: Snap off metal of fixed length, designed to prevent spalling of concrete upon removal. Provide units that will leave no metal within 1-1/2 inches (38 mm) of concrete surface.
- B. Form Release Agent: Colorless, nonstaining, free from oils; chemically active agent that shall not impair bonding of paint or other coatings intended for use. Nox-Crete Form Coating as manufactured by Nox-Crete, Inc. or equal.

- C. Expansion Joint Filler:
 - 1. Fiber Type: Preformed asphalt impregnated fiber, ASTM D1751, 1/2 inch (13 mm) thick unless otherwise noted.
 - 2. Cork Type: Preformed cork expansion joint, ASTM D1752, Type II, 1/2 inch thick unless otherwise noted.
- D. Expansion Joint Sealant: ASTM C920, Type M, Class 25, Use T; two-part, polyurethane traffic grade sealant, gray color.
 - 1. Horizontal Joints: Pourable, Grade P.
 - 2. Vertical Joints: Nonsag, Grade NS.
- E. Waterstops: Polyvinyl chloride, Corps of Engineers CRD-C-572. As manufactured by the Burke Co., Greenstreak Plastic Products, or equal.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Obtain necessary information for coordination of formwork with items to be embedded in concrete.
- B. Coordinate size and location of openings in concrete. Obtain Architects approval for openings not shown on Structural Drawings.
- C. Verify that reinforcing steel has been inspected prior to concealing with formwork.

3.2 CONSTRUCTION

- A. Construct forms to sizes, shapes, lines and dimensions shown and to obtain accurate alignment, level and plumb work in finished structure. Finished work shall conform to tolerances of ACI 301.
 - 1. Tolerance for surface irregularities shall conform to ACI 347, Class A for exposed to view surfaces and Class C for all other surfaces.
- B. Earth Forms: Footing forms may be omitted and foundation concrete may be placed directly into neatly and accurately cut excavations, provided the excavation walls are stable.
 - 1. Where sides are unstable or excavations are not accurately cut to tolerances of ACI 301, construct formwork to the extent required, at no additional cost to Owner.
 - 2. Hand trim sides and bottom of earth forms; remove loose dirt prior to placing concrete.
 - 3. Form footings to minimum extent shown on Drawings.
- C. Provide temporary openings in formwork to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain. Close ports with tight fitting panels, flush with inside face of forms. Locate temporary openings in inconspicuous locations.
- D. Chamfer external corners of beams, columns and walls using wood or PVC strips fabricated to produce uniform smooth lines.
- E. Plywood Forms at Exposed Surfaces:
 - 1. Keep number of panel joints to practical minimum.
 - 2. Ensure vertical joints are plumb and horizontal joints are level.

3. Form inside corners with mitered plywood so that no concrete is placed against panel edges.
 4. Align form ties vertically and horizontally.
- F. Formwork for Architectural Concrete:
1. Conform to ACI 301, paragraph 13.3.
 2. Arrange joints in facing material in geometric pattern as approved by the Architect.
 3. Seal joints to prevent leakage of paste using demonstrated effective method that will not affect appearance of finished surface.
 4. Locate form ties in symmetric pattern within panels as shown or as approved by Architect.
- G. Shoring: Shores and struts shall be provided with positive means of adjustment and settlement shall be taken up during construction.
- H. Form Release Agent: Apply a coating of form release agent immediately before use, but prior to installation of reinforcing steel and embedded items.
- I. Provision for Other Trades:
1. Provide openings in formwork and sleeves to accommodate work of other trades. Determine size and location of openings and recesses from trades requiring them. Obtain approval of Architect for openings not shown on Structural Drawings.
 2. Accurately place and securely support inserts and items built into forms required by other trades.
 3. Set anchor bolts for framing, machines and equipment at correct elevations, complying with templates furnished by manufacturer.
- J. Expansion Joints:
1. Provide expansion joints and isolation joints where shown or noted on Drawings. Provide sealed joints where concrete surface remains exposed to view or at conditions with nonbituminous or liquid waterproofing, unless otherwise shown or noted.
 2. Place joint filler in straight line with edge held back to specified dimension from finish surface and secured to formwork or previously placed construction.
 3. Use fiber type joints typically and hold edge back 1/8 inch (3 mm) from concrete surface.
 4. Use cork type joint fillers at sealed joints and hold edge back 1/2 inch (13 mm). After curing concrete, carefully clean, prime and fill joints with sealant to 1/8 inch (3 mm) from the finished surface in accordance with manufacturer's recommendations.
- K. Construction Joints:
1. Provide where shown or noted on the Drawings or as approved by the Architect.
 2. Provide key indentations at vertical joints. Where not otherwise shown, keys in beams and slabs shall be 1/3 height of member high and 1/10 height of member deep.
 3. Prevent formation of shoulders and ledges.

3.3 FORM REMOVAL

- A. Do not remove forms until concrete has hardened and attained sufficient strength to permit safe removal and adequate support of inherent and imposed loads.

- B. Remove forms carefully to avoid damaging corners and edges of exposed concrete. Prying against the face of concrete shall not be allowed.
- C. After concrete is placed, forms and shores shall remain in place for not less than the following period of time:
 - 1. Walls and Columns: 24 hours.
- D. Where concrete placing continues on upper levels, shoring may be required to be in place longer than minimum time noted for purpose of supporting weight of floor or roof pours above.
- E. Where forms are removed in less than 7 days, curing shall be continued as follows:
- F. Loosen form ties and run water down inside of form to keep concrete wet.
- G. Immediately following form removal thoroughly wet surface.
- H. Continue curing in accordance with provisions of Section 03 3000.

3.4 REUSE OF FORMS

- A. The Architect will approve reuse of forms provided they are straight, clean, free from nails, dirt, hardened concrete, rust, and other injurious matter and edges and surfaces are in good condition.
- B. Clean and repair all damage caused by placing, removal, or storage. Reuse of formwork with patches or repairs which would result in adverse effects to exposed concrete finish will not be permitted.
- C. Forms shall not be reused for Architectural Concrete if there is any evidence of surface wear or defect which would impair the quality of the surface.

END OF SECTION

SECTION 03 2000
CONCRETE REINFORCING (SITE)

PART 1 - GENERAL

1.1. SECTION INCLUDES

- A. Reinforcing steel bars, wire fabric and accessories for cast-in-place concrete.
- B. Support chairs, bolsters, bar supports, spacers for supporting reinforcement.

1.2. REFERENCES

- A. ACI 301 - Structural Concrete for Buildings.
- B. ACI 315 - Details and Detailing of Concrete Reinforcement.
- C. ASTM A82 - Steel Wire, Plain for Concrete Reinforcement.
- D. ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement.
- E. ANSI/AWS D1.4 - Structural Welding Code for Reinforcing Steel.
- F. ASTM A615 - Deformed and Plain Billet Steel Bars for Concrete Reinforcement.
- G. ASTM A706 - Low-Alloy Steel Deformed Bars for Concrete Reinforcement.
- H. CRSI - Concrete Reinforcing Steel Institute Handbook.
- I. CRSI 63 - Recommended Practice For Placing Reinforcing Bars.
- J. CRSI 65 - Recommended Practice For Placing Bar Supports, Specifications and Nomenclature.
- K. California Building Code (2010) - Chapter 19 "Concrete".

1.3. SUBMITTALS

- A. Submit under provisions of Section 01 3000.
- B. Shop Drawings: Indicate bar sizes, spacings, locations, and quantities of reinforcing steel and wire fabric, bending and cutting schedules, splicing, stirrup spacing, and supporting and spacing devices.

1.4. QUALITY ASSURANCE

- A. Perform Work in accordance with CRSI 63, 65 and Handbook, ACI 301, and ACI 315.

1.5. CERTIFICATIONS

- A. Submit certified copies of mill test report of supplied concrete reinforcement materials, indicating physical and chemical analysis of reinforcing bars shown welded on Drawings.

1.6. COORDINATION

- A. Coordinate with placement of formwork, formed openings and other work.

PART 2 - PRODUCTS

2.1. REINFORCEMENT

- A. Reinforcing Steel: ASTM A615, Grade 60; deformed billet steel bars, uncoated finish.
- B. Reinforcing Steel: ASTM A706, Grade 60; deformed billet steel bars, uncoated finish, as noted on drawings.
- C. Welded reinforcing steel: ASTM A706.

2.2. ACCESSORY MATERIALS

- A. Tie Wire: Minimum 16 gage annealed type or patented system, as accepted by Architect/Engineer.
- B. Chairs, Bolsters, Bar Supports, Spacers: Non-metallic; sized and shaped for strength and support of reinforcement during installation and concrete placement conditions including load bearing pad on bottom to prevent vapor barrier puncture.

2.3. FABRICATION

- A. Fabricate concrete reinforcing in accordance with CRSI Handbook and ACI 315.
- B. Weld reinforcement in accordance with ANSI/AWS D1.4.
- C. Locate reinforcing splices not indicated on Drawings, at point of minimum stress. Indicate location of splices on Shop Drawings. Review location of splices with Architect/Engineer.
- D. Splices not shown on Drawings shall conform to the requirements of CBC class "B" tension splice, with a minimum length of 24 inches. Use top bar splice requirements, where required.

PART 3 - EXECUTION

3.1 PLACEMENT

- A. Place, steel reinforcement and dowels accurately as detailed on Drawings, positively secured and supported by chairs, spacers or hangers, in such a manner that no displacement occurs while concrete is being poured. Do not deviate from required position.
- B. Do not displace or damage vapor barrier.
- C. Accommodate placement of formed openings.
- D. Minimum Clear Distance Between Bars: 1-1/2 times the nominal diameter for round bars, and in no case less than 1-1/2 inches.
- E. Provide laps and bends as detailed on Drawings. Comply with the requirements of the Uniform Building Code, current edition. Horizontal bars may be wired together at laps.

- F. Not Permitted: Use of bars with kinks and bends not shown on Drawings; bars injured due to bending or straightening; heating bars for bending; field bending of bars partially embedded in concrete; tack welding of bars; wet-setting of dowels and anchor bolts; and field bending of Grade 60 bars.
- G. Clean reinforcement of all coatings to prevent impairment of bond to concrete at time of pour.
- H. Welding of Reinforcement Bars: Weld as shown on Drawings. Employ only certified welders for this work. Preheat requirements for welding rebars shall be based on carbon equivalent. Submit certified chemical composition as shown in the mill report of grade 60 bars to inspection and testing firm and Architect/Engineer for review of preheat temperature requirement. Do not preheat rebars more than required by AWS D1.4.
- I. Maintain minimum concrete cover around cast-in-place concrete reinforcing as follows:

<i>Item</i>	<i>Coverage</i>
Slabs on Grade	mid depth of slab
Footings and concrete formed against and permanently exposed to earth	3 inches
Concrete surfaces exposed to weather or earth after removal of forms:	
▪ No. 6 through No. 18 bars	2 inches
▪ No. 5 bar, W31 or D31 wire, and smaller	1-1/2 inches
Concrete surfaces not exposed to weather or in contact with earth:	
▪ Slabs, walls and joists:	
– No. 14 and No. 18 bars	1-1/2 inches
– No. 11 bars and smaller	3/4 inch
▪ Beams, columns:	
– Primary reinforcement, ties, stirrups, spirals	1-1/2 inches
– All other conditions	1-1/2 inches

3.2 FIELD QUALITY CONTROL

- A. Field inspection will be performed under provisions of 01 4000.
- B. Notify Architect/Engineer at least 48 hours prior to concrete pour to allow inspection of reinforcing approved on Shop Drawings. Do not place concrete until reinforcing steel has been installed and reviewed by Architect/Engineer is complete.
- C. Bar Welding Inspection: Visually inspected by an inspection and testing firm. Submit results of inspection to the city building department and Architect/Engineer. Owner will pay for testing.

END OF SECTION

SECTION 03 3000

CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.
- B. Related Sections:
 - 1. Division 31 Section "Earth Moving" for drainage fill under slabs-on-grade.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Product Data for Credit IEQ 4.3: For curing and sealing compounds, documentation including printed statement of VOC content.
 - 3. Design Mixtures for Credit ID 1: For each concrete mixture containing fly ash as a replacement for portland cement or other portland cement replacements, and for equivalent concrete mixtures that do not contain portland cement replacements.
- C. Design Mixtures: For each concrete mixture.
- D. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement.

1.3 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Material certificates.
- C. Material test reports.
- D. Floor surface flatness and levelness measurements.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."
- D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5 and Section 7, "Lightweight Concrete."
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- F. Preinstallation Conference: Conduct conference at Project site.

PART 2 – PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

2.2 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 60 percent.
- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- C. Low alloy steel reinforcing bars: ASTM A706.
- D. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.
- E. Galvanized-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from galvanized-steel wire into flat sheets.
- F. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type II,.
 - a. Fly Ash: ASTM C 618, Class F or C.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, graded.

1. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Lightweight Aggregate: ASTM C 330.
- D. Water: ASTM C 94/C 94M and potable.

2.4 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: 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. Do not use calcium chloride or admixtures containing calcium chloride.
 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.5 WATERSTOPS

- A. See Section 07 1700 Bentonite Waterproofing.

2.6 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
- G. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
 1. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- H. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

2.8 CONCRETE MIXTURES

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
- B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
- D. CM-1 Footings, Drilled Piers and Grade Beams: Proportion normal-weight concrete mixture as follows:
 1. Minimum Compressive Strength: 4000 psi at 28 days.
 2. Slump Limit: 5 inches (125 mm), plus or minus 1 inch (25 mm).
 3. Fly Ash: Cementitious material shall contain a minimum of 20% fly ash.
 4. Aggregate size: Size 57 (1").
- E. CM- 2 Slabs on Grade (Interior): Proportion normal-weight concrete mixture as follows:
 1. Minimum Compressive Strength: 4000 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.40.
 3. Slump Limit: 8 inches (200mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25mm)..
 4. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
 5. Fly Ash: Cementitious material shall contain a minimum of 20% fly ash.
 6. Aggregate size: Size 57 (1").
 7. Cement Factor: Mix shall have a minimum cementitious material content of 540 pounds per cubic yard.
- F. CM- 3 Metal Deck Fill: Proportion normal-weight concrete mixture as follows:
 1. Minimum Compressive Strength: 3500 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.40.
 3. Slump Limit: 8 inches (200mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25mm)..
 4. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
 5. Aggregate size: Size 57 (1").

6. Cement Factor: Mix shall have a minimum cementitious material content of 540 pounds per cubic yard.
- G. CM- 4 Miscellaneous Cast-In-Place Concrete: Proportion normal-weight concrete mixture as follows:
 1. Minimum Compressive Strength: 3000 psi at 28 days.
 2. Slump Limit: 5 inches (125 mm), plus or minus 1 inch (25 mm).
 3. Fly Ash: Cementitious material shall contain a minimum of 20% fly ash.
 4. Aggregate size: Size 57 (1").

2.9 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.10 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
 1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 – EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Chamfer exterior corners and edges of permanently exposed concrete.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
 1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.5 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
- C. Waterstops: Install in construction joints and at other joints indicated according to manufacturer's written instructions.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
- C. Cold-Weather Placement: Comply with ACI 306.1.
- D. Hot-Weather Placement: Comply with ACI 301.

3.7 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces exposed to public view.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
 - 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 - 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.

3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in one direction.
 1. Apply scratch finish to surfaces to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
 1. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 2. Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.- (3.05-m-) long straightedge resting on two high spots and placed anywhere on the surface does not exceed 3/16 inch (4.8 mm) use typically.
 3. Specified overall values of flatness F(f)25) and of levelness F9L) 20; with minimum local values of flatness, F9F) 17 and of levelness F(L) 15 in accordance with ASTM E1155..
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated and where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
 1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
- G. Slab Finish at Garage: Wood float swirl finish as approved by Architect.

3.9 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
 - 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.10 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

3.11 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

END OF SECTION

SECTION 03 4900

GLASS-FIBER-REINFORCED PRECAST CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes (but Is Not Necessarily Limited to):
 - 1. Glass-fiber-reinforced concrete (GFRC) units for exterior wall cladding and trim, including anchorage and connection devices, inserts, and embeds.
- B. Related Sections:
 - 1. Design-Build Requirements: Section 01 3520.
 - 2. Quality Requirements: Section 01 4000.
 - 3. Cast-in-Place Concrete: Section 03 3000; general requirements for concrete.
 - 4. Metal Fabrications: Section 05 5000; fabricated-steel attachment devices.
 - 5. Water Repellant: Section 07 1900
 - 9. Building Insulation: Section 07 2113
 - 7. Firestopping: Section 07840; firesafing and firestopping field installed in connection with GFRC.
 - 8. Joint Sealants: Section 07 9200.
 - 10. Aluminum Window Wall and Storefront Systems: Section 08 4413

1.2 DESIGN CRITERIA

- A. General: Cooperate and coordinate with Architect and Architect's consultants to develop GFRC fabrications, connections, and supports. Drawings are diagrammatic and intended to indicate external dimensions, appearance, profiles, conditions, and scope.
- B. Appearance and Intent:
 - 1. Fabrications shall be formed to match the color and texture of Architect's control sample, and to reproduce the same level of quality and detail.
 - 2. Connections and supports shall be designed to last the life of the building.
- C. Structural and Wind Loads: Except as otherwise specified, conform to loads specified in the CBC 2001, and applicable state and local codes. Refer to Structural Drawings for general criteria.
- D. Thermal Movement: Provide for noiseless expansion and contraction of the components and assemblies caused by an external temperature range of +20 degrees F to +180 degrees F.
- E. Anchorage and Support:
 - 1. Design anchorage and support assemblies to accommodate all loads and thermal, seismic, and building movements without any harmful effect on GFRC.
 - 2. Fastener Types and Profiles: Final types shall be as designed by a structural engineer registered in the State of California and employed by the Contractor and are subject to Architect's review.
 - 3. In no case shall connections to structure conflict with or require revision of finish profiles, materials, or framing.
 - 4. Provide clips as required to maintain specified dimensional tolerances.
- F. GFRC system shall be designed to support and receive all windows, where required. GFRC

system shall not transmit horizontal loads to structural steel beam bottom flanges. Attach all bracing to top 3 inches of structural steel beam.

1.3 SUBMITTALS

- A. Procedures: In accordance with Section 01300, "Submittal Procedures."
- B. Submittals with Bid:
 - 1. With bid, provide sufficient drawings and manufacturer's literature to enable Architect to verify that proposed GFRC work meets design intent.
 - 2. Prior to award of contract, provide typical interior and exterior joinery elevations; details of each condition at large scale for each section, joint, and anchor assembly; sealant application; and details of interface with other materials and systems.
- C. Shop Drawings: Show the following information for fabrication and installation of GFRC.
 - 1. Member dimensions and cross section.
 - 2. Location, size, and type of reinforcement, including special reinforcement and lifting devices required for handling and erection. Lifting points shall be located away from exposed surfaces.
 - 3. Erection procedure for GFRC, sequence of erection, and required handling equipment.
 - 4. Layout, dimensions, and identification of units corresponding to sequence and procedure of installation.
 - 5. Welded connections, using AWS standard symbols.
 - 6. Details of inserts, connections, and joints, including accessories and construction at openings in units.
 - 7. Location and details of anchorage, reinforcement, and attachment devices to be embedded in other construction or attached to the structural frame.
 - 8. Details of interface with other products and systems.
- D. Product Data:
 - 1. Manufacturer's specifications, data, and instructions for manufactured materials and products. Include manufacturer's certifications and laboratory test reports as required by Architect.
 - 2. Repair and Patching Materials: Procedures and examples as specified in Part 3 below.
- E. Samples:
 - 1. Initial Samples for Submission to Architect: Approximately 12 inches square to illustrate color and texture of surface finish. Include samples of cast-in-place anchorages and other attachments and accessories as requested by Architect.
 - 2. Visual Plant Samples:
 - a. Upon Architect's acceptance of initial sample, provide one full-size GFRC panel for each type of finish required for review of materials, color, quality of workmanship, finish, and conformance with architectural design intent. Fabricate in full-size units suitable for use in finished work.
 - b. Notify Architect for plant review of completed panels prior to erecting. Erect at plant in a location which will permit reviewing in full.
 - c. Architect will review samples for visual quality only. Retain accepted samples at fabricating plant to serve as a standard of quality for GFRC work.

- F. Design Calculations: Demonstrate compliance with applicable codes and specified structural requirements.
 - 1. Calculations shall be by a structural engineer licensed in the State of California.
 - 2. Indicate loads on which calculations are based.
 - 3. Submit wind design calculations for various values including positive and negative loading.
 - 4. Cross-reference calculations to shop drawings.
 - 5. Although all calculations shall be submitted, only reactions to structure are subject to review by Architect and Project Structural Engineer. Review of calculations by Architect will not relieve Contractor of any responsibilities for providing systems of required strength.
 - 6. Calculations are subject to review and approval by building official having jurisdiction.
- G. Quality Control:
 - 1. Statement of fabricator qualifications, if requested by Architect.
 - 2. Statement of installer qualifications.
- H. Test Reports: Reports on materials, specified tests and inspections, and water-absorption tests.
- I. Mix Design: Include amount and proportion of color admixture, sources of cement, and fine and coarse aggregates. All aggregates shall be from one source.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: GFRC manufacturing plant shall be certified by the PCI "Plant Certification Program".
- B. Installer Qualifications: Regularly engaged for at least 5 years in erection of GFRC fabrications similar to those required on this Project.
- C. Qualification of Welders: In accordance with AWS D1.1 and D1.3.
- D. Source Quality Control: Fabricator shall have an established quality control program in effect prior to letting of the Contract. If requested, a copy of this program shall be submitted to Architect.
- E. Preinstallation Conference:
 - 1. Contractor shall schedule a job conference to review GFRC work prior to installation.
 - 2. Conference shall be attended by representatives of the Architect, Owner, Contractor, structural steel erector, installer of window wall and storefront systems, and other installers whose work may affect quality of GFRC installation.
 - 3. The following major considerations shall be reviewed at the conference:
 - a. Review in detail the Specifications, GFRC design, flashing details, construction tolerances, interface with adjoining materials, and other work related to GFRC.
 - b. Review in detail job conditions, schedule, construction sequence, installation requirements, and quality of completed installation.
 - c. Review in detail the means of protecting completed work during remainder of construction period.
 - d. Record discussions of conference and any conflict, incompatibility, or inadequacy. Furnish a copy of record to each participant.
- F. Mock-up: First installed area or example of each type or configuration of GFRC shall serve as a mock-up for review and approval by Architect of workmanship and visual effect. Coordinate with related Sections to show interface with adjoining materials and systems.

1.5 PROJECT CONDITIONS

- A. Coordinate with Section 07 1900, "Water Repellent" for optional shop application of water repellent to GFRC.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver GFRC to Project site in quantities and at times to assure continuity of installation.
- B. Store to prevent cracking, distortion, warping, staining, and other physical damage, with markings visible. Do not store on ground.
- C. Lift and support fabrications at designated lifting or supporting points indicated on reviewed shop drawings.
- D. Comply with the additional requirements specified in Section 01610, "Delivery, Storage, and Handling."

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Glass-Fiber-Reinforced Concrete:
 - 1. Portland Cement:
 - a. White Cement: ASTM C150, Type I or III, uniform color.
 - b. For surfaces exposed to view in finish structure, use integral color; same brand, type, and source of supply throughout GFRC production.
 - 2. Sand: Washed and dried silica or accepted equal with a history of successful use in GFRC. Sand shall pass through a No. 16 sieve.
 - 3. Water: Potable.
 - 4. Admixtures: Conform to ASTM C260, ASTM C494, ASTM C618, or acrylic thermoplastic copolymer dispersion conforming to PCI "Recommended Practice for Glass Fiber Reinforced Concrete Panels," Appendix F. Do not use admixture containing calcium chloride.
 - 5. Coloring Agent, If Required: Conform to ASTM C979.
 - 6. Glass Fiber: Conform to PCI "Recommended Practice for Glass Fiber Reinforced Concrete Panels," Appendix E.
 - a. Fibers specifically designed to be compatible with the aggressive alkaline environment of Portland cement based on composites or fibers with a history of successful use in a Portland cement-based composite that has been modified to be compatible with the fiber.
 - b. Fabricator shall submit, on request, evidence that the glass composition, Portland cement matrix, or both have been designed for GFRC applications.
- B. Attachment Hardware and Sprayed-in Anchors: Hot-dip galvanized steel or stainless steel, of types selected by Fabricator.

2.2 MIXES

- A. GFRC shall consist of Portland cement, water, glass fibers, and sand and may contain admixtures. Component materials shall be in accordance with Article 2.1 above.
 - 1. Nominal glass content shall be not less than 5 percent.
- B. Facing Mix:
 - 1. Thickness: Minimum possible to achieve desired finish.
 - 2. Facing shall be a uniform integral color, to match approved sample and mock-up. Amount of coloring agent, if required, shall not exceed 10 percent of cement weight.

2.3 FABRICATION

- A. Minor modifications to fabrications may be made only as necessary to meet field conditions and to ensure proper fitting of work and as acceptable to Architect. Maintain design concept indicated without increasing or decreasing sizes of fabrications or altering profiles and alignment. If a fabrication is to be modified, obtain prior approval of Architect.
- B. Forms:
 - 1. Constructed as required to produce finished products conforming to the profiles, dimensions, and tolerances indicated by the Contract Documents and on the accepted shop drawings.
 - 2. Release agents shall be applied and used according to manufacturer's instructions.
- C. Proportioning and Mixing:
 - 1. Measure mix constituents to achieve desired mix proportions.
 - 2. Meter glass fiber and cement slurry to spray head at rates to achieve desired mix proportion and glass content. Verify in accordance with standard procedures described in PCI "Recommended Practice for Glass Fiber Reinforced Concrete."
- D. Hand-Spray Application:
 - 1. Spray operators shall be trained personnel.
 - 2. A mist coat consisting of matrix without fiber may, if necessary, be sprayed onto form. Thickness of this coating shall generally not exceed 1/16 inch in order to avoid an unreinforced surface.
 - 3. Spray-up of main body of material shall proceed before mist coat or facing mix has set.
 - 4. Apply by spraying so that uniform thickness and distribution of glass fiber and cement matrix is achieved during application process.
 - 5. Consolidate by rolling or such other techniques as necessary to achieve complete encapsulation of fibers and compaction.
 - 6. Control thickness by using a pin-gauge or other approved method.
 - 7. Complete hand forming of intricate details, incorporation of formers or infill material, and overspraying before material has achieved initial set, to ensure complete bonding.
- E. Inserts and Embedments:
 - 1. Inserts shall be properly embedded in built-up homogeneous GFRC bosses or bonding pads to develop their strength. Waste material such as overspray is not acceptable to encapsulate inserts or for bonding pads.
 - 2. Rigid embedded items bonded to GFRC shall not create undesirable restraint to volume changes.
- F. Thickness: As required by design.

- G. Tolerances: Comply with dimensional tolerances listed in PCI MNL-130, "Manual for Quality Control for Plants and Production of Glass-Fiber-Reinforced Concrete."
- H. Finish: Exposed face shall be smooth to match approved sample, and free from joint marks, "grain," or other obvious defects.
- I. Cover: Provide embedded anchors, inserts, and other sprayed-in items with sufficient anchorage and embedment for design requirements.
- J. Curing:
 - 1. Cure in form until sufficient strength for removing is attained.
 - 2. After initial curing, remove GFRC from form and place in a controlled curing environment. Keep continuously wet for a minimum of 7 days in accordance with manufacturer's standard curing practice. Maintain temperature between 60 and 120 degrees F. In lieu of moist curing, an acrylic thermoplastic copolymer dispersion may be used as a curing admixture.
- K. Identification: Mark each GFRC fabrication to correspond to identification mark on shop drawings for location, and with date cast.
- L. Acceptance: GFRC fabrications which do not meet color and texture range of dimensional tolerances may be rejected, at option of Architect, if they cannot be satisfactorily corrected.

PART 3 - EXECUTION

3.7 EXAMINATION

- A. Verify the following:
 - 1. Building lines, center, and grades are in sufficient detail to allow installation of the GFRC fabrications.
 - 2. Bearing surfaces are true and level.
 - 3. Accurate placement and alignment of anchor bolts, plates, or dowels on the structure.
- B. Prior to installation, check jobsite dimensions for discrepancies between design dimensions and field dimensions which could adversely affect installation. If discrepancies do exist, installation shall not proceed until they are corrected or until installation requirements are modified. Modifications shall be reviewed by Architect before proceeding.

3.2 ERECTION

- A. Setting:
 - 1. Lift GFRC with suitable devices at points provided by manufacturer.
 - 2. Set GFRC level, plumb, square, and true within allowable tolerances.
- B. Provide temporary supports and bracing as required to maintain position, stability, and alignment as fabrications are being permanently connected.
- C. Fasten GFRC in place by concealed bolting or welding or both as shown on reviewed erection drawings. Field welding shall be done by qualified welders using equipment and materials compatible with base material.

3.3 PATCHING

- A. Mix and place patching mixture to match color and texture of surrounding concrete.
- B. Remove fabrications which cannot be satisfactorily patched, or an which patches are visible, and replace with new.

END OF SECTION

SECTION 04 2200
CONCRETE UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete masonry units.
- B. Reinforcement, anchorage, and accessories.

1.02 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Section 01 4000 – Quality Requirements: CMU core testing and anchor pull-out tests.
- B. Section 05 1200 - Structural Steel: Placement of fabrications in masonry.
- C. Section 05 5000 - Metal Fabrications: Placement of metal fabrications in masonry.
- D. Section 07 6200 - Flashing and Sheet Metal: Placement of reglets for flashings.
- E. Division 23 Mechanical: Placement of vents, louver panels and other penetrations through masonry.
- F. Division 26 Electrical: Placement of recessed outlet and other boxes and conduits within masonry and coordination of penetrations through masonry.

1.03 RELATED SECTIONS

- A. Section 03 3000 - Cast-In-Place Concrete.
- B. Section 07 9200- Joint Sealers: Rod and sealant at control and expansion joints.

1.04 REFERENCES

- A. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. ASTM A615 - Deformed and Plain Billet Steel Bars for Concrete Reinforcement.
- C. ASTM C90 - Hollow Load Bearing Concrete Masonry Units.
- D. ASTM C744 - Prefaced Concrete and Calcium Silicate Masonry Units.
- E. CBC California Building Code (2013) - Chapter 21 "Masonry".

1.05 SUBMITTALS

- A. Submit under provisions of Section 01 6000 – Submittals, Shop Drawings, Product Data, and Samples.
- B. Submit three samples of decorative block units to illustrate color, texture, and extremes of color range.

- C. Submit manufacturer's certificate under provisions of Section 01 4000 - products meet or exceed specified requirements.

1.06 QUALIFICATIONS

- A. Installer: Masonry contractor specializing in performing the Work of this Section with minimum 5 years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and protect to site under provisions of Section 01 6000.
- B. Accept units on site. Inspect for damage.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Maintain materials and surrounding air temperature to minimum 50 degrees F prior to, during, and 48 hours after completion of masonry work.

1.09 SEQUENCING AND SCHEDULING

- A. Coordinate Work under provisions of Section 01 7300.
- B. Coordinate masonry work with installation of electrical, security system or other outlet, conduit and other installation within or through CMU.

1.10 TESTING AND INSPECTION

- A. When test results from unit strength method (see section 1.10.B) do not meet requirements of CBC Section 2105.2, a minimum of two sample cores having a diameter of 6 inches shall be taken from each project for testing. Two cores shall be taken for each 5,000 square feet of the greater of the masonry wall area or the floor area or fraction thereof. The Architect or Structural Engineer responsible in charge of the project or his/her representative shall select the areas for sampling. One-half of the number of cores taken shall be tested in shear. The shear loading shall test both joints between the grout core and the outside wythes of the masonry. Core samples shall not be soaked before testing. Materials and workmanship shall be such that for all masonry when tested in compression, cores shall show an ultimate strength not less than 2000 psi. When tested in shear, the unit shear on the cross section of the core shall not be less than $2.5\sqrt{f'_m}$ psi. Shear testing apparatus shall be of a design approved by DES. Visual examination of all cores shall be made to ascertain if the joints are filled. The project inspector or testing agency shall inspect the coring of the masonry walls and shall prepare a report of coring operations for the testing laboratory files and provide one copy to DES. Such reports shall include the total number of cores cut, the location, and the condition of all cores cut on each project, regardless of whether the core specimens failed during cutting operation. All cores shall be submitted to the laboratory for examination.
- B. Verification by the unit strength method shall meet the following:
 - 1. Test masonry units prior to construction and test units during construction for each 5000 square feet of wall area for compressive strength to show compliance with the compressive strength required in Table 2105.2.2.1.2 of the 2013 CBC. Exception: Prior to the start of construction, prism testing may also be used in lieu of testing the unit strength. During construction, prism

testing may also be used in lieu of testing the unit strength and the grout as required by section 2105.2.2.2.1 of the 2013 CBC.

2. At the beginning of all masonry work, at least one test sample of the mortar and grout shall be taken on three successive working days and at least one-week intervals thereafter. The samples shall be continuously stored in moist air until tested. They shall meet the minimum strength requirement given in section 2105.2 of the 2013 CBC for mortar and grout, respectively. Additional samples shall be taken whenever any change in materials or job conditions occurs, or whenever in the judgement of the Architect, Structural Engineer such tests are necessary to determine the quality of the material. Test specimens for mortar and grout shall be made as set forth in CBC Tables 2103.8(1) and 2103.12. In making the mortar test specimens, the masonry unit molds shall be broken away after the grout has taken its set, but before it has hardened. If an absorbent paper liner is used, the mold may be left in place until the specimen has hardened. The prisms shall be stored as required for concrete cylinders. They shall be tested in the vertical position.
3. Structural masonry work shall be inspected during laying and grouting by an inspector. The inspector shall make test samples and perform such tests as are required and shall check the materials, details of construction, and construction procedures. The special masonry inspector shall furnish a verified report that, of his own personal knowledge, the work covered by the report has been performed, and materials used and installed, is in compliance with the duly approved plans and specifications. Inspection criteria per 2013 California Building Code Table 1704.5.1.

PART 2 PRODUCTS

2.01 MANUFACTURERS - CONCRETE MASONRY UNITS

- A. Basalite Concrete Products, Dixon, CA (800) 776-6690
- B. Substitutions: Under provisions of Section 01 6000.

2.02 CONCRETE MASONRY UNITS

- A. Hollow Load Bearing Block Units, Precision Face: ASTM C90, Grade N, Type I - Moisture Controlled; Light-Weight. Nominal modular size of 8 by 8 by 16 inches unless otherwise noted on Drawings. Provide special units for 90 degree corners, bond beams, and lintels. Color to match existing. Final selection to be approved by Architect.

2.03 MORTAR MATERIALS

- A. Mortar shall be Type S (CBC Tables 2103.8). Freshly prepared and uniformly mixed in the ration by value of one part cement, 1/2 part lime putty, 4-1/4 parts sand, and shall conform to ASTM designation C270. If plastic type cement is used, the lime putty shall be omitted. Use red label seconem as per manufacturer's recommendations. Color to be selected by the Architect.

2.04 MORTAR MIX

- A. Provide minimum 1800 psi mortar.
- B. Thoroughly mix mortar ingredients, in quantities needed for immediate use.

- C. Do not use anti-freeze compounds to lower the freezing point of mortar.
- D. Use mortar within (2) hours of mixing at temperatures over 26 degrees C., and two and one half (2-1/2) hours at temperatures under 10 degrees C.
- E. If necessary, re-temper mortar within two (2) hours of mixing to replace water lost by evaporation. Do not re-temper mortar after two (2) hours of mixing.

2.05 GROUT MIX

- A. Grout shall be proportioned by volume and shall consist of one part Portland cement, one-tenth part hydrated lime or lime putty and two and one-fourth parts sand. Grout shall have minimum compressive strength of 2,500 psi at twenty-eight days.
- B. Grout shall be proportioned by volume and shall have sufficient water to produce consistency for pouring without segregation. Aggregate shall conform to CBC Section 2103.12. Add suconem grout aid or Sika grout aid type II as per manufacturer's recommendations, 1 pound per sack of cement to a maximum of 6 pounds per cu. yd.
- C. Masonry Units: Nominal modular size of 8 by 8 by 16 inches, 6 x 8 x 16 inches or 8 by 12 by 16 inches unless otherwise noted on Drawings. Provide special units for 90 degree corners, bond beams, and lintels.

2.06 REINFORCEMENT AND ANCHORAGE

- A. Reinforcing Steel: Specified in Section 03 2000; clean and free from rust, scale and dirt.
- B. Strap Anchors: Steel; shape and size as indicated on Drawings; galvanized to ASTM A123 G90 finish.
- C. Dovetail Anchors: Bent steel strap, 12 gage; galvanized to ASTM A123 G90 finish.

2.07 FLASHINGS

- A. Galvanized Steel: ASTM A525, G90 finish; 20 gage core steel.

2.08 ACCESSORIES

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, heat fused joints.
- B. Joint Filler: Neoprene filler strip with peel off pressure sensitive adhesive on one side, maximum lengths.
- C. Building Paper: #15 asphalt saturated felt.
- D. Nailing Strips: Softwood, preservative treated for moisture resistance, dovetail shape, sized to masonry joints.
- E. Weep Holes: Preformed plastic tubes.
- F. Cavity Vents: Aluminum grilles; insect proof.

- G. Cleaning Solutions: Non-acidic, not harmful to masonry work or adjacent materials, as recommended by concrete masonry manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Verify items provided by other Sections of work are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.
- D. Beginning of installation means installer accepts existing conditions.

3.02 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied to other Sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.
- C. Verify top surface of concrete foundation is clean and free of laitance, and aggregate exposed prior to beginning masonry construction.

3.03 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Lay concrete masonry units in running bond. Course one unit and one mortar joint to equal 8 inches or 6 inches where indicated. Form concave mortar joints.

3.04 PLACING AND BONDING

- A. Verify masonry units are free of excessive dust and dirt.
- B. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- C. Lay hollow masonry units with face shell bedding on head and bed joints.
- D. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.
- E. Remove excess mortar as Work progresses. Take care to prevent breaking masonry corners.
- F. Interlock and fully bond intersections and external corners.

- G. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- H. Perform jobsite cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

3.05 REINFORCEMENT AND ANCHORAGES

- A. Install vertical and horizontal reinforcement as shown in the Drawings.
- B. Lap reinforcement splices minimum 48 bar diameters. Extend minimum 16 inches each side of openings.
- C. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position. Secure in place with wire ties at 192 bar diameters maximum.
- D. Embed anchors attached to structural steel members as indicated in the drawings.

3.06 GROUTED COMPONENTS

- A. Lap splices minimum 48 bar diameters.
- B. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
- C. Place and consolidate grout fill without displacing reinforcing.
- D. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening.

3.07 LINTELS

- A. Install reinforced unit masonry lintels over door and window openings.
- B. Place reinforcing bars 1 inch from bottom web.
- C. Openings Over 78 Inches: Reinforce openings as detailed in the drawings.
- D. Use single piece reinforcing bars only.
- E. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
- F. Place and consolidate grout fill without displacing reinforcing.
- G. Allow masonry lintels to attain specified strength before removing temporary supports.
- H. Maintain minimum 2 inch bearing on each side of opening.

3.08 ENGINEERED MASONRY

- A. Lay masonry units with core cells vertically aligned.

- B. Place mortar in masonry unit bed joints back 1/4 inch from edge of unit grout spaces, bevel back and upward. Permit mortar to cure 7 days before placing grout.
- C. Reinforce masonry unit cores and cavities with reinforcement bars and grout as indicated.
- D. Retain vertical reinforcement in position at top and bottom of cells and at intervals not exceeding 192 bar diameters. Splice reinforcement in accordance with Section 03200.
- E. Grout spaces less than 2 inches in width with fine grout using low lift grouting techniques. Grout spaces 2 inches or greater in width with coarse grout using high or low lift grouting techniques.
- F. When grouting is stopped for more than one hour, terminate grout 1-1/2 inch below top of upper masonry unit to form a positive key for subsequent grout placement.
- G. Low Lift Grouting: Place first lift of grout to a height of 16 inches and rod for grout consolidation. Place subsequent lifts in 8 inch increments and rod for grout consolidation.
- H. High Lift Grouting:
 1. Provide cleanout opening no less than 4 inches high at the bottom of each cell to be grouted by cutting one face shell of masonry unit.
 2. Clean out masonry cells and cavities with high pressure water spray. Permit complete water drainage.
 3. Request the Architect/Engineer to inspect the cells and cavities. Allow 3 days advance notice of inspection.
 4. After cleaning and cell inspection, seal openings with masonry units.
 5. Pump grout into spaces. Maintain water content in grout to intended slump without aggregate segregation.
 6. Limit grout lift to 4 feet, 0 inches, and vibrate for grout consolidation. Wait 30 to 60 minutes before placing next lift.
 7. Provide for special inspection during grouting according to CBC Section 1704.5.

3.09 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control and expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
- C. Size control joint in accordance with Section 07 9200 for sealant performance.
- D. Form expansion joint as detailed.

3.10 BUILT-IN WORK

- A. As work progresses, build in fabricated metal frames, window frames, wood nailing strips, anchor bolts, plates, and other items furnished by other Sections.
- B. Build in items plumb and level.

- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.
- D. Do not build in organic materials subject to deterioration.

3.11 TOLERANCES

- A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
- B. Maximum Variation From Plane of Wall: 1/4 inch in 10 feet and 1/2 inch in 20 feet or more.
- C. Maximum Variation From Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
- D. Maximum Variation From Level Coursing: 1/8 inch in 3 feet and 1/4 inch in 10 feet; 1/2 inch in 30 feet.
- E. Maximum Variation of Joint Thickness: 1/8 inch in 3 feet.
- F. Maximum Variation From Cross Sectional Thickness of Walls: 1/4 inch.

3.12 CUTTING AND FITTING

- A. Cut and fit for chases, pipes, conduit, sleeves and grounds. Coordinate with other Sections of work to provide correct size, shape, and location.
- B. Obtain Architect/Engineer approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.
- C. Core masonry work for core samples tests as indicated in clause 1.10 herein.

3.13 CLEANING

- A. Clean Work under provisions of Section 01 7300.
- B. Remove excess mortar and mortar smears.
- C. Replace defective mortar. Match adjacent work.
- D. Clean soiled surfaces with cleaning solution.
- E. Use non-metallic tools in cleaning operations.

3.14 PROTECTION OF FINISHED WORK

- A. Protect finished installation under provisions of Section 01 7300.
- B. Without damaging completed work, provide protective boards at exposed external corners which may be damaged by construction activities.

END OF SECTION

SECTION 05 1200

STRUCTURAL STEEL FRAMING

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes structural steel and grout.

1.2 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: Provide 50% recycled content for the structural steel. Also include documentation indicating percentages by cost of postconsumer and preconsumer recycled content. Include official invoice indicating cost for each product having recycled content.
 - 2. Product Data for Credit EQ 4.2: For paints and coatings, include printed statement of VOC content highlighted to expedite LEED review process.
 - a. For architectural paints, coatings, and primers applied to interior walls and ceilings: Do not exceed the VOC content limits established in Green Seal Standard GS-11, Paints, First Edition, May 20, 1993 (flats: 50g/L, non-flats: 150 g/L).
 - b. For anti-corrosive and anti-rust paints applied to interior ferrous metal substrates: Do not exceed the VOC content limit of 250 g/L established in Green Seal Standard GC-03, Anti-Corrosive Paints, Second Edition, January 7, 1997.
- C. Shop Drawings: Show fabrication of structural-steel components.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified fabricator.
- B. Welding certificates.
- C. Mill test reports for structural steel, including chemical and physical properties.
- D. Source quality-control reports.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC 303.
 - a. Only the top sheet of each submittal package will be stamped.
 - 2. AISC 360.
 - 3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- E. Preinstallation Conference: Conduct conference at Project site.

PART 2 – PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.
- B. W-Shapes: ASTM A 992/A 992M.
- C. Channels, Angles, Shapes: ASTM A 36/A 36M, unless otherwise noted on drawings.
- D. Plate and Bar: ASTM A 36/A 36M, unless otherwise noted on drawings.
- E. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
- F. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
- G. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.
- B. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy-hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends; ASTM A 563, Grade DH, (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers with plain finish.
 - 1. Direct-Tension Indicators: ASTM F 959, Type 490 (ASTM F 959M, Type 10.9), compressible-washer type with plain finish.
- C. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers.
 - 1. Finish: Hot-dip or mechanically deposited zinc coating.
 - 2. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with mechanically deposited zinc coating finish.

- D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
 - 1. Finish: Plain.
- E. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- F. Unheaded Anchor Rods: ASTM F 1554, Grade 36, unless otherwise noted.
 - 1. Configuration: Straight.
 - 2. Finish: Plain.
- G. Headed Anchor Rods: ASTM F 1554, Grade 36 unless otherwise noted, straight.
 - 1. Finish: Plain.
- H. Threaded Rods: ASTM A 36/A 36M unless otherwise noted.
 - 1. Finish: Plain.

2.3 PRIMER

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Primer: Comply with Division 09 painting Sections.
- C. Primer: SSPC-Paint 25, Type I, zinc oxide, alkyd, linseed oil primer.
- D. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

2.4 GROUT

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

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
- B. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened, unless otherwise noted.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces at Garage levels P1 and P2 only. No other shop priming is required.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
 - 2. SSPC-SP 3, "Power Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.8 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Testing Laboratory will:
 - 1. Review manufacturer's test reports for compliance with specified requirements.
 - 2. Verify material identification.
 - 3. Inspect high-strength bolted connections as required by CBC Section 1701A for conformance with RCSC Specification. Bolts in connections identified, as shear/bearing need not be inspected for bolt tension.
 - 4. Inspect welding as required by CBC Section 1701A in accordance with AWS D1.1. The following should be performed for each weld:
 - a. Verify Welding Procedure Specification (WPS) sheet has been provided and has been reviewed with each welder performing the weld. Welds not executed in conformance with the WPS are rejectable.
 - b. Verify fit-up meets tolerances of WPS and mark joint prior to welding.
 - c. Verify welding consumables per Contract Documents and WPS.
 - d. Verify welder qualification and identification.
 - e. Verify amperage and voltage at the arc with hand-held meters.
 - f. Observe preheat and interpass temperatures, weld pass sequence and size of weld bead.

5. For Seismic Critical Welds, inspect removal of back-up and run-off plates, preparatory grinding and execution of reinforcing fillet when required by these specifications.
6. Nondestructive test all complete penetration groove welds larger than 5/16 inches by ultrasonic methods for conformance with the weld quality and standard of acceptance of AWS D1.1 for welds subject to tensile stress. Pass sound through the entire weld volume from two crossing directions to extent feasible.
7. Where continuity plates are welded within 1.5 inches of K-line of rotary straightened sections, inspect column web for cracking above and below continuity plates after welding. Use dye-penetrant or magnetic particle test for inspection.
8. Ultrasonically inspect base metal thicker than 1.5 inches of K-line of rotary straightened sections, inspect column web for cracking above and below continuity plates after welding. Use dye-penetrant or magnetic particle test for inspection.
9. Periodically, inspect and test stud welding as required by CBC Section 1701A in accordance with AWS D1.1; review pre-production testing and qualification, periodically inspect welding and perform verification inspection and testing.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Base Bearing and Leveling Plates: Clean concrete-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 1. Set plates for structural members on setting nuts as required.
 2. Weld plate washers to top of baseplate where shown on Details.
 3. Snug-tighten anchor rods after supported members have been positioned and plumbed.
 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.3 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 1. Joint Type: Snug tightened unless noted otherwise.

- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Bolted Connections: Bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.
 - 1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

END OF SECTION

SECTION 05 1213

ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes architecturally exposed structural-steel (AESS).
 - 1. Requirements in Section 051200 "Structural Steel Framing" also apply to AESS.

1.02 DEFINITIONS

- A. AESS: Structural steel designated as "architecturally exposed structural steel" or "AESS" in the Contract Documents.

1.03 ACTION SUBMITTALS

- A. Shop Drawings: Show fabrication of AESS components. Shop Drawings for structural steel may be used for AESS provided items of AESS are specifically identified and requirements below are met for AESS.
 - 1. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain. Indicate grinding, finish, and profile of welds.
- B. Samples: Submit Samples of AESS to set quality standards for exposed welds.
 - 1. Two steel plates, 3/8 by 8 by 4 inches (9.5 by 200 by 100 mm), with long edges joined by a groove weld and with weld ground smooth.
 - 2. Steel plate, 3/8 by 8 by 8 inches (9.5 by 200 by 200 mm), with one end of a short length of rectangular steel tube, 4 by 6 by 3/8 inches (100 by 150 by 9.5 mm), welded to plate with a continuous fillet weld and with weld ground smooth and blended.

1.04 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172).
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector.
- C. Shop-Painting Applicators: Qualified according to SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Use special care in handling to prevent twisting, warping, nicking, and other damage. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.06 FIELD CONDITIONS

- A. Field Measurements: Where AESS is indicated to fit against other construction, verify actual dimensions by field measurements before fabrication.

PART 2 – PRODUCTS

2.01 FILLER

- A. Filler: Polyester filler intended for use in repairing dents in automobile bodies.

2.02 PRIMER

- A. Primer: Comply with Section 099600 "High-Performance Coatings."
- B. Etching Cleaner for Galvanized Metal: MPI#25.
- C. Galvanizing Repair Paint: ASTM A 780/A 780M.

2.03 FABRICATION

- A. In addition to special care used to handle and fabricate AESS, comply with the following:
 1. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, and roughness.
 2. Grind sheared, punched, and flame-cut edges of AESS to provide smooth surfaces and edges.
 3. Fabricate AESS with exposed surfaces free of mill marks.
 4. Fabricate AESS with exposed surfaces free of seams to maximum extent possible.
 5. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.
 6. Fabricate with piece marks fully hidden in the completed structure or made with media that permits full removal after erection.
 7. Fabricate AESS to the tolerances specified in AISC 303 for steel that is designated AESS.
 8. Seal-weld open ends of hollow structural sections with 3/8-inch (9.5-mm) closure plates.
- B. Curved Members: Fabricate indicated members to curved shape by rolling to final shape in fabrication shop.
 1. Distortion of webs, stems, outstanding flanges, and legs of angles shall not be visible from a distance of 20 feet (6 m) under any lighting conditions.
 2. Tolerances for walls of hollow steel sections after rolling shall be approximately 1/2 inch (13 mm).
- C. Coping, Blocking, and Joint Gaps: Maintain uniform gaps of 1/8 inch (3.2 mm) with a tolerance of 1/32 inch (0.8 mm).
- D. Cleaning Corrosion-Resisting Structural Steel: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

- E. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.04 SHOP CONNECTIONS

- A. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work, and comply with the following:
 - 1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding specified tolerances.
 - 2. Use weld sizes, fabrication sequence, and equipment for AESS that limit distortions to allowable tolerances.
 - 3. Provide continuous, sealed welds at angle to gusset-plate connections and similar locations where AESS is exposed to weather.
 - 4. Provide continuous welds of uniform size and profile where AESS is welded.
 - 5. Grind butt and groove welds flush to adjacent surfaces within tolerance of plus 1/16 inch, minus zero inch (plus 1.5 mm, minus zero mm).
 - 6. Make butt and groove welds flush to adjacent surfaces within tolerance of plus 1/16 inch, minus zero inch (plus 1.5 mm, minus zero mm). Do not grind unless required for clearances or for fitting other components, or unless directed to correct unacceptable work.
 - 7. Remove backing bars or runoff tabs; back-gouge and grind steel smooth.
 - 8. At locations where welding on the far side of an exposed connection of AESS occurs, grind distortions and marking of the steel to a smooth profile aligned with adjacent material.
 - 9. Make fillet welds oversize and grind to uniform profile with smooth face and transition.
 - 10. Make fillet welds of uniform size and profile with exposed face smooth and slightly concave. Do not grind unless directed to correct unacceptable work.

2.05 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
 - 1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
 - 2. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
 - 3. Galvanize members attached to structural-steel frame and located in exterior walls.

2.06 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
 - 2. Surfaces to be field welded.

3. Surfaces to be high-strength bolted with slip-critical connections.
 4. Surfaces to receive sprayed fire-resistive materials.
 5. Galvanized surfaces.
- B. Surface Preparation for Nongalvanized Steel:
1. SSPC-SP 3, "Power Tool Cleaning."
 2. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
 3. SSPC-SP 14/NACE No. 8, "Industrial Blast Cleaning."
 4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
 5. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 6. SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning."
- C. Preparing Galvanized Steel for Shop Priming: After galvanizing, thoroughly clean steel of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
- D. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verify, with steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep AESS secure, plumb, and in alignment.
1. If possible, locate welded tabs for attaching temporary bracing and safety cabling where they will be concealed from view in the completed Work.

3.03 ERECTION

- A. Set AESS accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
1. Erect AESS to the tolerances specified in AISC 303 for steel that is designated AESS.
- B. Do not use thermal cutting during erection.
- C. Weld Connections: Comply with requirements in "Weld Connections" Paragraph in "Shop Connections" Article.
1. Remove backing bars or runoff tabs; back-gouge and grind steel smooth.
 2. Remove erection bolts, fill holes, and grind smooth.
 3. Fill weld access holes and grind smooth.

3.04 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect AESS as specified in Section 051200 "Structural Steel Framing." The testing agency is not responsible for enforcing requirements relating to aesthetic effect.
- B. Architect will observe AESS in place to determine acceptability relating to aesthetic effect.

3.05 REPAIRS AND PROTECTION

- A. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Grind steel smooth.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 051213

SECTION 05 1250

BUCKLING RESTRAINED BRACES

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Furnishing Buckling Restrained Braces (BRB's).
 - 2. Engineering design of BRB's.
 - 3. Qualification of BRB's by uniaxial and subassemblage cyclic testing. If a pin and collar connection is used the subassemblage test need not be performed.
- B. Related Sections:
 - 1. Division 05 Section "Structural Steel Framing" for installation of BRB's and furnishing of connection hardware for BRB's including loose plates and fasteners.

1.2 REFERENCES

- A. Standards listed below apply where designation is cited in this Section. Where the applicable year of adoption or revision is not listed below, the latest edition applies."
- B. AISC - American Institute of Steel Construction
 - 1. American Institute of Steel Construction's "Manual of Steel Construction", Thirteenth Edition (AISC)
 - a. "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings", 2010 Edition (AISC 360).
 - b. "Code of Standard Practice for Steel Buildings and Bridges", 2011 Edition (AISC 303).
 - c. "Specification for Structural Joints Using ASTM A325 or A490 Bolts", June 30, 2009 (RCSC).
 - 2. American Institute of Steel Construction: "Seismic Provisions for Structural Steel Buildings", 2005 edition including Supplement 1 dated 2010 (AISC 341).
- C. ASTM - American Society for Testing and Materials
 - 1. A6 - Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use.
 - 2. A36 - Specification for Steel.
 - 3. A500 - Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing.
 - 4. A325 – Specification for Structural Steel Bolts
 - 5. A490 – Specification for Heat-Treated Steel Structural Bolts, 150 ksi min. tensile strength.
 - 6.
- D. AWS - American Welding Society
 - 1. "Structural Welding Code – Steel", 2006 Edition (AWS D1.1).
 - 2. "Structural Welding Code – Seismic Supplement", 2005 edition (AWS D1.8).

1.3 DEFINITIONS

- A. Buckling Restrained Brace (BRB): Specialty structural brace element consisting of an axial force resisting steel core encased by a system that prevents buckling of the steel core.

1.4 SUBMITTALS

- A. Submit the following in accordance with requirements of Division 1.
 - 1. All requested submittals shall be furnished in English language.
- B. Qualification Testing Report evidencing manufacturer's compliance with Article 2.01 D.
 - 1. The Qualification Testing Report shall conform to requirements of Appendix T of the American Institute of Steel Construction "Seismic Provisions for Structural Steel Buildings", (AISC 341-2010).
 - 2. If project specific testing is required to supplement available test data, include schedule for fabrication of BRB test specimens, description of proposed testing program and name of test facility and schedule for testing and reporting
- C. Manufacturer's Quality Assurance Plan: Conform to requirements of Article 1.05A, "Quality Assurance".
- D. Engineering Design: Refer to Article 2.01A for design requirements.
 - 1. Design Drawings: Show size and configuration of steel core for full length of BRB. Indicate casing size, thickness and length.
 - 2. Calculations: Provide design calculations showing the adequacy of proposed BRB's to achieve Performance Requirements specified herein.
 - 3. Certification: In accordance with Article 2.01A, Design Requirements.
 - 4. Preliminary Design: At Contractor's option, make an initial submittal of the items listed above, based on assumed material properties, prior to delivery of materials to be employed in work.
 - 5. Final Design: Submit final drawings, calculations and certifications that include the final dimensions of steel core plates based on results of coupon testing of Steel to be employed in Work
 - a. The Design Engineer shall seal final calculations and required certification.
 - b. Submittal shall be accompanied by the results of coupon testing.
- E. Erection Drawings.
 - 1. Show location and size and of BRB's. Give complete information necessary for fabrication of elements of structural steel frame to receive braces and fabrication of connection plates. Show methods of assembly, including type and size of bolts and/or pins, hole diameter, and preparation and finish of faying surfaces. Identify tolerances for fabrication and erection.
- F. Submit certified material test reports to Testing Laboratory for record purposes.
 - 1. All steel: Tensile tests and chemical analysis. 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 testing for plates 2 inches (50 mm) and thicker.
 - 3. Welding Electrodes: Include tensile, elongation, and CVN toughness tests. Identify diffusible hydrogen.
- G. Submit Quality Assurance test and inspection reports to Testing Laboratory for record purposes prior to shipping of braces.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Shall have manufactured and successfully tested braces in accordance with Article 2.01D, "Qualification Tests" prior to opening of bids.
- B. Design Engineer Qualifications: Structural Engineer, registered in the State where the project is located, that is knowledgeable with the results of cyclic testing of BRB's and experienced in the design of BRB's based on engineering analysis.
- C. Quality Assurance Plan: The manufacturer shall have a detailed Quality Assurance Plan to evidence that the BRB's being manufactured continue to be the same as those tested. The Plan shall include the following elements:
 - 1. Indicate how the product is to be identified, such that it can be traced back to production quality assurance records.
 - 2. Include a flow chart of the process by which the product is manufactured, including description of production methods.
 - 3. List tests for materials, including the applicable recognized standard for each test and the qualifications of testing agency and/or personnel.
 - 4. Identify manufacturing tolerances for each production process.
 - 5. In-process quality control, including all points of internal inspection for control and monitoring of the fabrication and assembly process.
 - a. Include copies of forms and checklists used to document inspections.
 - b. Include required qualifications of personnel performing each inspection.
 - c. Identify how inspection reports are reviewed and approved.
 - 6. Plan shall also include manufacturer furnished quality assurance for erection, including, at a minimum, attendance at pre-erection conference and a minimum of one visit thereafter to observe installation of braces
- D. Qualification Testing: Refer to Article 2.01D, "Qualification Tests" for requirements.
- E. Extrapolation of Qualification Testing: All deviations from materials, details of fabrication, and quality assurance controls used for the fabrication of tested prototype braces shall be identified by manufacturer and reviewed by Design Engineer to ensure that production braces meet or exceed the level of quality used in fabrication of prototype braces. Include the following items:
 - 1. Weld filler material, including CVN toughness
 - 2. Welding procedures and details, including weld terminations.
 - 3. Shape and finish of plate edges at transitions.
 - 4. Finish of plate edges, including roughness and treatment of occasional notches.
 - 5. Tolerances for flatness and straightness of plates
 - 6. Details of isolation between plates and core at transitions, to accommodate lengthening and shortening.
 - 7. Type and thickness of coating materials.
- F. Pre-Erection Conference: Contractor shall schedule meeting with Owner's Representative, BRB-manufacturer, and the steel erector's personnel supervising installation of buckling restrained braces to review installation procedures including handling, fit-up and fastening.

PART 2 – PRODUCTS

2.1 DESIGN AND PERFORMANCE REQUIREMENTS

- A. Design Requirements:
1. Engage a Structural Engineer, licensed in the State where the project is located, to design braces to achieve the Performance Criteria. Design shall be based on detailed examination and understanding of the results of qualifying cyclic tests and interpolation of results to project conditions.
 2. 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 the tested assemblies and that considers the adverse effects of larger material and variations in material properties.
 3. Consider the effect of imposed end rotations.
- B. Performance Criteria:
1. Initial "BRB" yield force or area shall be as indicated, within the tolerances specified on the Contract Documents.
 2. Braces shall provide for stable cyclic displacement within the ranges required per AISC 341.
 - a. Hysteretic behavior in the non-linear range shall show no sign of degradation or loss of strength.
 - b. Graphs of test results shall show no signs of pinched hysteretic behavior.
 3. The portion of the steel core that projects beyond the casing shall provide for stable cyclic loading.
 4. Tension and compression shall be resisted entirely by the steel core. The buckling restraining system shall prevent brace buckling and control plate buckling without restraining the steel core from transverse expansion and longitudinal shortening for deformations corresponding to 2 times the design interstory drift.
 5. End connections and connection configuration, including gusset stiffeners, must be similar to the tested conditions.
- 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. Coupons shall be taken from plates at point of brace manufacture and shall be used as the basis for brace design.
- D. Qualification Tests: The design of braces shall be based on results from qualifying cyclic tests. Tests shall consist of at least two successful cyclic tests: one is required to be a test of a brace subassembly that includes brace connection imposed rotations and the other may be either a uniaxial or subassembly test. If a pin and collar connection is used the subassembly test is not be required.
1. Qualification Tests shall conform to requirements of Appendix T of the AISC 341.
 2. Qualification tests are permitted to be based on documented full-scale cyclic tests performed for other projects or tests reported in research, provided that there is sufficient basis for extrapolation to project conditions.
 3. Extrapolation of previous test results beyond the limitations AISC 341 Appendix T will not be permitted.

2.2 ACCEPTABLE MANUFACTURERS

- A. The following manufacturer's, which have successfully completed qualification testing of braces similar to those required for the project, will be considered acceptable manufacturers, subject to compliance with other requirements of the Contract Documents, including limitations on maximum brace dimensions.
1. STAR Seismic; Park City, UT.
 2. CoreBrace, West Jordan, UT

2.3 MATERIALS

- A. Steel Core Areas: ASTM A36; except initial yield stress shall be within the tolerances shown on the Contract Documents, as evidenced by coupon testing of plates to be incorporated in work. If the contract documents do not state the initial yield stress it shall be 42.0 ksi with the averages of the coupon tests be between 39 and 46 ksi."
1. Plates 2 inches (50 mm) and thicker shall be supplied with Charpy VNotch testing in accordance with ASTM A6 Supplementary Requirement S5, or approved equal. The impact test shall meet a minimum average value of 20 ft-lbs absorbed energy at +70 degrees F and shall be conducted in accordance with AISC Specification, or approved equal.
- B. Casing: ASTM A500, Grade B.
- 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 –not required.
- E. Debonding Agent: Manufacturer's standard; demonstrated suitable to maintain separation of steel core and grout encasement when subjected to a minimum of 30 cycles of inelastic yielding at 2.0 percent strain; resistant to aging effects for a life cycle of 50 years.
- F. Fill Material: Manufacturer's standard cementitious grout; demonstrated suitable for function as a confining in-fill material by uniaxial or subassembly qualification testing.

2.4 FABRICATION

- A. Fabricate steel in accordance with Section 051200, "Structural Steel Framing".
1. Cut core plates to profile shown on Buckling Restrained Brace Design Drawings. Conform to tolerances of Quality Assurance Manual, except tolerance on plate width shall not exceed plus or minus 0.2 inches (5 mm).
 2. Splices in the 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 (5 mm) deep in edges of core plates may be repaired by grinding to a smooth transition. The length of transition shall be a minimum of 10 times the depth of gouge. The area shall be inspected by MT after grinding to ensure the entire depth of gouge has been removed. Deeper gouges shall be cause for rejection of piece.
- B. The maximum dimensions of the casing of the buckling restrained brace shall be as indicated on the Contract Documents.

- C. Bolted Connections: All holes for bolted connections shall be drilled and burrs removed.
- D. Pin Connections: All holes for pinned connections shall be machined 1/32 in larger than the pin diameter. Pin hole tolerance shall not exceed plus or minus 1/64 in in.
- E. Welding: Weld joints using procedures intended to minimize distortion.
 - 1. Where cruciform plates are terminated in core, pay particular attention to the 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 the brace.
 - 1. Examine steel core areas for straightness prior to coating with debonding agent or pouring with concrete
 - 2. Provide end-confining plates to ensure confinement of the fill material while allowing for non-restricting movement of the steel core
 - 3. For braces exposed to exterior or corrosive conditions, interior of brace shall be sealed or otherwise protected from moisture/corrosive element infiltration into the interior core region.

2.5 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 the start of fabrication of the buckling restrained braces, to allow Owner's Representative to observe fabrication and assembly process.
 - 2. Perform testing and inspection in accordance with approved Quality Assurance Plan and requirements of Contract Documents

PART 3 – EXECUTION

3.1 ERECTION

- A. Braces are erected under Division 05 Section "Structural Steel Framing"..
- B. 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.
- C. Buckling restrained braces shall not be field cut or altered. Alterations to structural steel components to receive Buckling Restrained Braces shall be as permitted by Division 05 Section "Structural Steel Framing".
- D. No field welding to buckling restrained brace members will be permitted, including attachment of nonstructural components.

END OF SECTION

SECTION 05 1260

WELDED STUD CONNECTORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Welded stud connectors, anchor studs, and shear stud connectors.

1.2 RELATED SECTIONS

- A. Section 05 1200 - Structural Steel.
- B. Section 05 3100 - Steel Deck

1.3 REFERENCES

- A. AISC 14th Edition – Steel Construction Manual.
- B. AISI - Specification for the Design of Cold-Formed Steel Structural Members.
- C. ASTM A108 - Steel Bars, Carbon, Cold-Finished, Standard Quality.
- D. AWS D1.1 - Structural Welding Code.

1.4 QUALITY CONTROL SUBMITTALS

- A. Submit under provisions of Section 01 3000, when requested.
- B. Building Department Approvals: Submit for studs, stud bases, and arc shields.
- C. Certificates: Submit certified evidence stud bases are qualified in accordance with Code.
- D. Manufacturer's Installation Instructions: Provide manufacturer's approved list of stud welding equipment by manufacturer and model number.
- E. Welders' Certificates: Submit manufacturer's certificates under provisions of Section 01 4000 that welders employed on the Work have met AWS verification within the previous 12 months.

1.5 QUALIFICATIONS

- A. Installer: Company specializing in performing the work of this Section with minimum 5 years documented experience.

1.6 REGULATORY REQUIREMENTS

- A. Conform to above References.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and protect products to site under provisions of Section 01 6000.

- B. Deliver studs in manufacturer's original, unopened packages with manufacturer's name and labels intact.

1.8 FIELD MEASUREMENTS

- A. Verify that field measurements are as shown on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. TRW, Nelson Stud Welding Division.
- B. Omark Industries, KSM Division.
- C. Substitutions: Under provisions of Section 01 6000.

2.2 MATERIALS

- A. Shear Stud Connectors: ASTM A108, Grade 1010 through 1020, cold-drawn steel, headed, uncoated; 60,000 psi minimum tensile strength with 20 percent elongation in 2 inches and 50 percent area reduction.
- B. Welding Materials: AWS D1.1; type required for materials being welded.
- C. Welding Equipment: Automatically timed stud-welding equipment and suitable power source, of stud manufacturer approved type and manufacturer. Interlock welding equipment supplying current to two or more stud-welding guns so that only one gun can operate at a time and so power source has fully recovered from making one weld before another weld is started.
- D. Arc Shield: Heat resistant ceramic or equivalent. For studs 5/16 inch diameter or larger, provide deoxidizing and arc stabilizing flux.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Inspect studs to verify they are of uniform quality and condition, free of injurious laps, fins, seams, cracks, twists, bends not indicated, rust, rust pits, scale, oil or other injurious defects or substances.
- C. Verify steel deck and substrate below decking is clean and dry.
- D. Beginning of installation means erector accepts existing conditions.

3.2 PREPARATION

- A. Cleaning: Clean surfaces to receive studs by wire brushing, peeling, prick-punching, or grinding to produce clean, bare substrate.

- B. Preparation for Replacement Studs and Repairs: Repair steel surfaces wherever a defective stud is removed.
 - 1. Areas Subject to Tensile Stress: Make area flush and smooth.
 - 2. Areas Subject to Compression: Install a new stud adjacent to the defective area in lieu of repairing defective area, with approval of Architect/Engineer.
- C. Damage to Base Metal During Repairs: If base metal is pulled out by stud removal, repair surfaces as follows:
 - 1. Areas Subject to Tensile Stress: Fill pocket by shielded metal-arc welding conforming to AWS D1.1 using low-hydrogen electrodes; grind weld surfaces flush.
 - 2. Areas Subject to Compression: Fill pocket as above except, if the defect depth is not more than the lesser of 1/8 inch or 7 percent of base metal thickness, the defect may be faired by grinding in lieu of weld filling.
- D. Complete repairs before installing a replacement stud on a defect area.
- E. Make area where a stud is removed flush and smooth if the surface remains exposed in the Work.

3.3 STUD WELDING

- A. Install studs promptly after cleaning and preparation.
- B. Produce welded studs free from any defect or substance, which interferes with intended functions.
- C. Hold steel decking tight to the supports prior to stud installation.
- D. Do not install studs on wet surfaces. Do not install defective studs.
- E. Hold welding gun in correct position, without movement until weld metal has solidified. Break and remove arc shields after welding.
- F. Space shear stud connectors individually along beam with excess double studs spaced symmetrically from each end of the beam. Place adjacent studs on centers, not closer than 3 inches transversely, nor more than 32 inches longitudinally.
- G. Provide minimum distance between the centers of the shear studs and the flange edges equal to 1-1/4 inches, minimum.
- H. Place other stud types accurately to allow assembly of attachments without alterations or reaming.
- I. Stud lengths indicated are minimum acceptable net lengths after welding.
- J. If a stud length is reduced more than 1/16 inch over that specified by stud manufacturer, discontinue stud installation until the cause is determined, eliminated, and pre-production testing is satisfactorily repeated.
- K. Exercise extreme care to prevent defective welds.
- L. Defective Fillets: Studs not showing a full 360 degree weld fillet after welding may be repaired by welding a 5/16 inch fillet weld in accordance with AWS D1.1 using low-hydrogen electrodes.

- M. Do not cause excessive burning of steel when welding through metal decking. Do not weld through more than one thickness of decking material.

3.4 FIELD QUALITY CONTROL

- A. Perform field quality control testing and inspections under provisions of Section 01 4000.
- B. Perform continuous pre-production testing, welded stud installation testing, and production testing of studs. Inspection and testing is waived for studs connecting only non-structural and non-stressed finish materials.
- C. Welding Inspector's Reports:
 - 1. Include standard reports.
 - 2. Detail the location of defective studs, including repair or replacement action taken.
 - 3. Identify damage resulting from stud installation.
 - 4. Indicate any defects and unusual occurrences during installation.

3.5 PRE-PRODUCTION TESTS - SHEAR STUD CONNECTORS

- A. After cooling, test the first two studs on a member by hammer bending to a 45-degree angle.
- B. If failure occurs in the weld zone of either stud, correct the procedure, then weld and bend test two more studs on the member.
- C. If either of the second two studs fails, continue additional welding on separate materials until two consecutive studs are tested and found satisfactory.
- D. Weld two additional studs to the same member, bend test, and verify procedure before any more studs are welded to the member.

3.6 PRE-PRODUCTION TESTS - STUDS OTHER THAN SHEAR STUD CONNECTORS

- A. Weld two studs to separate material in the same general position and of similar steel material and thickness as members to receive studs.
- B. After cooling, hammer bend the studs to a 30-degree angle.
- C. If failure occurs in any stud shank, ascertain and correct the cause before making further welds.
- D. If failure occurs in the weld zone of either stud correct the procedure and successfully weld and test two successive studs before any studs are welded to members.

3.7 PRODUCTION INSPECTION AND TESTING - SHEAR STUD CONNECTORS

- A. After cooling, test at least one stud on each steel member by hammer bending to a 15-degree angle, or test each stud by striking twice with a 6-pound hammer to verify quality welds are obtained.
- B. If failure occurs either in weld zone or stud shank, follow method of correction for pre-production testing until successful installations are produced. Replace all defective studs.

- C. Test studs under the following conditions:
 - 1. Studs not showing full 360 degree fillet weld.
 - 2. Studs repaired by welding.
 - 3. Replacement studs.
 - 4. Studs in which the reduction in length is less than correct by hammer bending to a 15-degree angle.
- D. For studs showing less than a 360-degree weld fillet, bend the stud in the direction opposite to missing fillet metal.
- E. Remove and replace studs that crack in the weld zone, base metal, or shank under inspection and testing or under subsequent straightening.

3.8 STUD INSPECTION AND TESTING OTHER THAN SHEAR STUD CONNECTORS

- A. Test not less than one stud in every 100 studs by hammer bending to a 15-degree angle.
- B. If threaded, torque test with a calibrated torque wrench to an approved value for stud diameter and thread in an approved device.
- C. If stud fails, follow method of correction for pre-production testing to correct procedure. Bend or torque test two more in-place studs.
- D. If of the two second studs fails, bend or torque test each remaining stud represented by the tests, or replace.
- E. Extent of additional inspection and testing for critical structural connections shall be determined by Building Department and approved by Architect/Engineer.

3.9 STRAIGHTENING

- A. Leave in a bent condition those stud shear connectors and shear transfer devices that are bent less than 16 degrees and are free of any failure, provided no part of stud is within 1 inch of an exposed concrete surface.
- B. Perform stud bending and straightening without heating and before the completion of each day's welding operations.
- C. Obtain inspection and approval of straightened studs before covering.

END OF SECTION

SECTION 05 3100

STEEL DECKING

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Roof deck.
 - 2. Composite floor deck.
 - 3. Noncomposite form deck.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include official invoice statement indicating cost for each product having recycled content.
 - 2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include official invoice indicating cost for each regional material and the fraction by weight that is considered regional.
 - 3. Product Data for Credit EQ 4.2: For paints and coatings, include printed statement of VOC content highlighted to expedite LEED review process.
 - a. For architectural paints, coatings, and primers applied to interior walls and ceilings: Do not exceed the VOC content limits established in Green Seal Standard GS-11, Paints, First Edition, May 20, 1993 (flats: 50g/L, non-flats: 150 g/L).
 - b. For anti-corrosive and anti-rust paints applied to interior ferrous metal substrates: Do not exceed the VOC content limit of 250 g/L established in Green Seal Standard GC-03, Anti-Corrosive Paints, Second Edition, January 7, 1997.
- C. Shop Drawings:
 - 1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.3 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product certificates.
- C. Evaluation reports.
- D. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 – PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- C. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 COMPOSITE FLOOR DECK

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. ASC Profiles, Inc.; a Blue Scope Steel company.
 - 2. Epic Metals Corporation.
 - 3. Nucor Corp.; Vulcraft Group.
 - 4. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
- B. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
 - 1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230), G60 (Z180) zinc coating.
 - 2. Profile Depth As indicated.
 - 3. Design Uncoated-Steel Thickness: As indicated.

2.3 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck. For drains, cut holes in the field.
- G. Galvanizing Repair Paint: ASTM A 780.

PART 3 – EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- C. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- D. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- E. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- F. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- G. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld flanges to top of deck. Space welds not more than 12 inches (305 mm) apart with at least one weld at each corner.
 - 1. Install reinforcing channels or zees in ribs to span between supports and weld.
- H. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.
 - 1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.
- I. Pour Stops and Girder Fillers: Weld steel-sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

- J. Floor-Deck Closures: Weld steel-sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.2 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Field welds will be subject to inspection.
- C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.
- D. Remove and replace work that does not comply with specified requirements.
- E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.3 PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

END OF SECTION

SECTION 05 4000

COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Exterior non-load-bearing wall framing.
 - 2. Interior non-load-bearing wall framing.

1.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.
 - 1. Design Loads: As indicated on Drawings.
 - 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/240 of the wall height.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product and accessory indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include official invoice indicating cost for each regional material and the fraction by weight that is considered regional.
 - 3. Product Data for Credit EQ 4.2: For paints and coatings, include printed statement of VOC content highlighted to expedite LEED review process.
 - a. For architectural paints, coatings, and primers applied to interior walls and ceilings: Do not exceed the VOC content limits established in Green Seal Standard GS-11, Paints, First Edition, May 20, 1993 (flats: 50g/L, non-flats: 150 g/L).
 - b. For anti-corrosive and anti-rust paints applied to interior ferrous metal substrates: Do not exceed the VOC content limit of 250 g/L established in Green Seal Standard GC-03, Anti-Corrosive Paints, Second Edition, January 7, 1997.
- C. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
 - 1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification data.

- B. Welding certificates.
- C. Product test reports.
- D. Research/evaluation reports.

1.5 QUALITY ASSURANCE

- A. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements.
- B. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code-Sheet Steel."
- C. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
- D. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."
 - 1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
 - 2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."
- E. Comply with AISI's "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.
- B. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
 - 1. Grade: As required by structural performance.
 - 2. Coating: [60 (Z180), A60 (ZF180), AZ50 (AZ150), or GF30 (ZGF90).

2.2 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: As required by analysis, or 0.0329 inch (0.84 mm) minimum.
 - 2. Flange Width: As required by analysis, or 1-3/8 inches minimum.
 - 3. Section Properties: As required by analysis.

- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and same minimum base-metal thickness as steel studs.
- C. Vertical Deflection Clips: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads.

2.3 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members, unless otherwise indicated.
- B. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- C. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.
- D. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
- E. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.
- F. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

2.4 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035 or ASTM A 780.
- B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Shims: Load bearing, high-density multimonomer plastic, nonleaching.
- D. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.
- B. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.2 INSTALLATION, GENERAL

- A. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.
- B. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
- C. Install framing members in one-piece lengths where possible. Provide splice details as required.
- D. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- E. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.
- F. Install insulation, specified in Division 07 Section "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- G. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
- H. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.3 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: As required by analysis, 16 inches minimum.

- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Install single deflection tracks and anchor to building structure.
 - 2. Connect vertical deflection clips to bypassing studs and anchor to primary building structure.
- E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
 - 1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches (305 mm) of single deflection track. Install a combination of flat, taut, steel sheet straps of width and thickness indicated and stud or stud-track solid blocking of width and thickness matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - a. Install solid blocking as required by analysis, or 96-inch centers maximum.
 - 2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 - 3. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - 4. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable curtain-wall-framing system.

3.4 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Remove and replace work where test results indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 4000

SECTION 05 5000

METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Miscellaneous steel framing and supports.
 - 2. Metal ladders.
 - 3. Metal floor plate and supports.
 - 4. Miscellaneous steel trim.
 - 5. Metal bollards.
- B. Products furnished, but not installed, under this Section:
 - 1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
 - 2. Steel weld plates and angles for casting into concrete.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design ladders, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Delegated Design: Design decorative guardrails, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Prefabricated building columns.
 - 2. Metal nosings and treads.
 - 3. Paint products.
 - 4. Grout.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include official invoice indicating cost for each product having recycled content.

2. Product Data for Credit EQ 4.2: For paints and coatings, include printed statement of VOC content highlighted to expedite LEED review process.
 - a. For architectural paints, coatings, and primers applied to interior walls and ceilings: Do not exceed the VOC content limits established in Green Seal Standard GS-11, Paints, First Edition, May 20, 1993 (flats: 50g/L, non-flats: 150 g/L).
 - b. For anti-corrosive and anti-rust paints applied to interior ferrous metal substrates: Do not exceed the VOC content limit of 250 g/L established in Green Seal Standard GC-03, Anti-Corrosive Paints, Second Edition, January 7, 1997.
- C. Shop Drawings: Show fabrication and installation details for metal fabrications.
 1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
- D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

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

2.2 FERROUS METALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Stainless-Steel Bars and Shapes: ASTM A 276.
- D. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- E. Rolled-Stainless-Steel Floor Plate: ASTM A 793.
- F. Abrasive-Surface Floor Plate: Steel plate with abrasive granules rolled into surface or with abrasive material metallurgically bonded to steel.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. IKG Industries, a division of Harsco Corporation; Mebac.
 - b. SlipNOT Metal Safety Flooring, a W. S. Molnar company; SlipNOT.
- G. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- H. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.
- I. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M.

2.3 NONFERROUS METALS

- A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.

2.4 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 or Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls.
 - 1. Provide stainless-steel fasteners for fastening aluminum.
 - 2. Provide stainless-steel fasteners for fastening stainless steel.
 - 3. Provide stainless-steel fasteners for fastening nickel silver.
 - 4. Provide bronze fasteners for fastening bronze.
- B. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated, or as provided by approved manufacturer.
 - 2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M), or as provided by approved manufacturer.
- D. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.5 MISCELLANEOUS MATERIALS

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Shop Primers: Provide primers that comply with Division 09 painting Sections.
- C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
- D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- E. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

- H. Concrete: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

2.6 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.
- C. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended.
- D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Locate joints where least conspicuous.
- E. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors not less than 24 inches (600 mm) o.c.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS

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

2.8 METAL LADDERS

- A. General:
 - 1. Comply with ANSI A14.3 unless otherwise indicated.
 - 2. For elevator pit ladders, comply with ASME A17.1.
- B. Steel Ladders:
 - 1. Space siderails 18 inches (457 mm) apart unless otherwise indicated.
 - 2. Space siderails of elevator pit ladders 12 inches (300 mm) apart.
 - 3. Siderails: Continuous, 3/8-by-2-1/2-inch (9.5-by-64-mm) steel flat bars, with eased edges.
 - 4. Rungs: 3/4-inch- (19-mm-) diameter steel bars.
 - 5. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
 - 6. Provide nonslip abrasive surfaces on top of each rung.
 - 7. Galvanize ladders, including brackets and fasteners.

2.9 METAL FLOOR PLATE

- A. Fabricate from rolled-steel floor plate.
 - 1. Thickness: As indicated.
- B. Provide steel angle supports as indicated.
- C. Provide flush steel bar drop handles for lifting removable sections, one at each end of each section.

2.10 MISCELLANEOUS STEEL TRIM

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

2.11 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 80 steel pipe or steel shapes, as indicated.
 - 1. Cap bollards with 1/4-inch- (6.4-mm-) thick steel plate.
- B. Fabricate sleeves for bollard anchorage from steel pipe or tubing with 1/4-inch- (6.4-mm-) thick steel plate welded to bottom of sleeve.
- C. Prime bollards with zinc-rich primer.

2.12 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.13 FINISHES, GENERAL

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

2.14 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with universal shop primer unless indicated.
- C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
 - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 3. Items Indicated to Receive Primers Specified in Division 09 Section "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 4. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

3.2 INSTALLING METAL BOLLARDS

- A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
- B. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete. Fill annular space around bollard solidly with nonshrink, nonmetallic grout.

- C. Anchor bollards in place with concrete footings. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
- D. Fill bollards solidly with concrete, mounding top surface to shed water.

3.3 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
- C. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING AND CLEANING

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

END OF SECTION 05 5000

SECTION 05 5100

METAL STAIRS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Structural steel stair framing and supports.
- B. Pan treads to receive concrete fill, and landings.
- C. Handrails and guardrails at stairs.
- D. Deferred Submittal to Building Department.

1.02 RELATED SECTIONS

- A. Section 03 3000 - Cast-in-Place Concrete: Placement of metal anchors in concrete.
- B. Section 05 1200 - Structural Steel.
- C. Section 05 5000 - Metal Fabrications.
- D. Section 05 5200 - Handrails and Railings: Metal handrails and balusters other than specified in this section.
- E. Section 09 9600 – High Performance Coatings: Paint finish.

1.03 REFERENCES

- A. ASTM A 36/A 36M - Standard Specification for Carbon Structural Steel; 2005.
- B. ASTM A 53/A 53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2005.
- C. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2005.
- D. ASTM A 283/A 283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2003.
- E. ASTM A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2004b.
- F. ASTM A 325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Tensile Strength (Metric); 2005.
- G. ASTM A 500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2003a.
- H. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2005a.
- I. ASTM A 1008/A 1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength, Low Alloy, and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened; 2005b.
- J. ASTM E 985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2000.
- K. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society; 1998.

- L. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2006.
- M. NAAMM AMP 510 - Metal Stairs Manual; The National Association of Architectural Metal Manufacturers; 1992, Fifth Edition.
- N. SSPC-Paint 15 - Steel Joist Shop Primer; Society for Protective Coatings; 1999 (Ed. 2004).
- O. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings; 2002 (Ed. 2004).
- P. SSPC-SP 2 - Hand Tool Cleaning; Society for Protective Coatings; 1982 (Ed. 2004).

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

- A. Architectural metal stairs shall be considered Architecturally Exposed Structural Steel (referred to as "AES" or "AESS"), as defined by the American Institute of Steel Construction (AISC).
- B. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of ASTM E 985 and applicable local code.
 - 1. Design and fabricate stair assembly to support a uniform live load of 100 lb/sq ft and a concentrated load of 300 lb with deflection of stringer or landing framing not to exceed 1/240 of span.
 - 2. Handrails shall resist a point load of at least 250 pounds, applied in any direction at any point.
 - 3. Railings shall resist a uniform vertical and horizontal load of 50 pounds per lineal foot, applied at the top rail.
 - 4. Final stair design to be consistent with all drawings and details as indicated in construction documents and specifications.
 - 5. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of ASTM E 985 and applicable local code.
 - 6. Stairs shall be designed to accommodate the code required story drift between floors in all directions without collapse. This may entail sliding connections at the base of the stairs.
 - 7. Comply with the requirements of the CBC and ADA for tread striping.
 - 8. Design and fabricate stair assembly to support a uniform live load of 100 lb/sq ft and a
- C. Fabricate metal stairs to comply with NAAMM AMP 510, Class Commercial.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures and requirements for Deferred Submittals.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
 - 2. All design criteria with signed calculations.
 - 3. Stair opening size.
 - 4. Loads to structure, and calculations with stringer sizes called out.
 - 5. Edge of deck requirements, and all significant plans and details.
- C. Calculations: Provide stamped and signed calculations by a civil engineer licensed to practice in California.
- D. Permit Package: Contractor shall prepare and submit package to the City of Pleasanton to obtain the permit for this portion of work.
- E. Welders' Certificates: Show certification of welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.06 QUALITY ASSURANCE

- A. Perform design and prepare shop drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in California.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Steel Sections: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A 500, Grade B cold-formed structural tubing.
- C. Steel Plates: ASTM A 283.
- D. Pipe: ASTM A 53/A 53M, Grade B Schedule 40, black finish.
- E. Ungalvanized Steel Sheet: ASTM A 1008/A 1008M, Designation SS, Grade 33, Type 1.
- F. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS) Grade 33/230 with G40/Z120 coating.
- G. Tread and Landing Concrete Reinforcement: Mesh type, galvanized.
- H. Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, galvanized to ASTM A 153/A 153M where connecting galvanized components.
- I. Welding Materials: AWS D1.1; type required for materials being welded.
- J. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- K. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 COMPONENTS

- A. Stringers to be tubes, size as indicated on drawings and verified by stair manufacturer's Structural Engineer
- B. Metal Pan Stair Treads: Concrete in metal pan
- C. Concrete for Treads and Landings: Portland cement Type I, 3000 psi 28 day strength, 2 to 3 inch slump.

2.03 FABRICATION - GENERAL

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

2.04 FABRICATION - PAN STAIRS AND LANDINGS

- A. Fabricate stairs and landings with closed risers and treads of metal pan construction using ungalvanized steel sheet, ready to receive concrete.
- B. Form treads and risers with minimum 12 gage sheet steel stock.
- C. Secure reinforced tread pans to stringers with clip angles; welded in place.
- D. Form stringers with rolled steel tubes. Stringers shall have closed ends. Grind smooth for proper fit to headers.
- E. Form landings with minimum 12 gage sheet stock. Reinforce underside with angles to attain design load requirements.
- F. Provide necessary anchors, bolts, angles, hangers, supports, and other accessories for complete assembly and installation.
- G. Provide temporary construction cable guardrails as required by building code.
- H. Prime paint components.

2.05 RAILINGS

- A. Construct of steel members of sizes and shapes indicated.
- B. Rails shall have flush fittings. Assemble with full-welded connections.
- C. Members shall be neatly coped.
- D. Longitudinal members shall be parallel with each other and with floor surface or slope of stairs as shown.
- E. Center line of members within each railing run shall be in same vertical plane.
- F. Pipe railings may be bent at corners instead of joining, provided that the bends are uniformly formed in jigs, with cylindrical cross-section of pipe maintained throughout the entire bend.
- G. Top rail at landings shall run continuously across top of each post.
- H. Intermediate rails to be stainless steel cables as shown in Drawings. Cables to be continuous from top to bottom of each stair run, anchored with toggle jaws. Cables shall be spaced such that a sphere 4 inches in diameter cannot pass through.
- I. Weld connections. Grind smooth with no visible grind markings.

2.05 FINISHING

- A. Solvent clean.
- B. Remove loose rust, loose mill scale, and other foreign substances using blast cleaning according to SSPC-SP 6.prior to finishing.
- C. Do not prime surfaces in direct contact with concrete or where field welding is required.
- D. Prime paint items with one coat.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install components plumb and level, accurately fitted, free from distortion or defects.
- B. Provide anchors, plates, angles, hangers, and struts required for connecting stairs to structure.

- C. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- D. Mechanically fasten joints butted tight, flush, and hairline. Grind welds smooth and flush.
- E. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.02 ERECTION TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.

END OF SECTION 05 5100

SECTION 05 5200

HANDRAILS, GUARDRAILS AND RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall mounted handrails.
- B. Roof Fall protection railings and guardrails.

1.02 REFERENCES

- A. ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2002.
- B. ASTM A 500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2003a.
- C. ASTM E 935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2000.
- D. ASTM E 985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2000.
- E. SSPC-Paint 15 - Steel Joist Shop Paint; The Society for Protective Coatings; 1999 (Ed. 2004).
- F. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); The Society for Protective Coatings; 2002 (Ed. 2004).

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. See Section 05 5100 – Metal Stairs.
- C. Section 09 9600 – High Performance Coatings: Paint finish.
- D. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

PART 2 PRODUCTS

2.01 RAILINGS - GENERAL REQUIREMENTS

- A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of ASTM E 985 and applicable local code.
- B. Exterior railings shall be hot dip galvanized.
- C. Guardrails shall resist a point load of at least 250 pounds, applied in any direction at any point.
- D. Railings shall resist a uniform vertical and horizontal load of 50 pounds per lineal foot, applied at the top rail.
- E. Allow for expansion and contraction of members and building movement without damage to connections or members.
- F. Dimensions: See drawings for configurations and heights.
- G. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.

- H. Provide welding fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

2.02 STEEL RAILING SYSTEM

- A. Steel Tube: ASTM A 500, Grade B cold-formed structural rectangular tube.
- B. Steel Pipe: ASTM 53; Type E, Grade A, standard weight Schedule 40; unless another grade and weight are required by structural loads.
- C. Steel Rectangular Bar: ASTM A36
- D. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.
- E. Exposed Fasteners: No exposed bolts or screws.
- F. Galvanizing: In accordance with requirements of ASTM A 123/A 123M.
 - 1. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic.
- G. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.03 FABRICATION

- A. Accurately form components to suit specific project conditions and for proper connection to building structure.
- B. Fit and shop assemble components in largest practical sizes for delivery to site.
- C. Fabricate components with joints tightly fitted and secured.
- D. Welded Joints:
 - 1. Exterior Components: Continuously seal joined pieces by intermittent welds and plastic filler. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
 - 2. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.
 - 3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

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

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
- C. Anchor railings securely to structure.

3.04 ERECTION TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.
- B. Maximum Offset from True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION 05 5200

SECTION 07 1300

UNDER SLAB WATERPROOFING, HORIZONTAL & VERTICAL APPLICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sheet membrane waterproofing at elevator pit.
- B. Cant strips and other accessories.
- C. Drainage panels and Protection boards.

1.02 RELATED SECTIONS

- A. Section 31 2000 – Site Earthwork.
- B. Section 03 3000 – Cast-In-Place Concrete: Concrete substrate.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for membrane.
- C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.
- D. Manufacturer's Installation Instructions: Indicate perimeter conditions requiring special attention and acceptable installation temperatures.

1.04 QUALITY ASSURANCE

- A. Materials: For each type of material required for the work of this section, provide primary materials which are the products of one manufacturer.
- B. Schedule Coordination: Schedule work such that membrane will not be left exposed to weather for longer than that recommended by the manufacturer.
- C. Pre-Installation Conference: A pre-installation conference shall be held prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Agenda for meeting shall include review of special details and flashing.
- D. Membrane Manufacturer Qualifications: Company specializing in waterproofing sheet membranes with three years experience.
- E. Installer Qualifications: Company specializing in performing the work of this section with minimum three years experience.

1.05 MOCK-UP

- A. Construct mockup 100 sq ft of horizontal waterproofed panel; to represent finished work including internal and external corners.
- B. Locate where directed.
- C. Mockup may remain as part of the Work.

1.06 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for waterproofing failing to resist penetration of water.

PART 2 PRODUCTS

2.01 GENERAL

- A. A minimum 15-mil thick vapor barrier meeting minimum ASTM E 1745, Class A requirements should be placed directly below the slab. The vapor barrier should extend to the edge of slab. At least 2 inches of free-draining gravel, such as 1/2 inch or 3/4 inch crushed rock with no more than 5 percent passing the ASTM No. 200 sieve, should be placed below the vapor barrier to serve as a capillary break (no sand). The crushed rock should be consolidated in place with vibratory equipment. The vapor barrier should be sealed at all seams and penetrations. The crushed rock may be considered as part of the expansionary fill requirement.

2.02 MANUFACTURERS

- A. Grace Construction Products: Florprufe 120
 1. Polyolefin Sheet with non-tacky adhesive (Florprufe 120):
 2. Sheet Size: 4 ft x 115 ft.
 3. Thickness: 0.021 inches nominal.
 4. Water Vapor Permeance: 0.03 perms per ASTM E 96 - Method B.
 5. Tensile Strength: 65 lbs/in² per ASTM E-154..
 6. Elongation: 300% per ASTM D412.
 8. Puncture Resistance: 3300 gms per ASTM D1709.
 8. Peel Adhesion to Concrete: >4 lbs/in. per ASTM D 903.
- B. Substitutions: See Section 01 6000 - Product Requirements, no known equal.

2.03 ACCESSORIES

- A. Sealant for penetrations and seams: Bituthene Liquid Membrane by Grace Construction Products.
- B. Tape: Grace Preprufe Tape by Grace Construction Products.
- C. Protection and Drainage Panel: 3/8 inch thick formed plastic, hollowed sandwich panel, Hydroduct 225 manufactured by Grace Construction Products.
- D. Cant Strips: Pre-molded composition material.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.
- C. Verify items which penetrate surfaces to receive waterproofing are securely installed.

3.02 PREPARATION

- A. Protect adjacent surfaces not designated to receive waterproofing.
- B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions.
- C. Do not apply waterproofing to surfaces unacceptable to membrane manufacturer.
- D. Seal cracks and joints with sealant using depth to width ratio as recommended by sealant manufacturer.
- E. Apply surface conditioner at a rate recommended by manufacturer. Protect conditioner from rain or frost until dry.

3.03 INSTALLATION - MEMBRANE

- A. Install membrane waterproofing in accordance with manufacturer's instructions.
- B. Roll out membrane. Minimize wrinkles and bubbles.
- C. Self-Adhering Membrane: Remove release paper layer.
- D. Overlap edges and ends and seal by method recommended by manufacturer, minimum 3 inches. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.
- E. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.
- F. Weather lap joints on sloped substrate in direction of drainage. Seal joints and seams.
- G. Install flexible flashings. Seal items penetrating through membrane with flexible flashings. Seal watertight to membrane.
- H. Seal membrane and flashings to adjoining surfaces. Install termination bar at all edges. Install counterflashing over all exposed edges.

3.04 INSTALLATION, VERTICAL APPLICATIONS

- A. Substrates shall be smooth and sound. Suitable substrates include Hydroduct® Drainage Composites by Grace Construction Products.
- B. Strictly comply with installation instructions in manufacturer's published literature, including but not limited to, the following:
 - 1. Apply membrane with the HDPE film facing the prepared soil retention system. Remove the release liner and fasten membrane along uncoated edge to Hydroduct drainage composite with large head nails or to plywood with large head nails or staples.
 - 2. Apply succeeding sheets by overlapping the previous sheet 75 mm (3 in.) along the uncoated edge of the membrane. Side laps must be firmly rolled to ensure a tight seal.
 - 3. Overlap the ends of the membrane 75 mm (3 in.). Apply Preprufe® Tape centered over the end lap and roll firmly to ensure a tight seal. Remove release liner.

3.05 INSTALLATION, HORIZONTAL APPLICATIONS

- A. Earth and stone substrates shall be well compacted to produce an even, solid substrate. Remove loose aggregate or sharp protrusions. Concrete substrates shall be smooth or broom finished and monolithic. Fill gaps or voids greater than 13 mm (0.5 in.). Remove standing water prior to membrane applications.

- B. Strictly comply with installation instructions in manufacturer's published literature, including but not limited to, the following:
 - 1. Apply membrane with the HDPE film facing the prepared substrate. Remove the release liner during application.
 - 2. Apply succeeding sheets by overlapping the previous sheet 75 mm (3 in.) along the uncoated edge of the membrane. Lap area must be firmly rolled to ensure a tight seal.
 - 3. Overlap the ends of the membrane a minimum of 75 mm (3 in.) and apply Preprufe® Tape centered over the lap and roll firmly to ensure a tight seal.

3.06 INSTALLATION - PROTECTION AND DRAINAGE PANEL

- A. Install at vertical walls only.
- B. Place drainage panel directly against membrane, butt joints, place to encourage drainage downward. Scribe and cut boards around projections, penetrations, and interruptions.

3.07 FIELD QUALITY CONTROL

- A. On completion of horizontal membrane installation, dam installation area in preparation for flood testing.
- B. Flood to minimum depth of 1 inch with clean water. After 48 hours, inspect for leaks.
- C. If leaking is found, remove water, repair leaking areas with new waterproofing materials as directed by ; repeat flood test. Repair damage to building.
- D. When area is proven watertight, drain water and remove dam.

3.08 SCHEDULE

- A. Elevator Pit floor Slab: Preprufe 300R.
- B. Elevator Pit Walls: Preprufe 300R.

END OF SECTION

SECTION 07 1900
WATER REPELLENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes (but Is Not Necessarily Limited to):
 - 1. Fluid-applied water repellent coating for exterior vertical concrete.
- B. Related Sections:
 - 1. Glass-Fiber-Reinforced Precast Concrete: Section 03 4900.

1.2 DESIGN AND PERFORMANCE REQUIREMENTS

- A. Water repellent shall not darken, stain, or discolor substrate.
- B. Water repellent shall not change reflectivity of substrate by having a sheen or a gloss when dry.
- C. Water repellent shall reduce water absorption of treated substrate to less than 25 percent of water absorbed by an untreated sample of the same material in a 24-hour water-absorption test.

1.3 SUBMITTALS

- A. Procedures: In accordance with Section 01 3000, "Administrative Requirements."
- B. Product Data: Manufacturer's specifications, installation instructions, and general recommendations for water repellent coating. Include:
 - 1. Instructions and recommendations for cleaning and preparation of surfaces.
 - 2. Coating application techniques.
 - 3. Equipment to be used.
 - 4. Coverage rates.
 - 5. Protection of adjacent materials.
 - 6. Cleaning methods for overspray.
 - 7. Special procedures.
- C. Samples: 18-inch-square sample of each substrate to receive water repellent, with water repellent applied to half of sample.
- D. Quality Control:
 - 1. Statement of Applicator qualifications.
 - 2. Post-application inspection report by manufacturer's representative, verifying work has been applied in compliance with specifications and manufacturer's written instructions.
- E. Closeout: Extended warranty.

1.4 QUALITY ASSURANCE

- A. Applicator Qualifications: Approved by manufacturer; with successful experience in application of water repellent of type specified for at least 5 years.

- B. Regulatory Requirements: Comply with applicable air quality regulations.
- C. Mock-up:
 - 1. Where directed by Architect, treat 24-inch-square area of each substrate at site, in accordance with water repellent manufacturer's recommendations.
 - 2. 5 days after application, in presence of Architect, flood mock-up with water or use a suitable water-absorption device, to verify that surface will repel moisture effectively.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials at site in a protected location, away from flame and excessive heat. Storage temperature shall be at least 50 degrees F unless otherwise authorized by manufacturer.
- B. Comply with the additional requirements specified in Section 01 6000, "Product Requirements".

1.6 PROJECT CONDITIONS

- A. Coordinate with Section 03 4900, "Glass-Fiber-Reinforced Precast Concrete" for optional shop application of water repellent to GFRC.
- B. Apply sprayed material in such a way that it will not drift beyond building property lines.

1.7 WARRANTY

- A. Warrant that surfaces treated with water repellent will be free of defects in materials and workmanship, and that surfaces will remain water repellent.
 - 1. Upon expiration of warranty period, sufficient water repellent shall remain on treated material to reduce water absorption to less than 50 percent of the water absorbed by an untreated sample of the same material in a 24-hour water-absorption test.
 - 2. Where terms of manufacturer's guarantee require, provide a full-time jobsite inspector to supervise application.
- B. Locate and recoat defective work during warranty period at no cost to the Owner.
- C. Warranty Period: 10 years.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Water-Repellent Coating: Water-borne 20 percent silane/siloxane formulation; Sure Klean Weather Seal" by ProSoCo Inc., or accepted equal.
- B. Application Equipment: Low-pressure airless sprayer and hoses as recommended by manufacturer. Pump shall not atomize material.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that sealant work specified in Section 07 9200, "Joint Sealants" is complete and has cured minimum 6 hours or until set.
- B. Test for moisture content in accordance with manufacturer's instructions to ensure that surface is sufficiently dry.

3.2 PREPARATION

- A. Clean and prepare substrates in accordance with manufacturer's instructions.
- B. Protect adjoining work from spillage or overspray. Cover nearby aluminum and glass where required.

3.3 INSTALLATION

- A. Apply a heavy saturation spray coating of water repellent using low-pressure airless spray equipment as required to properly cover surface. Comply with water repellent manufacturer's instructions and recommendations. Use airless spraying procedure.
- B. Work from bottom to top of wall.
- C. Apply one coat of water repellent at coverage rate of approximately 140 square feet per gallon, depending on porosity and texture of substrate. Allow water repellent to run down the surface 6 to 8 inches. Adjust precise application rates for effective treatment.

3.4 CLEANING

- A. Clean spillage of water repellent from adjoining surfaces immediately after spillage while still wet. Comply with manufacturer's recommendations for cleaning.

END OF SECTION

SECTION 07 2116

BLANKET INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Insulation in batt form of the following types:
 1. Thermal building insulation.
 2. Acoustic batt insulation.

1.3 LEED REQUIREMENTS

- A. Refer to Section 01 81 13 for LEED requirements related to this Section.

1.4 SUBMITTALS

- A. Product Data: For each type of insulation product specified.
- B. LEED Submittals: See Section 01 81 13 for additional requirements; provide the following:
 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - a. Include statement indicating costs for each product having recycled content.
 2. Insulation: Product Data Sheets and MSDS for each product to be used as required by the U.S.G.B.C. as proof that each product meets the requirements of the GREENGUARD Environmental Institute's GREENGUARD certification.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for insulation products.

1.5 QUALITY ASSURANCE

- A. Thermal Conductivity: Where insulation is indicated or specified by "R" value, provide thickness required to achieve indicated value. Use aged and settled values for thermal resistance factors (R-values), tested in accordance with ASTM C518 at 75-deg. F. and 50-percent relative humidity for at least 6-months.
- B. Insulation shall be certified by the manufacturer to comply with California standards for insulating materials.
- C. Fire Performance Characteristics: Provide insulation materials identical to those whose indicated fire performance characteristics have been determined per the ASTM test method indicated below, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing and inspecting organization.
 1. Surface Burning Characteristic: ASTM E84.

2. Fire Resistance Ratings: ASTM E119.
3. Combustion Characteristics: ASTM E136.

- D. Single-Source Responsibility for Insulation Products: Obtain each type of building insulation from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's recommendations for handling, storage, and protection during installation.

PART 2 - PRODUCTS

2.1 LEED MATERIAL REQUIREMENTS, GENERAL

- A. Recycled Content: Provide products made from fiberglass batts with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 30 percent.
- B. Insulation Materials: Provide only insulation materials that are GREENGUARD Certified.

2.2 GLASS FIBER BLANKET INSULATING MATERIALS

- A. Preformed Units: Sizes to fit applications indicated, selected from manufacturer's standard thicknesses, widths, and lengths.
- B. Insulation at Exterior Walls: ASTM C665, Type I; "Thermal Batt"; preformed glass fiber batts conforming to the following:
1. Thermal Resistance R-value: Owens Corning EcoTouch R-30C
 2. Batt Width: Maximum width as required for application.
 3. Thickness: 8-1/4-inches.
 4. Facing: Unfaced; see Drawings for locations.
 5. Flame Spread Rating: Less than 25, as tested in accordance with ASTM E84.
- C. Insulation for Sound Attenuation: ASTM C665; "Sound Attenuation Batt"; Type I preformed glass fiber batts conforming to the following:
1. Batt Width: Maximum width as required for application.
 2. Thickness: 3-1/2-inches.
 3. Facing: Unfaced.
 4. Flame Spread Rating: Less than 10, as tested in accordance with ASTM E84.
 5. Smoke Developed: Less than 10, as tested in accordance with ASTM E84.
 6. Overall Sound Transmission: STC 50.
 7. Minimum density of 6 lb/cu ft (96 kg/cu m), thermal resistivity of 4.5 deg F x h x sq ft/Btu x in. at 75 deg F (31.2 K x m/W at 24 deg C).

2.3 LOOSE-FILL INSULATION

- A. Cellulosic-Fiber Loose-Fill Insulation: ASTM C739, chemically treated for flame-resistance, processing, and handling characteristics.

2.4 AUXILIARY INSULATING MATERIALS

- A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation or mechanical anchors securely to substrates indicated without damaging or corroding insulation, anchors, or substrates.
 - 1. Use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Staples: Steel wire; type and size to suit application.
- C. Tape: Mesh reinforced, self-adhering type, 2-inch wide.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions with Installer present, for compliance with requirements of the Sections in which substrates and related work are specified and to determine if other conditions affecting performance of insulation are satisfactory.
- B. Verify that substrate, adjacent materials, and insulation are dry and ready to receive insulation.
- C. Verify mechanical and electrical services within walls have been installed and tested.
- D. Do not proceed with installation of insulation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with insulation manufacturer's instructions applicable to products and application indicated. If printed instructions are not available or do not apply to project conditions, consult manufacturer's technical representative for specific recommendations before proceeding with installation of insulation.
- B. Extend insulation full thickness as indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation. Remove projections that interfere with placement.
- C. Apply a single layer of insulation of required thickness, unless otherwise shown or required to make up total thickness. Trim insulation neatly to fit spaces.
- D. Install in exterior and interior walls where indicated, without gaps or voids.
- E. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- F. Install blanket insulation in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.

2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures.
4. Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
5. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically.

G. Stuff glass fiber loose fill insulation into miscellaneous voids and cavity spaces where shown. Compact to approximately 40 percent of normal maximum volume (to a density of approximately 2.5 pcf).

H. Tape seal butt ends, lapped flanges, and tears or cuts in insulation membrane.

3.3 CLEANING AND PROTECTION

A. Construction Waste Management: Manage construction waste in accordance with provisions of Section 01 74 19 Construction Waste Management and Disposal. Submit documentation for Credit MR 2 to satisfy the requirements of that Section.

B. Protect installed insulation from damage due to physical abuse and other causes.

C. Provide temporary coverings or enclosures where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 07 2400

EXTERIOR INSULATION AND FINISH SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Roof screen.
- B. Finish.

1.2 RELATED SECTIONS

- B. Section 07 6200: Sheet Metal Flashing and Trim: Perimeter Flashings
- C. Section 07 920: Joint Sealers.

1.3 DESCRIPTION OF WORK

- A. The System:
 - 1. Provide and furnish all labor, materials, technical services, equipment and transportation necessary to install the field applied exterior insulation and finish system.
 - 2. The System (Dryvit "Outsulation") consists of:
 - a. EIFS assembly at Roof Screen:
 - (1) Steel decking, see Section 05 3100
 - (2) "Primus" adhesive.
 - (3) Rigid insulation - thickness as required.
 - (4) Standard weight, open weave, glass fiber fabric embedded in basecoat, "Genesis" or "Primus". Color to suit finish.
 - (5) Texture and color to match existing.
 - b. FS parapet coping: Similar construction to typical wall EXCEPT:
 - (1) Apply waterproof basecoat, "Dryflex", over typical basecoat.

1.5 QUALITY ASSURANCE

- A. Applicator.
 - 1. Application of the System shall be by an Applicator approved by the manufacturer of the system.
 - 2. Follow manufacturer's latest printed application instructions.
- B. Submit 2'-0" x 4'-0" sample of specified color, shape and texture to be used prior to final acceptance.
 - 1. Sample to be made by applicator utilizing tools, materials and techniques proposed for installation.
- C. Design Criteria
 - 1. The system and connections to the building structure shall be designed to resist a wind load of 25 P.S.I., with a live load deflection not to exceed L/240 (except when other more stringent requirements are called for) on the Drawings.

1.6 REGULATORY AGENCIES

- A. Code Approvals

1. The system shall be approved by the building codes or agencies with jurisdiction on the project.
2. Approval shall be based on full scale diversified fire testing by independent agencies whose specifications and requirements have general acceptance as regulatory.

1.7 REFERENCE STANDARDS

- A. Federal Specification (Fed. Spec.) HH-I-524 B Insulation Board, Thermal (Polystyrene).
- B. Federal Standard (Fed. Std.)
141A/6201 Moisture Resistance
141A/6191 Abrasion Resistance (Falling Sand)
141A/6061 Salt Spray (Fog) Test
141A/6151 Accelerated Weathering
- C. American Society of Testing and Materials (ASTM)
C 355 Water Vapor Transmission
D 1682 Breaking Load and Elongation of Textile Fabrics
E 72 Strength Tests of Panels for Building Construction
C 578 Preformed, Cellular Polystyrene Thermal Insulation
E84 Surface Burning Characteristics of Building Materials
A446 Sheet Steel, Zinc Coated (galvanized) by the Hot-Dip Process, Structural Quality

1.8 SUBMITTALS

- A. Shop Drawings
 1. Submit shop drawings in accordance with the Section 01300.
 2. Clearly indicate general construction, configurations, jointing methods and locations when applicable, fastening methods and installation details.

1.9 MOCK-UP

- A. The Contractor shall, before the project commences, provide Owner/Architect with a mock-up for approval.
- B. The mock-up shall be approximately 3' X 3' to accurately represent the products being installed, as well as each color and texture to be utilized on the project.
- C. The approved mock-up shall be available and maintained at the jobsite.

1.10 PRODUCT HANDLING

- A. Delivery products in original unopened packaging with legible manufacturer's identification.
- B. General Protection: Do not allow materials to become wet, soiled or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage and protection during installation.
- C. Protection for plastic insulation:
 1. Do not expose to sunlight.
 2. Protect against ignition at all times. Do not deliver plastic insulating materials to project site ahead of installation time. Complete installation

and concealment of plastic material as rapidly as possible in each area of work.

1.11 JOB CONDITIONS

- A. Environmental Requirements
 - 1. Application and installation shall be in ambient temperature ranges as prescribed by the manufacturer.
- B. Protection
 - 1. Protect surrounding areas and surfaces to preclude damage during application of the exterior insulation and finish system.
 - 2. Protect finished work when stopping for the day or when completing an area in order that water will not penetrate behind the system.
- C. Coordination
 - 1. The work of this section requires close coordination between related sections.
 - 2. All joints to be caulked shall be done immediately after the installation of the exterior insulation and finish system.

1.12 GUARANTEE

- A. Guarantee all work for a period of five (5) years.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Dryvit Systems, Inc., 354 S. Acacia, Woodlake, CA 93286. (800) 556-7844.
 - 1. Substitutions of the individual components to the exterior insulation and finish systems shall not be submitted without prior written consent from manufacturer.
- B. Substitutions: Complete systems of same function and performance are acceptable in conformance with Section 01630.

2.2 MATERIALS

- A. Substrate
 - 1. Dens-Glass Gold, 5/8" thick, Type X.
- B. Adhesive
 - 1. The adhesive shall be designed to be compatible, both in bond strength and chemical structure, with the specific rigid insulation used and with the stratum to which it is adhered. Adhesive shall be "Genesis", "Primus", or "Primus DM" by Dryvit.
- C. Water
 - 1. Water shall be clear, clean and potable, without any foreign matter in solution which might affect the color or setting qualities of cement, adhesive, or finish coat.

- D. Insulation Board
 - 1. Expanded polystyrene; Federal Specification HH-I-524 B less than 25 flame spread, and less than 450 smoke development.
 - 2. The density and shear modulus of the insulation board shall be such that it serves as a buffer between wall structure and exterior finish.
 - a. It shall be coordinated so that thermal and structural movements in the wall structure and thermal contraction of the insulation will not produce excessive shear stresses in the reinforced coating.
- E. Base Coat
 - 1. The fiber-reinforced acrylic-based veneer shall be hard, breathing type bonding layers.
 - 2. These bonding layers shall be of an especially prepared mastic type material applied in a thickness sufficient to completely embed the reinforced fabric and/or to create a crack-resistant, cementitious leveling coat. Base coat shall be "Genesis" or "Primus" by Dryvit.
 - 3. The strength of the shear bond on the surface of the insulation board shall be sufficient to develop the full tensile strength of the reinforcing fabric.
 - 4. The base coat colors shall be factory mixed and integral. Color shall match color of the finish coat.
- F. Fiberglass Reinforcing Fabric
 - 1. The fiberglass fabric is twisted multi-end strands, specifically treated for compatibility with all of the components of the System.
 - 2. Fabric at first floor shall be heavy duty, "Panzer 15" by Dryvit. Fabric at other floors shall be "Intermediate" by Dryvit.
- G. Waterproof Base Coat
 - 1. The polymer-based waterproof base coat takes the place of the standard base coat and is applicable to all parapet caps. Base coat must resist high moisture activity and high UV exposure. Waterproof base coat shall be "Dryflex" by Dryvit.
 - 2. The waterproof coat color shall be factory mixed and integral
- H. Acrylic Finish Coat
 - 1. The plastic veneer finish shall be of a hardening, air cured mastic type material.
 - 2. It shall form a breathing type coating fully bonded and compatible with the plastic veneer base to which it is applied.
 - 3. The plastic veneer finish color shall be factory mixed and integral. Color and texture shall be special architectural finish to be selected by Architect to be compatible with the glass fiber reinforced concrete cladding. Provide 12" x 12" sample to Architect for approval prior to preparing the mock-up.

2.3 FINISH SURFACE PROPERTIES The System specified shall have the following minimum characteristics and properties.

- A. Mechanical Properties
 - 1. Tensile Bond Strength of Adhesive - ASTM D1682 Insulation Board to: Exterior gypsum sheeting 1200 psf, Concrete 1900 psf.
 - 2. Impact Resistance - ASTM E72 (Sections 13.1 - 13.4)

Drop Height	Indentation	Observations
6 ft.	8.5mm	non-cracking

3. Freeze-Thaw Resistance - +20 C to -10 C
Soaked at 20 C - 4 days then -10 C for 2 hours and +20 C for 2 hours. Results: 60 Cycles with checking, cracking or splitting.
4. Water Vapor Transmission - ASTM C355
Insulation Board 1.2 to 2.0 perm-inch. Plaster Lamina 9.75 perm.

B. Weathering Properties

1. Accelerated Weathering - Fed. Std. 141A/6151 2000 Hours.
2. Salt Spray Resistance - Fed. Std. 141A/6061 300 Hours - 5% Salt Concentration.
3. Falling Sand Abrasion - Fed. Std. 141A/6191 500 Liters - no deleterious effects.
4. Moisture Resistance - Fed. Std. 141A/6201 14 days exposure - no deleterious effects.
5. Mildew Resistance - Mil. Std. 810 B. - No growth of mildew.

2.4 MIXING

A. Adhesive Plastic Veneer Base and Sweetner Coats

1. Use clean plastic container, free of all foreign substance, for mixing and preparing material. Do not use container which has been used for or cleaned with a petroleum product.
2. Use a mixer similar to Goldblatt Jiffler Mixer No. 15 311 H7, powered by 1.27 cm drill 400-5-- RPM.
3. Stir Adhesive or Plastic Veneer Base before adding Portland Cement to assure homogeneous material.
4. Mix Type 1 Portland Cement with Adhesive or Plastic Veneer Base in a ratio of one part Portland Cement to one part Adhesive or Plastic Veneer Base, by weight.
 - a. Measure quantities of Adhesive or Plastic Veneer Base and Portland Cement separately before mix.
 - b. Add Portland Cement to Adhesive or Plastic Veneer Base in small increments while thoroughly mixing each increment.
5. Water may be added to adjust workability.
6. Pot life for mixed Adhesive or Plastic Veneer Base should be the same as ordinary mortar or plastic materials.
 - a. Keep container closed when not in use.
7. No additives such as rapid binders, anti-freeze, accelerators, etc., shall be added to any material under any circumstances.

B. Plastic Veneer Finish

1. Thoroughly mix the factory prepared Plastic Veneer Finish material with the high speed mixer, until a uniform workable consistency is attained.
 - a. A small amount of clean potable water may be added to adjust workability.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Installer must examine substrate and conditions under which insulation work is to be performed and must notify contractor in writing of unsatisfactory conditions have been corrected in a manner acceptable to Installer.
 - B. Beginning of installation means acceptance of existing conditions.
- 3.2 PREPARATION
- A. Before fabrication of panel sections, fabricator is to take field measurements.
- 3.3 FABRICATION
- A. Field fabricate system according to the architectural profiles shown on the drawings.
 - B. Review all proposed modifications with Architect before proceeding with the work.
 - C. Expansion Joints: Provide expansion joints where required. Review proposed locations with Architect before proceeding.
- 3.4 INSTALLATION
- A. Comply with manufacturer's instructions for particular conditions of installation in each case. If 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 area to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation.
 - C. Apply a single layer of insulation of required thickness, unless otherwise shown or required to make up total thickness.
 - D. Installer must verify actual field dimensions prior to installation and provide all materials and labor necessary to insure secure anchorage of the composite panels to the structure.

END OF SECTION

SECTION 07 2500

WEATHER BARRIERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Water-Resistive Barrier (WRB, Type 1): Under WRB, Type 2 exterior wall cladding, over sheathing/SAM or other substrate; not air-tight or vapor retardant.
- B. Self-Adhering Membrane: Flexible rubberized, self-sealing wall flashing accessories.

1.2 RELATED REQUIREMENTS

- A. Section 09 2400 - Portland Cement Plastering: For WRB, Type 2.

1.3 DEFINITIONS

- A. Water-Resistive Barrier: Water-shedding barrier made of material that is moisture-resistant, to the degree specified, intended to be installed to shed water.

1.4 REFERENCE STANDARDS

- A. AATCC Test Method 127 - Water Resistance: Hydrostatic Pressure Test; 2008.
- B. ICC-ES AC-38 Air Barrier Requirements.
- C. ASTM D 822 - Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus; 2001.
- D. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2010.
- E. ASTM E 96/E 96M - Standard Test Methods for Water Vapor Transmission of Materials; 2005.
- F. ASTM E 2178 - Standard Test Method for Air Permeance of Building Materials; 2003.
- G. ASTM E 1677 – Standards for Type 1 air barrier.
- H. ASTM E 2357 – Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on material characteristics, performance criteria, and limitations.
- C. Shop Drawings: Provide drawings of special joint conditions.

- D. Samples: Submit samples of the following:
 - 1. Water-resistive barrier sheet (WRB, Type 1), minimum 10 by 10 inches (254 by 254 mm).
 - 2. Components including sill pan, minimum 12-inch (305-mm) lengths.
 - 3. Membrane flashings and tapes, including self-adhering membrane.
 - a. Length: 12 inches minimum.
 - b. Width: 9 inches or actual width of product if less than 9 inches.
 - 4. Fasteners.
 - 5. Sealants.
- E. Evaluation Report: ICC-ES report for water-resistive barrier. Must meet.
- F. Manufacturer's Installation Instructions: Indicate preparation, installation methods, and storage and handling criteria.
- G. Manufacturer's warranty: Submit sample warranty.

1.6 QUALITY ASSURANCE

- A. Single Source: Provide water-resistive barrier and accessories that are products of or recommended for use by a single manufacturer.
- B. Manufacturer Qualifications: Approved manufacturer of products listed in this Section with minimum 5 years experience in manufacture of similar products in successful use in similar applications.
 - 1. Approval of Comparable Products: Submit the following in accordance with project substitution requirements, within time allowed for substitution review:
 - a. Product data, including certified independent test data indicating compliance with requirements.
 - b. Samples of each component.
 - c. Sample warranty.
- C. Fire Performance Characteristics: Provide water-resistive barrier with the following fire-test characteristics.
 - 1. Surface-Burning Characteristics: ASTM E 84.
 - a. Flame spread index: 25 or less.
 - b. Smoke developed index: 450 or less.

1.7 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

1.8 WARRANTY

- A. On manufacturer's standard form, in which manufacturer agrees to provide replacement material for water-resistive barrier installed in accordance with manufacturer's instructions that fails due to material defects within 20 years from date of purchase.

PART 2 PRODUCTS

2.1 WEATHER RESISTIVE BARRIER (WRB, Type 1) (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)

- A. Weather Resistive Barrier, Mechanically Fastened:
1. Air Permeance: 0.001 cubic feet/min. per square foot at 75 Pa, when tested in accordance with ASTM E 2178.
 2. Water Vapor Permeance: 28 perms, minimum, when tested in accordance with ASTM E96/E 96M Method B (desiccant method).
 3. Water Penetration Resistance: 280 cm when tested in accordance with AATCC 127.
 4. Tear Resistance: 12/10 lbs., when tested in accordance with ASTM D11.
 5. Tensile Strength: 38/35 lbs/in. when tested in accordance with ASTM D 882.
 6. Surface Burning Characteristics: Class A, Flame spread index of 25, smoke developed index of 450, when tested in accordance with ASTM E 84.
 7. Weight: 2.7 oz. per sq. yard.
 8. Products:
 - a. Dupont Tyvek Commercial Wrap
 - b. Substitutions: See Section 01 6000 - Product Requirements.

2.2 SELF-ADHERING MEMBRANE

- A. As recommended by WRB, Type 1 membrane manufacturer to be compatible and to comply with required warranty.
1. Width: 9 inches minimum or as required for condition.
 2. Product shall conform to LEED VOC requirements.

2.3 ACCESSORIES

- A. General: Provide manufacturer's components and flashing elements for a complete, weather-tight, ventilated wall installation.
- B. Sill Pan: Extruded PVC, with integral slope, preformed corner dams, and window unit spacer supports, configured to drain moisture from window unit base to exterior. Coordinate selection of sill pan depth with window unit frame size.
1. Basis of Design: VaproShield, VaproSillSaver.
- C. Fasteners: Manufacturer's recommended corrosion-resistant, cap-headed steel or stainless steel nails, staples, or screws used in conjunction with manufacturer's spray adhesive, as appropriate for substrate.
- D. Flashing Tapes: Self-adhering single - and double - sided adhesive flashing , lap, and transition tapes, with UV white , aluminum, metallic, polymer alloy, and woven fabric composition as recommended by weather barrier manufacturer. For use at vertical and horizontal overlapping seams and to seal cuts or tears in membrane.
- E. Primer: As recommended by weather barrier manufacturer.
- F. Adhesive: As recommended by weather barrier manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and conditions are ready to accept the work of this section.

3.2 PREPARATION

- A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.
- B. Clean and prime substrate surfaces to receive adhesives in accordance with manufacturer's instructions.

3.3 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Self Adhering Membrane
 1. Install in accordance with drawings and manufacturer's instructions.
 2. At heads, sills and all flashing terminations turn up ends a minimum of 50 mm (2 in.) and make careful folds to form an end dam, with the seams sealed.
 3. Do not expose flashing membrane to sunlight for more than thirty days prior to enclosure.
 4. At Windows: Install in compliance with flashing, door and window manufacturers' instructions.
- C. Weather-Resistive Barrier (WRB, Type 1): Install continuous barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
- D. Mechanically Fastened WRB, Type 1 Sheets - On Exterior:
 1. Install sheets shingle-fashion to shed water, with seams generally horizontal.
 2. Starting at base of wall, unroll sheet horizontally across wall, color side up. Place a bead of sealant or butyl tape on foundation wall and seal sheet to it.
 3. Overlap seams as recommended by manufacturer but at least 6 inches.
 4. Overlap at outside and inside corners as recommended by manufacturer but at least 12 inches.
 5. Attach to framed construction with fasteners extending through sheathing into framing. Space fasteners at 12 to 18 inches on center along each framing member supporting sheathing.
 6. For applications specified to be air-tight, seal seams, laps, penetrations, tears, and cuts with self-adhesive tape; use only large-headed, gasketed fasteners recommended by the manufacturer.
 7. Where stud framing rests on concrete or masonry, extend lower edge of sheet at least 4 inches below bottom of framing and seal to foundation with sealant.
 8. Install WRB Type 1 and 2 OVER jamb flashings.
 9. Install head flashings under weather barrier.
 10. At openings to be filled with frames having nailing flanges, wrap excess sheet into opening; at head, seal sheet over flange and flashing.
- E. Openings and Penetrations in Exterior Weather Barriers:
 1. Install self-adhesive flashing over sills, covering entire sill frame member, extending at least 5 inches onto weather barrier and at least 6 inches up jambs; mechanically fasten stretched edges.

2. At openings to be filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with self-adhesive flashing at least 4 inches wide; do not seal sill flange.
3. At openings to be filled with non-flanged frames, seal weather barrier to all sides of opening framing, using self-adhesive flashing at least 9 inches wide, covering entire depth of framing.
4. At head of openings, install self-adhesive flashing under weather barrier extending at least 2 inches beyond face of jambs; seal weather barrier to flashing.
5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
6. Service and Other Penetrations: Form self-adhesive flashing around penetrating item and seal to weather barrier surface.

3.4 FIELD QUALITY CONTROL

- A. Do not cover installed weather barriers until required inspections have been completed.

3.5 PROTECTION

- A. Do not leave materials exposed to weather/UV light longer than recommended by manufacturer.

END OF SECTION

SECTION 07 2600

WEATHER RESISTANT MEMBRANE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sheathing membrane for installation over sheathing at parapets.

1.02 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets, samples, and Installation instructions.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer: BBA Nonwovens; Product-Typar; 70 Old Hickory Blvd., Old Hickory, TN 37138. ASD. Tel: (800) 321-6271 or (615) 847-7000. Fax: (615) 847-7068. Email: housewrap@reemay.com. www.reemay.com.
- B. Fortifiber Building Systems Group: Product-Weathersmart. www.fortifiber.com.
- C. DuPont Tyvek: Product-StuccoWrap. www.tyvek.com.
- D. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

- A. Sheathing Membrane: nonwoven sheet with the following characteristics:
 - 1. Ultraviolet Resistance: UV stabilizers in fibers and coating; no manufacturer limit on length of exposure.
 - 2. Surface Burning Characteristics: Flame spread index of 0, smoke developed index of 15 or less; when tested in accordance with ASTM E 84.
 - 3. Bursting Strength: 66 psi, minimum, when tested in accordance with ASTM D 3786.
 - 4. Tensile Strength: 94 lbf in machine direction, 80 lbf in cross-machine direction, when tested in accordance with ASTM D 4632 (grab).
 - 5. Tear Strength: 30 lbf in machine direction, 30 lbf in cross-machine direction, when tested in accordance with ASTM D 4533 (trapezoidal tear).
 - 6. Tear Strength After Exposure: Minimum 90 percent of original after 8 weeks exposure and minimum 80 percent after 16 weeks of exposure.
 - 7. Air Porosity: 10 to 20 seconds per 100 cc, when tested in accordance with TAPPI T460 (Gurley method).
 - 8. Moisture Vapor Transmission: At least 152 g/sq m/24 h, when tested in accordance with ASTM E 96/E 96M Procedure A.
- B. Joint Tape: Contractor grade, building code approved sheathing tape; minimum 1-1/2 inches wide.

- C. Mechanical Fasteners:
 - 1. For Attachment over Sheathing: Large-headed nails long enough to penetrate and hold in framing.
- D. Sealant: Acrylic latex sealant, building code approved; do not use silicone-based sealant.

PART 3 EXECUTION

3.01 PREPARATION

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

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions over entire exterior wall area except windows and doors.
- B. Comply with manufacturer's requirements for honoring of warranty.
- C. Locate joints over solid backing, lap 4 inches, and seal with tape.
- D. Trim membrane close to penetrations and seal with tape.

3.03 PROTECTION

- A. Protect installed membrane until installation of covering.
- B. Repair or replace damaged membrane before installing covering.

END OF SECTION 07 2600

SECTION 07 2616

BELOW-GRADE VAPOR RETARDERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Heavy-duty under-slab plastic vapor retarder.

1.3 RELATED SECTIONS

- A. Section 07 13 29 – Pre-Applied Sheet Membrane Waterproofing: Sheet waterproofing under concrete elevator pits, below-water table pits, and loading dock slab-on-grade.

1.4 LEED REQUIREMENTS

- A. Refer to Section 01 81 13 for LEED requirements related to this Section.

1.5 DEFINITIONS

- A. Vapor Retarder Assembly: The collection of vapor retarder materials and auxiliary materials applied over free draining gravel, including the sealing of sheet laps, joints, and penetrations, forming an impermeable membrane to control movement of moisture up through slabs-on-grade.

1.6 PERFORMANCE REQUIREMENTS

- A. Provide continuous vapor retarder under floor slab throughout the building, unless indicated otherwise on Drawings and ASTM E1643.

1.7 SUBMITTALS

- A. Product Data: Provide data indicating material characteristics, performance criteria, and limitations.
- B. Manufacturer's Installation Instructions: Indicate preparation and installation requirements, techniques.
- C. Certificates of Compliance: Include the name, description of the product. Provide third party independent testing reports to verify compliance with referenced standards.
 - 1. When Certificates of Compliance cannot be provided, the Contractor shall hire a professional testing laboratory to verify compliance. Contractor shall pay for the cost of testing.

1.8 QUALITY ASSURANCE

- A. Perform Work in accordance with ASTM E1643 and manufacturers recommend methods.
- B. Single-Source Responsibility: Obtain vapor retarder material and installation accessories from single source providing consistent quality in performance and appearance without delaying progress of the Work.
- C. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, junctures between below-slab membranes, testing and inspection procedures, and protection and repairs.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect vapor retarder materials from puncture damage prior to use.
- B. Comply with manufacturer's written recommendations for handling and storage, and protection during installation.

1.10 WARRANTY

- A. Special Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to replace vapor retarder material that does not comply with requirements or that fails achieve a watertight seal, or exhibits loss of adhesion or cohesion within specified warranty period.
 - 1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Plastic Vapor Retarder Sheeting: ASTM E1745, Class A, 15.0 mil total thickness, 14'-0" wide sheets.
 - 1. Product: Stego Wrap Vapor Barrier.
 - 2. Puncture Resistance, ASTM D1709, Dart Method: 2,266 grams
 - 3. Tensile Strength, ASTM D882: 70.6 lbf / in.
 - 4. Water Vapor Permeance, ASTM F1249: 0.0086 perms.

2.2 ACCESSORIES

- A. Tape: Polyethylene pressure sensitive, self-adhering type, mesh reinforced, 4-inch wide, compatible with vapor retarder material.
 - 1. Product: Stego Crete Claw Tape.
 - 2. Permeance: ASTM F1249; 0.3 perms or lower.
 - 3. Adhesion: ASTM D903; 17.6 lbf / in.
 - 4. Shear Strength in Adhesion: >49 lbf / sq in.
- B. Pipe Boots: Solid 10 mill pre-manufactured peel and stick patching product with aggressive all weather adhesive for direct adhesion to vapor retarder surface, pipes and penetrations.
 - 1. Water Vapor Transmission Rate: ASTM E96; 0.0016 perms or lower
- C. Cleaner for Vapor Retarder: As recommended by vapor retarder manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify required condition of substrate and adjacent construction with installer present. Make any corrections before proceeding with vapor retarder installation.
- B. Do not proceed with installation of retarder until unsatisfactory conditions have been corrected. Proceeding with installation indicates acceptance of substrate.

3.2 PREPARATION

- A. Remove loose or foreign matter that might impair adhesion.
- B. Level and tamp or roll aggregate or tamped earth base. Ensure that subsoil is approved by Architect.
- C. Clean and prime substrate surfaces to receive adhesive in accordance with manufacturers' instructions.

3.3 INSTALLATION

- A. Install vapor retarder materials in accordance with manufacturer's instructions and ASTM E1643 requirements. Extend vapor retarder over footings and seal to foundation wall, grade beam, or slab at an elevation consistent with the top of the slab or terminate at impediments such as waterstops or dowels.
- B. Seal vapor retarder to slab at perimeter. Install tape continuously around perimeter of vapor barrier at edge of foundation. Prior to the placement of concrete, ensure that the top of the tape is free of dirt, debris, or mud to maximize the bond to the concrete.
- C. Lay vapor retarder over base rock with width of sheet running parallel with the direction of concrete pour.
- D. Lap vapor retarder 6 inches minimum and seal with 4-inch wide adhesive tape. Position lap seals over firm bearing. Tape joints.
- E. Lap vapor retarder 3 inches over footings and grade beam waterproof membrane specified in Section 07 13 29 and as indicated on Drawings. Seal membrane to membrane with tape.
- F. Offset intermediate end joints in adjacent sheets no less than 4 feet.
- G. Cut sheeting to fit closely and neatly around penetrations of pipe and conduit. Seal tears and punctures.
- H. Slip sheeting over penetrations where possible, otherwise slit from penetration hole to nearest edge.
- I. Slip pipe boots fabricated from sheeting material over penetration holes and tape in place completely.
 - 1. Single pipe penetrations may be sealed using pipe boot constructed from the product. Cut a piece of plastic 12-inches wide x 1-1/2 times the circumference of the pipe. With scissors, cut slits half the width of the film Wrap boot around pipe; tape onto pipe and completely tape the base to the vapor barrier.

2. Multiple pipe penetrations in close proximity and very small pipes shall be sealed using mastic. Cut out a small area around pipes. Cut a patch of vapor barrier extending at least 6-inches past the cut out in all directions. Cut X's or small circles in the patch and install over pipes. Overlap at least 6-inches and tape. Build up 40- to 60-mils of mastic or as required to completely fill voids between the pipe and the vapor barrier.

J. Seal penetrations of pipe and conduit with tape to ensure an airtight seal. Seal tears and punctures with tape immediately before proceeding with covering the vapor retarder. Use a second layer of vapor retarder material where damage to vapor retarder is extensive and would require excessive use of tape to repair.

1. No penetration of the vapor retarder is allowed except for reinforcing steel and permanent utilities.

2. Repair damaged areas by cutting patches of vapor retarder, overlapping damaged area 6 inches and taping all four sides with tape.

3.4 CLEANING AND PROTECTION

A. Construction Waste Management: Manage construction waste in accordance with provisions of Section 01 74 19 Construction Waste Management and Disposal. Submit documentation for Credit MR 2 to satisfy the requirements of that Section.

B. Protect installed vapor retarders from damage by harmful weather exposure, and other construction activities.

C. Repair any punctures to vapor retarder before pouring concrete slab over retarder.

D. Do not permit adjacent Work to damage Work of this Section.

END OF SECTION 07 26 16

SECTION 07 4213

ALUMINUM BUILDING PANELS

PART 1 GENERAL

1.1. SECTION INCLUDES

- A. Preformed composite aluminum panel system for walls and soffits.

1.2. RELATED SECTIONS

- A. Section 01 3520: Design-Build Requirements
- B. Section 05 1200 - Structural Steel.
- C. Section 07 6200 - Metal Flashing and Trim.
- D. Section 07 9200 - Joint Sealants.

1.3. REFERENCES

- A. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- B. ASTM E84 - Surface Burning Characteristics of Building Materials.

1.4. SYSTEM DESCRIPTION

- A. System: Preformed and prefinished composite metal panel system configured as shown on drawings in horizontal and vertical applications; shop pre-assembled; with sub-girt framing, anchorage and stiffeners required to meet design loads and deflection criteria. Profiles as shown on drawings.

1.5. PERFORMANCE

- A. Preformed metal panel system to withstand code imposed design loads. Maximum allowable deflection of span 1/180.
- B. System to accommodate movement of components without buckling, failure of joint seals, undue stress on fasteners, or other detrimental effects, when subject to seasonal temperature ranges.
- C. System to accommodate tolerances of structure.
- D. Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
- E. All fasteners to be concealed.

1.6. SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 01 3000.
- B. Indicate dimensions, panel layout, construction details, method of anchorage, method and sequence of installation.

- C. Submit three custom color samples for approval. Color to match architects sample.
- D. Submit manufacturer's installation instructions under provisions of Section 01 3000.

1.7. QUALITY ASSURANCE

- A. Panel fabricator and installer shall be experienced and acceptable to panel manufacturer.
- B. Maximum deviation from the vertical and horizontal alignment of erected panels shall be no more than 1/4" in 20'-0" (6mm in 6m).
- C. Panel supplier shall furnish calculations confirming structural adequacy.
- D. Field measurements shall be taken prior to completion of shop fabrication.

1.8. PRODUCT DELIVERY, HANDLING AND STORAGE

- A. Protect panel finish and edges per panel manufacturer's recommendations.
- B. Store material in accordance with panel manufacturer's recommendations.

PART 2 PRODUCTS

2.1. ACCEPTABLE MANUFACTURERS

- A. Mitsubishi Chemical America, Alpolic FR, US Aluminum
- B. Substitutions: Under provisions of Section 01 6000.

2.2. MATERIALS

- A. Sheet Stock: .020 inch thick minimum alloy aluminum.
- B. Core: Thermoplastic.
- C. Sealants: Manufacturer's standard type suitable for use with installation of metal panel system and exterior applications; custom color to match panel.
- D. Concealed Fasteners: Manufacturer's standard type to suit application.
- E. Sub-girts: Aluminum alloy, in profile and size required to meet design requirements and to accept composite building panel system for attachment to building structural frame.
- F. Touch-up paint: As recommended by panel manufacturer.
- G. Bituminous Paint: Provide at all connections to dissimilar materials.

2.3. FABRICATION

- A. Panel Composition
 - 1. Aluminum composite material shall be composed of a compound core sandwiched between two aluminum sheets formed into a continuous process.
 - 2. Bond integrity, per ASTM C297, 1500 psi minimum. Peel strength: 33.6 in-lb/in.
- B. Finished Panel Thickness: 4mm.

- C. Tolerances
 - 1. Panel bow shall not exceed 0.8% 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 of warps and buckles.
- D. Panel surfaces shall be free of scratches or marks caused during fabrication.
- E. Internal and External Corners: Same material, thickness, and finish as metal panels. Profile as shown on drawings, brake formed and/or shop cut and factory mitered to required angles. Mitered corners, back braced as required to maintain continuity of profile.
- F. Expansion Joints: Same material and finish as panels of profile to suit system.
- G. Trim, Closure Pieces, Caps: Same material, thickness, and of same finish as sheet stock; brake formed to required profiles.
- H. Fabrication of component profiles on site not permitted.
- I. Fire Performance:
 - 1. Flamespread: ASTM E84
 - 2. Smoke Developed: ASTM E84, 10 max.
 - 3. Surface Flammability: Modified ASTM E108, Pass.

2.4. FINISH

- A. Exposed Exterior Surfaces: Kynar 500 or Megaflon finish of custom colors to match architects sample.
- B. Non-Exposed Interior Surfaces: Finish selected from manufacturer's standard range.
- C. Coating shall be factory applied on a continuous process paint line. Coating shall consist of a 0.2 mil (approx.) prime coat and a 0.8 mil (approx.) finish coat.

2.5 SCHEDULE

- A. Metal Panel A: White metal panel – color to match existing white metal panel color and metal finish currently on site. Color and finish to match architect's control sample.
- B. Metal Panel B: Accent color metal panel (at columns supporting overhead connector canopy between new building and existing Administration Building, and at Site Entrance wall): – Duranar Sunstorm "Moondust Mica". Use UC51742 primer with this product.

PART 3 EXECUTION

3.1. INSPECTION

- A. Panel substructure shall be level and plumb.
- B. Panel substructure shall be structurally sound as determined by Architect/Engineer.
- C. Panel substructure shall be free of defects detrimental to work.

- D. Panel installer shall inspect substructure and shall not proceed with panel erection until any deviations are corrected.

3.2 INSTALLATION

- A. Install composite metal building panel system on walls, column covers and colonnade cover in accordance with manufacturer's instructions.
- B. Protect panel surfaces in contact with cementitious materials and dissimilar metals with bituminous paint. Allow to dry prior to installation.
- C. Remove site cuttings from finish surfaces.
- D. Permanently fasten panel system to structural supports; align, level, and plumb, within specified tolerances.
- E. Locate panel joints over supports.
- F. Provide control joints where indicated.
- G. Use concealed fasteners unless otherwise approved by Architect/Engineer.
- H. Seal and place gaskets to prevent weather penetration. Maintain neat appearance.

3.3 TOLERANCES

- A. Maximum Offset From True Alignment Between Adjacent Members Butting or In Line: 1/16 inch.
- B. Maximum Variation from Plan or Location Indicated on Drawings: 1/4" inch.

3.4 ADJUSTING AND CLEANING

- A. Replace panels that have received irreparable damage.
- B. Remove strippable film coating as soon as possible after surrounding material has been installed.

END OF SECTION 07 4213

SECTION 07 5419

POLYVINYL-CHLORIDE (PVC) ROOFING

(BID RFI on Bid Package 2)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Adhered PVC membrane roofing system.

1.3 RELATED SECTIONS

- A. Section 07 6200 - Flashing and Sheet Metal: For metal roof penetration flashings, flashings, and counterflashings.
- B. Section 07 9200 - Joint Sealants: For joint sealants, joint fillers, and joint preparation.

1.4 LEED REQUIREMENTS

- A. Refer to Section 01 8113 for LEED requirements related to this Section.

1.5 DEFINITIONS

- A. Roofing Terminology: See ASTM D1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

1.6 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.
- C. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7.
- D. Fire Classification: UL Class A.

- E. Energy Performance: Provide roofing system with initial Solar Reflectance Index not less than 78 when calculated according to ASTM E1980, based on testing identical products by a qualified testing agency.
- F. Energy Performance: Provide roofing system with initial solar reflectance not less than 0.70 and emissivity not less than 0.75 when tested according to CRRC-1.

1.7 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Base flashings and membrane terminations.
 - 2. Tapered insulation, including slopes.
 - 3. Roof plan showing orientation of steel roof deck and orientation of membrane roofing and fastening spacings and patterns for mechanically fastened membrane roofing.
 - 4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
- C. Samples for Verification: For the following products:
 - 1. Sheet roofing, of color specified, including T-shaped side and end lap seam.
 - 2. Roof insulation.
 - 3. Roof paver in each color and texture required.
 - 4. Metal termination bars.
 - 5. Battens.
 - 6. Davit pedestal flashing boot.
 - 7. Six insulation fasteners of each type, length, and finish.
 - 8. Six roof cover fasteners of each type, length, and finish.
- D. LEED Submittals: See Section 01 8113 for additional requirements; provide the following:
 - 1. Product Data for Credit SS 7.2: For roof materials, documentation indicating that roof materials comply with Solar Reflectance Index requirement.
 - 2. Product Data for Credit IEQ 4.1: For adhesives and sealants used inside the weatherproofing system, documentation including printed statement of VOC content.
- E. Qualification Data: For qualified Installer and manufacturer.
- F. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - 1. Submit evidence of compliance with performance requirements.
- G. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.
- H. Research/Evaluation Reports: For components of membrane roofing system, from the ICC-ES.
- I. Maintenance Data: For roofing system to include in maintenance manuals.
- J. Warranties: Sample of special warranties.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for membrane roofing system identical to that used for this Project.

- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.
- C. Source Limitations: Obtain components including fasteners and roof insulation for membrane roofing system from same manufacturer as membrane roofing or approved by membrane roofing manufacturer.
- D. Exterior Fire-Test Exposure: ASTM E108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.
- E. Fire-Resistance Ratings: Where indicated, provide fire-resistance-rated roof assemblies identical to those of assemblies tested for fire resistance per ASTM E119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- F. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site. Comply with requirements for preinstallation conferences in Division 1 Section "Project Management and Coordination." Review methods and procedures related to roof deck construction and roofing system including, but not limited to, the following:
 - 1. Meet with Architect, Owner, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment.
 - 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 - 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
 - 5. Review structural loading limitations of roof deck during and after roofing.
 - 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
 - 7. Review governing regulations and requirements for insurance and certificates if applicable.
 - 8. Review temporary protection requirements for roofing system during and after installation.
 - 9. Review roof observation and repair procedures after roofing installation.
- G. Preinstallation Conference: Conduct conference at Project site. Comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to roofing system including, but not limited to, the following:
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment.
 - 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 - 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
 - 5. Review structural loading limitations of roof deck during and after roofing.

6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.10 PROJECT CONDITIONS

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

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.
 1. Special warranty includes membrane roofing, base flashings, roof insulation, fasteners, cover boards, substrate board, roofing accessories, roof pavers, and other components of membrane roofing system.
 2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LEED MATERIAL REQUIREMENTS, GENERAL

- A. Roof Material: With initial Solar Reflectance Index not less than 78 when calculated according to ASTM E1980.

2.2 PVC MEMBRANE ROOFING

- A. PVC Sheet: ASTM D4434, Type II, Grade I, with fiberglass reinforcement, lacquer coating, and a factory applied 9 oz. felt backing.
 - 1. Basis-of-Design Product: The design for the PVC roofing system is based on the manufacturer identified below. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
 - a. Basis-of-Design: Sika Sarnafil, G410 Feltback Adhered System.
 - b. Duro-Last Roofing, Inc.
 - c. IB Roof Systems.
 - 2. Thickness: 60 mils (1.5 mm), nominal.
 - 3. Exposed Face Color: White.

2.3 RIGID INSULATION

- A. Rigid Insulation:
 - 1. Basis-of-Design Product: 4'x (4/8)' IB Energy Board II Polyisocyanurate Thermal Insulation.
 - 2. Thickness: As indicated on Drawings or as require to achieve R-30.
 - 3. Permeance: ASTM E96, not more than 3.5 perms.
 - 4. R-Value per inch: ASTM C518; not less than 6.0 @ 75° F.
 - 5. Water absorption: ASTM C1177; less than 3.0 percent of weight.
 - 6. Compressive Strength: ASTM D1621; 20 psi.
- B. Insulation Adhesive: As recommended by roofing manufacturer for compatibility with specified roofing system.
- C. Fiberglass-Mat Faced Gypsum Cover Board:
 - 1. Product: Georgia-Pacific Gypsum, DensDeck.
 - 2. Thickness: 1/2 inch.
 - 3. Width: 4 feet.
 - 4. Length: 8 feet.
 - 5. Surfacing: Fiberglass mat.
 - 6. R-Value: ASTM C518; Not less than 0.28.
 - 7. Water Absorption: ASTM C1177; Less than 10 percent of weight.
 - 8. Surfacing: Fiberglass mat.
 - 9. Flexural Strength, Parallel (ASTM C473): 40 lbf, minimum.
 - 10. Permeance (ASTM E96): Not more than 50 perms
 - 11. R-Value (ASTM C518): Not less than 0.28
 - 12. Compressive Strength (Applicable Sections of ASTM C472): 500 - 900 pounds per square inch.
 - 13. Surface Water Absorption (ASTM C473): Not more than 2.5 grams.
- D. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48), unless otherwise indicated.
- E. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.
- F. Fasteners: Factory-coated steel fasteners and metal or plastic plates, corrosion-resistant, designed for fastening rigid insulation to substrate, and acceptable to roofing system manufacturer.

2.4 FLASHING MATERIALS

- A. Wall / Curb Flashing: G410 Flashing Membrane.
- B. Perimeter Edge Flashing:
 - 1. Edge Grip Fascia: Prefabricated perimeter edge system with concealed fasteners with no penetrations on the horizontal roof surface.
 - a. Retainer Base Plate: 20 gauge galvanized steel in 10 ft. lengths.
 - b. Snap-on Fascia Cover: 24 gauge galvanized steel in 10 ft. lengths, with a Kynar finish.
 - 1) Color: As selected by Architect from manufacturer's full range of colors including premium colors.
 - 2. Heat-Weldable Sheet Metal: 24 gauge, G90 galvanized metal sheet with a 20 mil (0.5 mm) unsupported Sarnafil membrane laminated on one side.
- C. Miscellaneous Flashing:
 - 1. Reglets: Sarnareglet; heavy-duty, extruded aluminum flashing termination reglet used at walls and large curbs.
 - 2. Pipe Boots/Jacks: Sarnastack Universal; 60 mil (1.5 mm) thick prefabricated stack/pipe boot injection molded.
 - 3. Patches and Corners: 60 mil (1.5 mm) thick prefabricated shapes, injection molded.

2.5 ADHESIVES AND SEALANTS

- A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use, and compatible with membrane roofing.
 - 1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
 - 2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Plastic Foam Adhesives: 50 g/L.
 - b. Gypsum Board and Panel Adhesives: 50 g/L.
 - c. Multipurpose Construction Adhesives: 70 g/L.
 - d. Fiberglass Adhesives: 80 g/L.
 - e. Contact Adhesive: 80 g/L.
 - f. Other Adhesives: 250 g/L.
 - g. PVC Welding Compounds: 510 g/L.
 - h. Adhesive Primer for Plastic: 650 g/L.
 - i. Single-Ply Roof Membrane Sealants: 450 g/L.
 - j. Nonmembrane Roof Sealants: 300 g/L.
 - k. Sealant Primers for Nonporous Substrates: 250 g/L.
 - l. Sealant Primers for Porous Substrates: 775 g/L.
- B. Flashing Adhesive: Solvent-based, VOC compliant, reactivating adhesive used to attach membrane to flashing substrate.
- C. Membrane Adhesive: A low odor, VOC compliant, one step foamable polyurethane adhesive used to attach feltback membrane to approved compatible substrates.
- D. Sealant: As recommended by manufacturer for compatibility with roofing system components.
- E. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

- F. Slip Sheet: Manufacturer's standard, of thickness required for application attached to the roof deck per the fastening and fastener requirements for the design pressure determined by the Authority Having Jurisdiction (AHJ) and the building code (whichever is more stringent).
 - G. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch (25 mm wide by 1.3 mm) thick, prepunched.
 - H. Factory Fabricated Drains/ Overflows/ Scuppers: 24 gauge, galvanized finished, 0.060 PVC clad steel scupper with factory welded smooth, unreinforced thermoplastic PVC membrane:
 - I. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.
 - J. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.
- 2.6 WALKWAYS
- A. **Flexible Walkways: Factory-formed, nonporous, heavy-duty, solid-rubber, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch thick, welded, and acceptable to membrane roofing system manufacturer.**
 - B. **Color: Match roofing membrane color or light gray (submit all available colors).**

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.3 RIGID ROOF 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 roof insulation.
- C. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- D. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4-inch (6 mm) with insulation.
- E. Cut and fit insulation within 1/4-inch (6 mm) of projections and penetrations.
- F. Seal joints between closed-cell (nonbreathing) insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.
- G. Install one or more layers of insulation to cover area of roofing to achieve required thickness. Where overall insulation thickness is 1-1/2-inches (38 mm) or greater, install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6-inches (150 mm) in each direction.
- H. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- I. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
- J. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Stagger joints from joints in insulation below a minimum of 6-inches (150 mm) in each direction. Loosely butt cover boards together and fasten to roof deck. Tape joints if required by roofing system manufacturer.

3.4 ADHERED MEMBRANE ROOFING INSTALLATION

- A. Adhere membrane roofing over area to receive roofing and install according to membrane roofing system manufacturer's written instructions.
 - 1. Install sheet according to ASTM D5036.
- B. Start installation of membrane roofing in presence of roofing system manufacturer's technical personnel.
- C. Start installation of membrane roofing in presence of membrane roofing system manufacturer's technical personnel.
- D. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

- E. Bonding Adhesive: Apply to substrate and underside of membrane roofing at rate required by manufacturer and allow to partially dry before installing membrane roofing. Do not apply to splice area of membrane roofing.
- F. In addition to adhering, mechanically fasten membrane roofing securely at terminations, penetrations, and perimeter of roofing.
- G. Apply membrane roofing with side laps shingled with slope of roof deck where possible.
- H. Seams: Clean seam areas, overlap membrane roofing, and hot-air weld side and end laps of membrane roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet membrane.
 - 2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
 - 3. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.
- I. Spread sealant bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.

3.5 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.6 WALKWAY INSTALLATION

- A. Roof-Paver Walkways: Install walkway roof pavers according to manufacturer's written instructions in locations indicated, to form walkways. Leave 3 inches (75 mm) of space between adjacent roof pavers.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
- C. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.

- D. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 PROTECTING AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Construction Waste Management: Manage construction waste in accordance with provisions of Section 01 74 19 Construction Waste Management and Disposal. Submit documentation for Credit MR 2 to satisfy the requirements of that Section.
- C. Correct deficiencies in or remove membrane roofing system that does not comply with requirements; repair substrates; and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

END OF SECTION

SECTION 07 5553

ELASTOMERIC TRAFFIC COATING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Elastomeric traffic coating at concrete roof platforms.

1.02 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's catalog data for base coat and finish coats, base flashing materials, and aggregate for slip resistant surface.
- C. Samples: Submit two samples, 12 x 12 inch in size, illustrating color and texture. Samples shall be applied to cement board.
- D. Manufacturer's Instructions: Indicate installation criteria and procedures.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years of experience.

1.04 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver product to project site in original 5-gallon containers with labels still in place and legible.

1.05 ENVIRONMENTAL REQUIREMENTS

- A. Do not install membrane when the surface temperature is less than 50 degrees or greater than 110 degrees.

1.06 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a one year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Vulkem 350 NF/351 by Tremco Commercial Sealants & Waterproofing; 3735 Green Road, Beachwood, Ohio, 44122, Tel (216) 292-5000, www.tremcosealants.com.
- B. Acceptable Manufacturers: Elastatex 500 Elastomeric Waterproofing by Dex-O-Tex: 3000 E. Harcourt Street, Rancho Dominguez, CA 90221. Tel (310) 886-9100, www.dexotex.com.
- C. Substitutions: See Section 01 6000 - Product Requirements.

2.02 COMPONENTS

- A. Vulkem 350 NF: A single component polyurethane basecoat.
- B. Vulkem 351: A one-part aliphatic polyurethane topcoat providing a chemical and UV resistant, color stable, waterproof wearing surface.

- C. Comply with ASTM C957-91, having a class A fire rating on concrete substrates.
- D. Aggregate:
 - 1. 40-50 mesh (0.4-0.5 mm diameter) silica sand or alumina oxide which imparts the non-slip texture.

2.03 ACCESSORIES

- A. Primer: primer as recommended by manufacturer.
- B. Sealant:
 - 1. Dymeric 240/240-FC.
 - 2. THC 900-901.
 - 3. Vulkem 227.
- C. Backer Rod: Closed cell polyethylene back-up material, diameter as recommended by manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that deck surface is clean, sound, dry and free of all coatings and contaminate.
 - 1. Dry shall be determined by fastening a rubber mat to the concrete deck for a minimum of six hours. The mat shall be located in the sun. After six hours (minimum), the surface beneath the rubber mat shall show minimal evidence of moisture or dampness.
- B. Concrete shall be in place a minimum of 14 days and preferably 28 days.

3.02 PREPARATION

- A. Prepare deck as required by manufacturer's written instructions.
- B. Structural or shrinkage cracks greater than 1/8 inch:
 - 1. Must be routed out to at least 1/4 inch in width and 1/2 inch in depth.
 - 2. Remove debris. Prime with primer,
 - 3. Install closed cell backer rod after primer is cured tack-free.
 - 4. Seal joint with sealant. Tool joint to be flush with plane of deck.
 - 5. Allow sealed crack to cure overnight.
 - 6. Prime sealed crack with primer.
 - 7. Apply 30 mil coat of base coat over crack once primer is cured.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Coat entire deck surface with primer, using solvent resistant rollers.
- C. Apply primer at a rate recommended by manufacturer.
- D. Allow primer to cure tack-free.
- E. Apply base coat 25 mils thick to cover the entire area with roller.
- F. Allow base coat to cure to firm rubber.
- G. Apply top coat 12 mils thick wet.
- H. Broadcast aggregate across the wet surface of the top coat. Cover the entire surface with aggregate, leaving no wet spots.
- I. Allow Vulkem 351 to cure overnight.

- J. Remove unbound aggregate. Install a second coat of Vulkem 351 over aggregate.
- K. Allow Vulkem 351 to cure for 24 hours.

3.04 CLEANING

- A. Clean all adjacent areas to remove any stains or spills with MEX, Toluene or Xylene..
- B. Protect installed work from subsequent construction operations.

3.05 PROTECTION OF FINISHED WORK

- A. Protect installed roofing and flashings from construction operations.
- B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION 07 5553

SECTION 07 6200

SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fabricated sheet metal items, including flashings, counterflashings, and coping.
- B. Sheet metal cap and counter flashing at selected concrete roof platforms.
- C. Reglets and accessories.

1.02 RELATED SECTIONS

- A. Section 07 5300 - Elastomeric Membrane Roofing: Roofing system.
- B. Section 07 9000 - Joint Sealers.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA Architectural Sheet Metal Manual requirements and standard details, except as otherwise indicated.
- B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with ten years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials which may cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

- A. Pre-Finished Galvanized Steel: ASTM A 653/A 653M, with G90/Z275 zinc coating; minimum 0.02 inch thick base metal, shop pre-coated with PVDF coating.
 - 1. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system; color as scheduled.
- B. Pre-Finished Aluminum: ASTM B 209 (ASTM B 209M); 0.032 inch thick; plain finish shop pre coated with fluoropolymer coating of color as selected.
 - 1. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system; color as scheduled.
- C. Lead: ASTM B 749, 2.5 lb/sq ft.

2.02 ACCESSORIES

- A. Fasteners: Galvanized steel, with soft neoprene washers.

- B. Underlayment: Ice and Water Shield by Grace Building Products.
- C. Primer: Zinc chromate type.
- D. Protective Backing Paint: Zinc molybdate alkyd.
- E. Sealant: Type SJ-1 specified in Section 07900.
- F. Plastic Cement: ASTM D 4586, Type I.
- G. Reglets: Surface mounted type, galvanized steel; face and ends covered with plastic tape.

2.03 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest possible lengths.
- C. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- D. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- E. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.
- F. Fabricate vertical faces with bottom edge formed outward 1/4 inch (6 mm) and hemmed to form drip.
- G. Fabricate flashings to allow toe to extend 2 inches over roofing gravel. Return and brake edges.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Install surface mounted reglets true to lines and levels. Seal top of reglets with sealant.
- C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

3.03 INSTALLATION

- A. Conform to drawing details:
- B. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted.
- C. Apply plastic cement compound between metal flashings and felt flashings.
- D. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- E. Seal metal joints watertight.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for field inspection requirements.

- B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

3.05 SCHEDULE

- A. Coping, Cap, Parapet, Sill and Ledge Flashings: 24 gauge.
- B. Counterflashings at Roofing Terminations (over roofing base flashings): 24 gauge.
- C. Counterflashings at Curb-Mounted Roof Items, including roof hatch: 24 gauge.
- D. Roofing Penetration Flashings, for Pipes, Structural Steel, and Equipment Supports: 24 gauge.

END OF SECTION

SECTION 07 7200
ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manufactured curbs, roof hatches, equipment rails, and pedestals.

1.02 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Maintenance requirements.

1.03 DELIVERY, STORAGE, AND PROTECTION

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products under cover and elevated above grade.

PART 2 PRODUCTS

2.01 MANUFACTURED CURBS

- A. Manufactured Curbs, and Other Roof Mounting Assemblies:
 - 1. AES Manufacturing Inc.: www.aescurb.com.
 - 2. The Pate Company: www.patecurbs.com.
 - 3. RPS Accessories: www.rpscurobs.com.
- B. Manufactured Curbs and Other Roof Mounting Assemblies: Factory-assembled hollow sheet metal construction with fully mitered and welded corners, integral counterflashing, internal reinforcing, and top side and edges formed to shed water.
 - 1. Sheet Metal: Hot-dip zinc coated steel sheet complying with ASTM A 653/A 653M, SS Grade 33; G60 coating designation; 18 gage, 0.048 inch thick.
 - 2. Manufacture curb bottom and mounting flanges for installation directly on roof deck, not on insulation; match slope and configuration of roof deck.
 - 3. Provide the layouts and configurations shown on the drawings.
- C. Curbs Adjacent to Roof Openings: Provide curb on all sides of opening, with top of curb horizontal for equipment mounting.
 - 1. Provide preservative treated wood nailers along top of curb.
 - 2. Insulate inside curbs with 1-1/2 inch thick fiberglass insulation.
 - 3. Height Above Finished Roof Surface: 8 inches, minimum.
 - 4. Height Above Roof Deck: 14 inches, minimum.
- D. Pipe, Duct, and Conduit Mounting Pedestals: Vertical posts, minimum 8 inches square unless otherwise indicated.
 - 1. Provide sliding channel welded along top edge with adjustable height steel bracket, manufactured to fit item supported.
 - 2. Height Above Finished Roof Surface: 8 inches, minimum.
 - 3. Height Above Roof Deck: 14 inches, minimum.

2.02 ROOF HATCHES

- A. Manufacturers - Roof Hatches:
 - 1. Bilco Co: www.bilco.com.
 - 2. Dur-Red Products: www.dur-red.com.
 - 3. Milcor Inc: www.milcorinc.com.
- B. Roof Hatches: Factory-assembled steel frame and cover; complete with operating and release hardware.
 - 1. Style: Provide flat metal covers unless otherwise indicated.
 - 2. Mounting: Provide frames and curbs suitable for mounting on flat roof deck.
 - 3. Size(s): As indicated on drawings; single-leaf style unless indicated as double-leaf.
 - 4. For Ladder Access: Single leaf; 48 x 48 inches.
- C. Frames/Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
 - 1. Material: Galvanized steel, 14 gage, 0.0747 inch thick.
 - 2. Finish: Factory prime paint.
 - 3. Insulation: 1 inch rigid glass fiber, located on outside face of curb.
 - 4. Curb Height: 12 inches from finished surface of roof, minimum.
- D. Metal Covers: Flush insulated, hollow metal construction.
 - 1. Capable of supporting 40 psf live load.
 - 2. Material: Galvanized steel; outer cover 14 gage, 0.0747 inch thick, liner 22 gage, 0.03 inch thick.
 - 3. Finish: Factory prime paint.
 - 4. Insulation: 1 inch rigid glass fiber.
 - 5. Gasket: Neoprene, continuous around cover perimeter.
- E. Hardware: Steel, zinc coated and chromate sealed, unless otherwise indicated or required by manufacturer.
 - 1. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf load.
 - 2. Hinges: Heavy duty pintle type.
 - 3. Hold open arm with vinyl-coated handle for manual release.
 - 4. Latch: Upon closing, engage latch automatically and reset manual release.
 - 5. Manual Release: Pull handle on interior.
 - 6. Locking: Padlock hasp on interior.
- I. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.
 - 1. Guardrails: Bilco; Bil-Guard Type S Hatch Rail System for single leaf roof hatch.
 - 2. Height: 42 inches (1060 mm) above finished roof deck.
 - 3. Posts and Rails: Galvanized-steel pipe, 1-1/4 inches (31 mm) in diameter or galvanized-steel tube, 1-5/8 inches (41 mm) in diameter.
 - 4. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches (533 mm) in diameter.
 - 5. Self-Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer's standard hinges and self-latching mechanism.
 - 6. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
 - 7. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.

8. Fabricate joints exposed to weather to be watertight.
9. Fasteners: Manufacturer's standard, finished to match railing system.
10. Finish: Manufacturer's standard.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify of unsatisfactory preparation before proceeding.

3.02 PREPARATION

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

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions, in manner that maintains roofing weather integrity.

3.04 CLEANING AND PROTECTION

- A. Clean installed work to like-new condition.
- B. Protect installed products until completion of project.
- C. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 07 7200

SECTION 07 9200

JOINT SEALANTS

PART 1 - GENERAL

1.1. SECTION INCLUDES

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

1.2. RELATED SECTIONS

- A. Section 03 3000 - Cast-In-Place Concrete: Sealants required in conjunction with cast-in-place concrete.
- B. Section 03 4900 - Glass-Fiber-Reinforced-Concrete: Sealants required in conjunction with GFRC.
- C. Section 07 8400 - Firestopping: Sealants required in conjunction with firestopping.
- D. Section 07 6200 - Sheet Metal Flashing and Trim: Sealants required in conjunction with metal flashings.
- E. Section 08 4113 - Aluminum Entrances: Sealants required in conjunction with door frames.
- F. Section 08 4413 - Aluminum Window Wall and Storefront Systems: Sealants required in conjunction with aluminum framing.
- G. Section 08 8000 - Glazing: Sealants required in conjunction with glazing methods.

1.3. REFERENCES

- A. ASTM C919 - Use of Sealants in Acoustical Applications.
- B. ASTM C920 - Elastomeric Joint Sealants.
- C. ASTM D1565 - Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Open-Cell Foam).
- D. SWRI (Sealant, Waterproofing and Restoration Institute) -Sealant and Caulking Guide Specification.

1.4. SUBMITTALS

- A. Submit under provisions of Section 01 3000.
- B. Prior to proceeding with submittals, the Contractor shall convene a pre-construction meeting to review all seismic/expansion joints as proposed in the drawings. Attendees to include all related trades, manufacturer's representatives, and Architect.
- C. Product Data: Manufacturer's specifications, recommendations, and installation instructions, including cleaning of joint surfaces, for each sealant material to be used.

1. Provide a manufacturers catalog cut sheet and a Material Safety Data Sheet (MSDS) highlighting VOC limits for each adhesive and sealant used.

D. Samples: Submit three ribbon samples, 2 inches long, illustrating sealant colors for selection.

E. Manufacturer's Installation Instructions: Indicate special procedures, surface preparation, and perimeter conditions requiring special attention.

1.5. QUALITY ASSURANCE

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform acoustical sealant application work in accordance with ASTM C919.

C. Before purchase of each required material, confirm its compatibility with each other material it will be applied to in joint system as well as itself during and after curing.

D. Adhesives and sealants must meet or be lower than the current VOC content limits of South Coast Air Quality Management District (SCAQMD) Rule #1168.

1.6. QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience.

B. Applicator: Company specializing in performing the Work of this Section with minimum five years documented experience and approved by manufacturer.

1.7. ENVIRONMENTAL REQUIREMENTS

A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.8. COORDINATION

A. Coordinate the Work with all sections referencing this section.

1.9. WARRANTY

A. Provide five year warranty under provisions of Division 1.

B. Warranty: Include coverage for installed sealants and accessories which fail to achieve air tight seal, water tight seal, and acoustic seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

A. Dow Corning Corporation.

B. Pecora Corporation.

C. Protective Treatments, Inc. (PTI).

- D. Sika Corporation.
- E. Sonneborn Building Products.
- F. Tremco.
- G. Vulkem.
- H. Substitutions: Under provisions of Section 01 6000.

2.2 SEALANTS

- A. Polyurethane Sealant (Type A): ASTM C920, Grade NS; use in expansion and control joints of G.F.R.C. panels, window and door perimeters, reglets, and flashings; single component, chemical curing, non-staining, non-bleeding, non-sagging type; color as selected.
 - 1. Dynatrol I - Pecora Corporation.
 - 2. Sikaflex 1a - Sika.
 - 3. Sonolastic NP 1 - Sonneborn.
 - 4. DyMonic - Tremco.
- B. Polyurethane Sealant (Type B): ASTM C920, Grade SL, use in concrete expansion and control joints in floor and sidewalk joints; multi-component, chemical curing, non-staining, non-bleeding, capable of continuous water immersion, self-levelling type; color as selected.
 - 1. Urexpan NR-200 - Pecora Corporation.
 - 2. THC-900 - Tremco.
- C. Silicone Sealant (Type C): ASTM C920, Type NS, Class 25; use at structural and conventional glazing and weatherproofing; single component, solvent curing, non-sagging, non-staining, fungus resistant, non-bleeding; color as selected.
 - 1. Dow Corning 795 - Dow Corning.
 - 2. 863 - Pecora Corporation.
 - 3. Spectrem II - Tremco.

2.3. ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Backer Rod: Round; oversized 20 to 50 percent larger than joint width; open-cell foam rod, Denver Foam; and as recommended by sealant manufacturer to suit application.

PART 3 - EXECUTION

3.1. EXAMINATION

- A. Verify that substrate surfaces and joint openings are ready to receive Work.
- B. Verify that joint backing and release tapes are compatible with sealant.

3.2. PREPARATION

- A. Remove loose materials and foreign matter which might impair adhesion of sealant.
- B. Clean and prime joints in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions.
- D. Protect elements surrounding the Work of this Section from damage or disfiguration.

3.3. INSTALLATION

- A. Install sealant in accordance with manufacturer's instructions. Use sufficient pressure to properly fill joints with sealant to the back up material.
- B. Measure joint dimensions and size materials to achieve required width/depth ratios.
- C. Install backer rod to achieve a neck dimension no greater than 1/3 of the joint width and in accordance with manufacturer's recommendations.
- D. Install sealant free of air pockets, embedded foreign matter, ridges, wrinkles, voids, and sags.
- E. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- F. Tool joints, as detailed, to provide a smooth, neat appearing finish in intimate contact with interfaces.

3.4. CLEANING

- A. Clean work under provisions of Division 1.
- B. Clean adjacent soiled surfaces.

3.5. PROTECTION OF FINISHED WORK

- A. Protect finished installation.
- B. Protect sealants until cured.

END OF SECTION

SECTION 08 1113

STEEL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire-rated steel doors and frames.
- B. Thermally insulated steel doors.

1.02 RELATED SECTIONS

- A. Section 08 7100 - Door Hardware.
- B. Section 09 9000 - Paints and Coatings: Field painting.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced grade standard.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.

1.04 DELIVERY, STORAGE, AND PROTECTION

- A. Store in accordance with NAAMM HMMA 840.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Steel Doors and Frames:
 - 1. Steelcraft: www.steelcraft.com.
 - 2. Stiles Custom Metal Inc. www.stilesdoors.com.
 - 3. Carmel Steel Products: www.carmelsteelproducts.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 DOORS AND FRAMES

- A. Requirements for All Doors and Frames:
 - 1. Accessibility: Comply with ANSI/ICC A117.1.
 - 2. Door Top Closures: Flush with top of faces and edges.
 - 3. Door Edge Profile: Beveled on both edges.
 - 4. Door Texture: Smooth faces.
 - 5. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
 - 6. Hardware Preparation: In accordance with DHI A115 Series, with reinforcement welded in place, in addition to other requirements specified in door grade standard.
 - 7. Galvanizing for exterior doors: All components hot-dipped zinc-iron alloy-coated (galvannealed), manufacturer's standard coating thickness.
 - 8. Finish: Factory primed, for field finishing.

- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with all the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 STEEL DOORS

- A. Exterior Doors:
 - 1. Grade: ANSI A250.8 Level 3, physical performance Level A, Model 2, seamless.
 - 2. Top Closures for Outswinging Doors: Flush with top of faces and edges.
 - 3. Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A 653/A 653M, with manufacturer's standard coating thickness.
 - 4. Insulation: U-value of 0.13, Polystyrene core.
- B. Interior Doors, Fire-Rated:
 - 1. Grade: ANSI A250.8 Level 2, physical performance Level B, Model 1, full flush.
 - 2. Fire Rating: As indicated on Door and Frame Schedule, tested in accordance with UL 10C ("positive pressure").
 - a. Rate of Temperature Rise across Door Thickness for 60 minute Doors: 250 F degrees.
 - b. Provide units listed and labeled by UL.
 - c. Attach fire rating label to each fire rated unit.
 - 3. Smoke and Draft Control Doors: In addition to required fire rating, comply with air leakage requirements of UBC Std 7-2, Part II; with "S" label; if necessary, provide additional gasketing or edge sealing.
- C. Interior Smoke and Draft Control Doors (Indicated as "S" on Drawings): Same construction as fire-rated doors with indicated fire rating, plus:
 - 1. Gasketing: No added gasketing or seals allowed.
 - 2. Label: UL "S" label.

2.04 STEEL FRAMES

- A. General:
 - 1. Comply with the requirements of grade specified for corresponding door.
 - 2. Finish: Same as for door.
- B. Exterior Door Frames: Fully welded.
 - 1. Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A 653/A 653M, with manufacturer's standard coating thickness.
 - 2. Weatherstripping: Separate, see Section 08 7100.
- C. Interior Door Frames, Fire-Rated: Fully welded.
 - 1. Fire Rating: Same as door, labeled.

2.05 ACCESSORY MATERIALS

- A. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.
- B. Temporary Frame Spreaders: Provide for all factory- or shop-assembled frames.

2.06 FINISH MATERIALS

- A. Primer: Rust-inhibiting, complying with ANSI A250.10, door manufacturer's standard.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.

3.02 INSTALLATION

- A. Install in accordance with the requirements of the specified door grade standard and NAAMM HMMA 840.
- B. In addition, install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Coordinate installation of hardware.

3.03 ERECTION TOLERANCES

- A. Maximum Diagonal Distortion: 1/16 in measured with straight edge, corner to corner.

3.04 ADJUSTING

- A. Adjust for smooth and balanced door movement.

END OF SECTION 08 1113

SECTION 08 4113

ALUMINUM ENTRANCES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes (but Is Not Necessarily Limited to):
 - 1. Aluminum and glass swing entrances, including hardware.
- B. Related Sections:
 - 1. Design-Build Requirements: Section 01 3520
 - 2. Door Hardware: Section 08 7100; cylinders.
 - 3. Glazing: Section 08 8000.
 - 4. Aluminum Window Wall and Storefront Systems: Section 08 4413.

1.2 SYSTEM DESCRIPTION

- A. Provide entrances as part of a complete enclosure system which includes the following and complies with the performance requirements specified:
 - 1. Doors complete with glass and glazing.
 - 2. Anchors, fasteners, shims, and inserts as required to attach to structure and storefront.
 - 3. Finish hardware.
- B. Performance Requirements:
 - 1. Resistance to corner racking shall be tested by the Dual Moment Load test as follows:
 - a. Test section shall consist of a standard top door corner assembly. Side rail section shall be 24 inches long, and top rail section shall be 12 inches long.
 - b. Anchor "top rail" positively to test bench so that corner protrudes beyond bench edge.
 - c. Anchor a lever arm positively to "side rail" at a point 19 inches from inside edge of "top rail." Attach weight support pad at a point 19 inches from inner edge of "side rail."
 - d. Test section shall withstand a load of 270 pounds on the lever arm before reaching the point of failure, which shall be considered a rotation of the lever arm in excess of 45 degrees.
 - 2. Air Infiltration, ASTM E283:
 - a. Pairs of Doors: Maximum of 2.3 cfm per linear foot of perimeter crack at a pressure differential of 1.56 psf.
 - b. Single Doors: Maximum of 2.0 cfm per linear foot of perimeter crack at a pressure differential of 6.24 psf.
 - 3. Expansion/Contraction: System shall provide for expansion and contraction within system components caused by a cycling temperature range of 170 degrees F over a 12-hour period without causing detrimental effect to system components.

1.3 SUBMITTALS

- A. Procedures: In accordance with Section 01 3000, "Submittals."
- B. Shop Drawings: Show elevations, dimension, member profiles, details of interface with curtain wall framing, reinforcement, and glazing materials and methods.
 - 1. Show deviations from Contract Documents.
 - 2. Prepare drawings at 1/2-inch-to-1-foot scale for elevations and 3-inches-to-1-foot scale for details.
 - 3. Indicate field measurements.

- 4. Manufacturer's standard drawings modified to show clearly that actual Project conditions and proposed work are acceptable.
- C. Verification Samples: Submit 12-inch-long section of typical stile extrusions in required width.
- D. Above submittals may, at Contractor's option, be included as part of the submittals specified in Section 08 4113, "Aluminum Window Wall and Storefront Systems."
- E. Quality Control:
 - 1. Verification of compliance with specified performance criteria.
 - 2. If requested by Architect, statement of fabricator/installer qualifications.
- F. Closeout: Extended warranty.

1.4 QUALITY ASSURANCE

- A. Fabricator/Installer Qualifications: Company specializing in work of this Section, with not less than 10 years' experience on jobs of similar type and complexity, and approved by manufacturer.
- B. Comply with AAMA "Metal Curtain Wall, Window, Store Front and Entrance Guide Specifications Manual."
- C. Conform to requirements of Title 24.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fabricated units and component parts to Project site completely identified in accordance with numbering system used on shop drawings or erection diagrams.
- B. Store inside building, protected from weather and from construction activities.
- C. Comply with the additional requirements specified in Division 1.

1.6 PROJECT CONDITIONS

- A. Coordinate installation of aluminum entrances with aluminum window wall and storefront systems so as to produce a weatherproof and waterproof installation.

1.7 WARRANTY

- A. Procedures: In accordance with Section 01 7800, "Closeout Submittals.
- B. Provide written warranty agreeing to repair or replace work that fails in materials or workmanship.
 - 1. Failure includes failure to perform as specified, glass breakage in excess of expected accidental breakage, and deterioration of finish or construction in excess of that to be expected under normal weathering.
 - 2. Warranty shall be signed by manufacturer, installer, and Contractor.
 - 3. Warranty Period: 5 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer:
 - 1. U.S. Aluminum.
 - 2. Kawneer.
 - 3. Walters & Wolf.
 - 4. Or approved equal.

2.2 MATERIALS

- A. Aluminum Extrusions: ASTM B221, alloy 6063-T5.
- B. Doors: Medium stile, with offset pivots. Joint securely and reinforce door stile and rails by means of structural corner assemblies. Fully weatherstrip; make doors adjustable vertically and front to back. Make cutouts for hardware accurately and reinforce as required. Provide snap-on type, square edged, glass stops with non-stretch vinyl beads. Provide sill to meet handicap requirements.
- C. Door Hardware: Install hardware furnished by manufacturer at factory. Install other hardware under provisions of Section 08 7100. For specific hardware components see Section 08710 General as follows:
 - 1. Weather Stripping: Wool pile, continuous and replaceable, manufacturer's recommended standard type, all door edges.
 - 2. Sill Sweep Strips: Retracting resilient seal type, of neoprene compound.
 - 3. Threshold: Extruded aluminum, one piece per door opening, ribbed, non-slip surface, of type to accommodate pivots; conforming to latest State handicapped regulations.
 - 4. Pivots: Top, bottom and intermediate offset type.
 - 5. Operation: Panic Device, provide pulls opposite side (electric switch security doors).
 - 6. Closer: Concealed overhead, with hold open feature - 90/105 degrees, or approved equal. Conform with latest State accessibility regulations for 5 pounds maximum effort to open doors. Provide 5 year warranty.
 - 7. Automatic door operator: Concealed floor mounted operator conforming with the latest State accessibility regulations
 - 8. Cylinder Lock: High Security Cylinder.
 - 8. Prep doors and frames for security and card access systems to be installed by others.
- D. Door Glazing: Tempered, glazing to match curtain wall system. See Section 08 8000, "Glazing".
- E. Glazing Gaskets: Full-Density EPDM conforming to NAAMM Standard SG-1.
- F. Glazing Blocks, Spacers, and Accessories: As specified in Section 08 8000, "Glazing."
- G. Fasteners: Aluminum, nonmagnetic, stainless steel or other materials warranted by manufacturer to be non-corrosive, non-corrodible, and compatible with aluminum components.
 - 1. Provide reinforcement where fasteners are screwed into aluminum members of less than 1/8-inch thickness.
 - 2. Do not use exposed fasteners.
- H. Miscellaneous Concealed Metal Members: Aluminum or nonmagnetic stainless steel.
- I. Hardware Group for Aluminum Entrances: see Drawings sheet A7.3, hardware group 100.

2.3 FABRICATION

- A. General:
 - 1. Perform all finishing prior to shipping to Project.
 - 2. Whenever it is necessary to proceed with fabrication without actual field measurements, provide adequate fabrication and installation tolerances for proper fit.
 - 3. Maintain accurate relationships of planes and angles, with hairline fit of contacting members.
 - 4. Perform fabrication operations, including cutting, fitting, forming, drilling, and grinding of metalwork in such a manner as to prevent damage to exposed finish surfaces.
- B. Nominal door stile face dimensions shall be as shown on the Drawings.
- C. Corner construction shall consist of mechanical clip fastening and SIGMA deep-penetration plug welds at top and bottom of channel clip.

2.4 FINISHES

- A. Extruded Aluminum Surfaces:
 - 1. Typical curtain wall and entrances: Duranar two-coat fluoropolymer coating system consisting of a 0.25 mil patented primer and a 1.0 mil color coat.
 - 2. Custom color to be selected by Architect to match existing.
- B. Hardware Finish: US26D brushed chrome.
- C. Concealed Steel Items: Galvanized in accordance with ANSI/ASTM A386 to 2.0 oz/sq ft.
- D. Apply one coat of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.
- E. Provide pressurized cans of touch-up coating, prepared by original applicator, for installer touch-up of field damaged coating. Assure proper color match.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's instructions, drawings, specifications, and reviewed submittals. Erection shall be plumb, level, square, and in proper alignment and relationship to other work.
- B. Glazing shall comply with requirements of Section 08 8000, "Glazing." Ensure proper seating of gaskets for continuous contact with glass around perimeter of glazed openings.
- C. Adjust entrances for proper operation of each door and its mechanical hardware. Comply with additional hardware installation requirements specified in Section 08 7100, "Door Hardware."
- D. Finished work shall be free of waves, buckles, dents, or other defects.

3.2 CLEANING AND TOUCH-UP

- A. Leave manufacturer's labels in place, intact, and legible until installation is reviewed and accepted.
- B. After initial inspection, remove labels, protective coating, and other foreign materials from glass and metal surfaces.

- C. Clean glass and metalwork of smears, spots, and other markings. Comply with additional requirements for final cleaning specified in Section 01 7300, "Execution Requirements."
- D. Touch up field abrasions and damage to factory-painted finish. Touch-up shall be unnoticeable in completed installation.

END OF SECTION

SECTION 08 4413

ALUMINUM WINDOW WALL AND STOREFRONT SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes (but Is Not Necessarily Limited to):
 - 1. Exterior wall system including:
 - a. Aluminum framing systems for window walls and storefronts.
 - b. Perimeter sealant.

- B. Related Sections:
 - 1. Design-Build Requirements: Section 01 3520
 - 2. Metal Fabrications: Section 05 5000; fabricated steel attachment devices.
 - 3. Building Insulation: Section 07 2100; insulation field installed in connection with glazed aluminum exterior wall system.
 - 4. Glass-Fiber-Reinforced Precast Concrete: Section 03 4900.
 - 5. Sheet Metal Flashing and Trim: Section 07 6200.
 - 6. Firestopping: Section 07 8400; firesafing and firestopping field installed in connection with glazed aluminum exterior wall system.
 - 7. Joint Sealants: Section 07 9200; system perimeter sealant and backup materials.
 - 8. Aluminum Entrances: Section 08 4113.
 - 9. Door Hardware: Section 08 7100; mortised hardware reinforcement requirements affecting framing members.
 - 10. Glazing: Section 08 8000.

1.2 SYSTEM DESCRIPTION

- A. Definition; Window Wall and Storefront Systems: Exterior glass systems supported by extruded aluminum glazing systems.

- B. Cooperate and coordinate with Architect and Architect's consultants to develop window wall and storefront systems, connections, and supports. Drawings are diagrammatic and intended to indicate external dimensions, appearance, profiles, conditions, and scope.
 - 1. Design modifications are acceptable as necessary to comply with design criteria. If modifications to designs indicated are proposed in order to meet code requirements, indicate them as such on shop drawing submittals.
 - 2. Submit variations in details and materials for review.
 - 3. Maintain general design concept without altering profiles or adversely affecting appearance, durability, or strength of materials.

- C. Design system to resist deflection and vertical and lateral forces as required by UBC seismic provisions and building drift requirements, except where more stringent requirements are indicated on the Structural Drawings.

- D. Safety Factor: Unless otherwise specified, design parts and assemblies (including glazing stops, gaskets, adhesives, and sealants) for safety factor not less than 1.65.
 - 1. Failure of any part or assembly shall not occur at less than 1.65 times maximum wind load pressure.
 - 2. Failure shall be defined as breakage, disengagement, or permanent deformation of framing members in excess of L/1,000 or 1/64 of their clear span, whichever is less, or

permanent deformation of anchor assemblies beyond tolerance and slippage limitations.

- E. Deflection: Under wind load pressure; do not exceed following clear span deflections.
 - 1. Normal to Wall Plane: $L/175$. $e/240 + 1/4$ " for spans that exceed 13'-6".
 - 2. Parallel to Wall Plane: Unless otherwise required for seismic drift, 75 percent of design clearance dimension or 1/8 inch vertically and 3/8 inch horizontally, whichever is less, between members and adjacent glass, panel, or other part immediately adjacent.
 - a. Door Headers: Horizontal members over doors; 1/16 inch.
 - 3. Sealant Interface: Do not exceed dynamic movement capacity of sealant.
 - 4. Design wind pressure shall be calculated in accordance with code using wind speed required by code.
- F. System Assembly: Accommodate without damage to system or components or deterioration of seals, movement within system, movement between system and perimeter framing components, dynamic loading and release of loads, deflection of structural support framing, tolerance of supporting components, and shrinkage of building structure, except as caused by seismic drift at corner conditions.
- G. Air Infiltration: Limit air infiltration through assembly to 0.06 cfm/square foot of wall area, measured at a reference differential pressure across assembly of 6.24-psf pressure differential when tested in accordance with ASTM E283.
- H. Water Leakage:
 - 1. Definition: "Water penetration" is defined as appearance of uncontrolled water other than condensation on indoor face of any part of window wall work.
 - 2. Static Pressure, ASTM E331: None, when subjected to water spray at 5 gallons per hour per square foot at static pressure of 10 psf.
 - 3. Dynamic Pressure, AAMA 501.1: None, when subjected to water spray at 5 gallons per hour per square foot and wind pressure of 10 psf.
- I. Expansion/Contraction: System shall provide for expansion and contraction within system components caused by a temperature range of 170 degrees F over a 12-hour period without detrimental effect to system components.
- J. Internal Drainage: Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system to exterior by a weep drainage network.
- K. Not Permitted: Vibration harmonics, wind whistles, noises caused by thermal movement, thermal movement transmitted to other building components, or loosening, weakening, or fracturing of attachments or components of system.

1.3 SUBMITTALS

- A. Procedures: In accordance with Section 01 3000, "Administrative Requirements."
- B. Submittals with Bid:
 - 1. With bid, provide enough drawings and manufacturer's literature to enable Architect to verify that proposed system meets design intent.
 - 2. Prior to award of contract, provide typical exterior elevations; details of each condition at large scale for typical sections, joints, anchor assemblies, sealant application, and glazing systems; and details of interface with other materials and systems.

- C. Shop Drawings:
 - 1. Submit complete shop and erection drawings. Show direction and magnitude of dynamic movement, interior and exterior joinery elevations, details of each condition at large scale for reach section, joint, anchor assembly, sealant application, and glazing system and as required for proper fabrication, assembly, and installation.
 - 2. Anchor Assemblies:
 - a. Shop Layout and Erection Drawings: Coordinate with related support system details.
 - b. Provide loading diagrams of resultant loads transmitted to support systems.
 - 3. Other Component Parts:
 - a. Shop and Erection Drawings: Prepare in same detail specified for window wall.
 - b. Verify and coordinate related details, conditions, dimensions, and tolerances.
- D. Product Data: Provide component dimensions describe components within assembly, anchorage and fasteners, glass and infill, internal drainage details, hardware, and other components.
- E. Samples:
 - 1. Framing: 12 inches long, finished as specified.
 - 2. Glass: As specified in Section 08 8000, "Glazing."
 - 3. Cutaway Sample of Framing Intersection: Show details of framing, joinery, anchorage, expansion provisions, glazing, flashing, and drainage.
 - 4. Infill panels, 12 inches square, illustrating specified construction and finish.
- F. Design Calculations: Demonstrate compliance with applicable codes and specified structural requirements.
 - 1. Calculations shall be by an engineer licensed in the State of California.
 - 2. Indicate loads on which calculations are based.
 - 3. Submit wind design calculations for various values, including positive and negative loading.
 - 4. Cross-reference calculations to shop drawings.
 - 5. Although all calculations shall be submitted, only reactions to structure are subject to review by Architect and Project Structural Engineer. Review of calculations by Architect will not relieve Contractor of any responsibilities for providing systems of required strength.
 - 6. Calculations are subject to review and approval by building official having jurisdiction.
- G. Quality Control: Statement of installer qualifications.
- H. Reports:
 - 1. NFRC label report to be provided by Design-Builder.
 - 2. Results of field water leakage tests by independent inspector. Costs by Owner.
- I. Closeout: Extended warranty, 5 years.

1.4 QUALITY ASSURANCE

- A. Comply with AAMA "Metal Curtain Wall, Window, Store Front and Entrance - Guide Specifications Manual."
- B. Installer Qualifications: Company specializing in performing the work of this Section and approved by manufacturer.
- C. Preinstallation Conference:
 - 1. Contractor shall schedule a job conference to review exterior wall and window work prior to installation.

2. Conference shall be attended by representatives of the Architect, Owner, Contractor, structural steel erector, installer of exterior wall cladding, and other installers whose work may affect quality of exterior wall installation.
 3. The following major considerations shall be reviewed at the conference:
 - a. Review in detail the Specifications, exterior wall and window design, drainage and flashing details, construction tolerances, interface with adjoining materials, and other work related to exterior walls and windows.
 - b. Review in detail job conditions, schedule, construction sequence, installation requirements, and quality of completed installation.
 - c. Review in detail the means of protecting completed work during remainder of construction period.
 - d. Record discussions of conference and any conflict, incompatibility, or inadequacy. Furnish a copy of record to each participant.
- D. Mock-up:
1. Provide a full size jobsite mock-up of window wall system for review and approval by Architect.
 2. Mock-up shall consist of typical assemblies in specified finish, complete with mounting devices. Mock-up shall be approximately 10 feet x 12 feet minimum, and sufficiently complete to demonstrate installation and aesthetic effect of completed system.
 3. Include glazing, metal wall panels, sealants, and other products used in conjunction with window wall system. Coordinate with other Sections as applicable.
 5. Provide shadow box at vision panels..
 6. Intent of mock-up is to permit verification of workmanship and visual qualities.
 7. If requested by Architect, make modifications to mock-up with additional charge to Owner.
 8. Remove mock-up at completion of work.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fabricated units and component parts to Project site completely identified in accordance with numbering system used on shop drawings or erection diagrams.
- B. Handle work of this Section in accordance with AAMA "Curtain Wall Manual #10."
- C. Protect prefinished aluminum surfaces with wrapping or strippable coating. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather. Puncture wrappings at ends for ventilation.
- D. Comply with the additional requirements specified in Division 1.

1.6 PROJECT CONDITIONS

- A. Established Dimensions: Where field measurements cannot be made without delaying work, establish dimensions and proceed with fabrication without field measurements. Coordinate with other construction to ensure that actual dimensions correspond to established dimensions.
- B. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and after installation of sealants.
- C. Coordinate construction and installation of exterior wall with other work having a direct bearing on work of this Section. Where applicable, furnish setting templates and layouts affecting work of other Sections.

1.7 WARRANTY

- A. Procedures: In accordance with Section 01 7800, "Closeout Submittals."
- B. Provide written warranty agreeing to repair or replace work which fails in materials or workmanship. Failure includes failure to perform as specified and/or deterioration of finish or construction in excess of that to be expected under normal weathering.
- C. Warranty Period: 5 years.

PART 2 - PRODUCTS

2.1 MANUFACTURED SYSTEMS

- A. Manufacturers:
 - 1. U.S. Aluminum.
 - 2. Kawneer.
 - 3. Walters & Wolf.
 - 4. Or approved equal.

2.2 MATERIALS

- A. Extruded Aluminum: ASTM B221, 6063-T5 alloy and temper, size, and shape as required by design criteria but not less than 0.125 inch thick.
- B. Sheet Aluminum: ASTM B209.
- C. Steel Sections: ASTM A36.
- D. Fasteners, Anchors, Embeds, and Miscellaneous Fastening Devices: Concealed type; aluminum, stainless steel, or other noncorrosive material compatible with aluminum.

2.3 STOREFRONT AND CURTAIN WALL SYSTEM

- A. Storefront and Curtain Wall System: ASTM B221, 6063-T5 extruded aluminum framing complete with glass glazing, anchorage attachments and shims required to secure window walls to building structural system.
- B. Custom extruded shapes as detailed on the drawings.

2.4 COMPONENTS AND MATERIALS

- A. General:
 - 1. Provide matching stops; drainage holes, deflector plates, and internal flashings to accommodate internal weep drainage system; internal mullion baffles to eliminate "stack effect" air movement within internal spaces.
 - 2. Pressure plates at stick systems shall be of sufficient size and strength to provide bite on glass and infill panels.
- B. Storefront and Curtainwall Frames: 2-1/2 inch wide by 6 inch deep profile, as indicated on Drawings; thick commercial quality extruded aluminum; ASTM B221, complete with matching flush stops of profile to suit frames and of adequate size to provide sufficient bite on glass

panels, in accordance with Flat Glass Marketing Manual, 1990 Edition, and Chapter 24 of the California Building Code, 2013 Edition; drilled holes, deflector plates and internal flashings to accommodate internal weep and drainage system.

- C. Structural Steel Reinforcement and Tubular Framing: ASTM A446, prime and paint after fabrication. Touch up abraded surfaces after installation.
- D. Glazing Materials: Type recommended by window wall manufacturer to suit locations and applications. Tempered glass shall be manufactured by a tongless method. Types as specified in Section 08800, "Glazing."
- E. Use fasteners of sufficient strength for the intended use which will not produce galvanic action. No fasteners shall be exposed to view. Any fasteners in the water drainage system shall be 300 series stainless steel.
- F. Flashings, brackets and other materials used internally and externally shall be corrosion resistant, non-staining, non-bleeding and compatible with adjoining materials. Provide isolation between dis-similar metals to prevent galvanic action.
- G. Flashings: Aluminum, finish to match window wall mullion sections where exposed, secured with concealed fastening method.
- H. Sealants: As specified in Section 07 9200, "Joint Sealants."
- I. Provide anchors, fasteners, clips, closures, and other components as required for a complete weatherproof system.

2.5 SEALANT MATERIALS

- A. Sealant: ASTM C920; Structural Silicone Sealant, Type S, Class 25, Grade NS.
- B. Sealant and Backing Materials:
 - 1. Perimeter Sealant: Dow Corning.
 - 2. Sealant used within system to be Dow Corning 795 or approved equal.
 - 3. Structural Sealant: Dow 795 or Tremco Spectrum Silicone.

2.6 FABRICATION

- A. Fabricate system components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- C. Prepare components to receive anchor devices. Fabricate anchors.
- D. Arrange fasteners and attachments to ensure concealment from view.
- E. Reinforce interior horizontal head rail to receive window treatment track brackets and attachments.
- F. Reinforce framing members for external imposed loads if required to meet design criteria.

- G. Ferrous Metal:
 - 2. Prime and paint in accordance with ASTM A123 after fabrication. Do not galvanize portions of items completely embedded in concrete. Touch up damaged surfaces and welds with zinc-rich paint.
 - 3. Contractor's Option: In lieu of hot-dip galvanize, use zinc-rich paint as follows:
 - a. Surface Preparation: Near-white blast cleaning in accordance with SSPC SP-10.
 - b. Application: Apply before rust bloom appears but not more than 8 hours after cleaning. Minimum dry film thickness, 2.5 mils.

2.7 PROTECTIVE COATINGS AND FINISHES

- A. Protect against galvanic action where dissimilar metals are in contact, except in case of aluminum in contact with galvanized steel, zinc, or relatively small areas of stainless steel or nickel silver (white bronze). Protect by applying one coat of specified bituminous paint or zinc chromate primer or by application of an appropriate sealant or tape.
- B. Extruded Aluminum Surfaces:
 - 1. Typical curtain wall: Kynar 500 coating, custom color to be selected by Architect.
- C. Provide pressurized cans of touch-up coating, prepared by original applicator, for installer touch-up of field-damaged coating. Assure proper color match.
- D. Concealed Steel Items: Zinc-rich paint.
- E. Apply one coat of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.

PART 3 - EXECUTION

3.8 EXAMINATION

- A. Verify tolerances, and method of attachment to other work. Adjust window wall construction and glazing panel size to accommodate field conditions.
- B. Representative of manufacturer shall examine structure and substrate to determine that they are properly prepared, sized, and ready to receive window wall and related work.

3.2 PREPARATION

- A. Ensure that metal surfaces to receive assembly components are properly painted, clean, and free of corrosion prior to commencing installation.
- B. Contact between aluminum and dissimilar metals shall receive protective coating as specified to prevent electrolytic action and corrosion.
- C. Galvanized Members: Clean and touch up welds, bolted connections, and abraded areas in accordance with ASTM A780, using galvanizing repair paint.

3.3 INSTALLATION

- A. Install window wall and storefront systems in accordance with reviewed shop drawings and manufacturer's specifications and recommendations.

- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments, anchors, embeds, and shims to fasten system permanently to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, and align with adjacent work.
- E. Install glass and infill panels in accordance with Section 08 8000, "Glazing," to glazing method required to achieve performance criteria.
- F. Sealant: Install perimeter sealant as required to achieve performance criteria and as specified in Section 07 9200, "Joint Sealants." Give special attention to cleaning of aluminum surfaces in contact with sealant.

3.4 ERECTION TOLERANCES

- A. Variations from Plumb or Angle Shown: 1/8-inch maximum variation in story height or 10-foot run, non-cumulative.
- B. Variation from Exterior Wall Plane: Unless otherwise shown, maximum 1/8-inch variation in planer alignment between exterior window wall and storefront components and adjacent exterior building components.
- C. Maximum Offset from True Alignment: Maximum 1/32-inch end-to-end or edge-to-edge alignment of adjacent or abutting sections. Offset cut edges of butting sections minimum 0.015 inch or as otherwise required to conceal cut edge.
- D. Sealant Space Between Window Wall Mullions and Adjacent Construction: Maximum of 1/2 inch and minimum of 1/4 inch.

3.5 CLEANING AND TOUCH-UP

- A. Leave manufacturer's labels in place, intact, and legible until installation is reviewed and accepted.
- B. After initial inspection, remove labels, protective coating, and other foreign materials from glass and aluminum surfaces.
- C. Touch up field abrasions and damage to factory-painted finish. Touch-up shall be unnoticeable in completed installation.

3.6 FIELD QUALITY CONTROL

- A. Water-Leakage Test - General:
 - 1. Test in accordance with AAMA 501.2 after completion of installation and curing of sealants.
 - 2. Testing does not relieve warranty responsibility required for watertightness.
 - 3. Test may be observed by an independent inspector at Owner's expense.

- B. Testing:
1. One test of window wall system at location as directed. Test shall be at first bay that is installed.
 2. Correct deficiencies, and modify system as required at no additional cost to Owner. Retest to assure no leakage.

END OF SECTION

SECTION 08 7100

DOOR HARDWARE
(02/25/16 SI-05)

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes items known commercially as finish or door hardware that are required for swing, sliding, and folding doors, except special types of unique hardware specified in the same sections as the doors and door frames on which they are installed.
- B. This Section includes the following, but is not necessarily limited to:
 - 1. Door Hardware, including electric hardware.
 - 2. Storefront and Entrance door hardware.
 - 3. Wall or floor-mounted electromagnetic hold-open devices.
 - 4. Power supplies for electric hardware.
 - 5. Low-energy door operators plus sensors and actuators.
 - 6. Thresholds, gasketing and weather-stripping.
 - 7. Door silencers or mutes.
- C. Related Sections: The following sections are noted as containing requirements that relate to this Section, but may not be limited to this listing.
 - 1. Division 8: Section - Steel Doors and Frames.
 - 2. Division 8: Section - Wood Doors.
 - 3. Division 8: Section - Aluminum Storefront
 - 4. Division 28: Section - Fire/Life-Safety Systems & Security Access Systems.

1.03 REFERENCES (Use date of standard in effect as of Bid date)

- A. 2013 California Building Code, CCR, Title 24.
- B. BHMA – Builders' Hardware Manufacturers Association
- C. DHI – Door and Hardware Institute
- D. NFPA - National Fire Protection Association.
 - 1. NFPA 80 - Fire Doors and Other Opening Protectives
 - 2. NFPA 105 - Smoke and Draft Control Door Assemblies
- E. UL - Underwriters Laboratories.
 - 1. UL 10C - Fire Tests of Door Assemblies
 - 2. UL 305 - Panic Hardware
- F. WHI - Warnock Hersey Incorporated
- G. SDI - Steel Door Institute

1.04 SUBMITTALS & SUBSTITUTIONS

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

Heading Number 1 (Hardware group or set number – HW -1)					
			(a) 1 Single Door #1 - Exterior from Corridor 101	(b) 90°	(c) RH
			(d) 3' 0"x7' 0" x 1-3/4" x (e) 20 Minute (f) WD x HM		
(g) 1	(h)	(i) ea	(j) Hinges - (k) 5BB1HW 4.5 x 4.5 NRP (l) ½ TMS	(m) 626	(n) IVE
2	6AA	1 ea	Lockset - ND50PD x RHO x RH x 10-025 x JTMS	626	SCH

(a) - Single or pair with opening number and location. (b) - Degree of opening (c) - Hand of door(s) (d) - Door and frame dimensions and door thickness. (e) - Label requirements if any. (f) - Door by frame material. (g) - (Optional) Hardware item line #. (h) - Keypad Symbol. (i) - Quantity. (j) - Product description. (k) - Product Number. (l) - Fastenings and other pertinent information. (m) - Hardware finish codes per ANSI A156.18. (n) - Manufacture abbreviation.

- D. Make substitution requests in accordance with Division 1. Substitution requests must be made prior to bid date. Include product data and indicate benefit to the project. Furnish samples of any proposed substitution.

- E. Wiring Diagrams: Provide product data and wiring and riser diagrams for all electrical products listed in the Hardware Schedule portion of this section.
- F. Keying Schedule: Submit separate detailed schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.
- G. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- H. Furnish as-built/as-installed schedule with close-out documents, including keying schedule and transcript, wiring/riser diagrams, manufacturers' installation and adjustment and maintenance information.
- I. Fire Door Assembly Testing: Submit a written record of each fire door assembly to the Owner to be made available to the Authority Having Jurisdiction (AHJ) for future building inspections.
- J. LEED Certification Points: Submit information and certifications necessary to achieve maximum points for LEED certification; coordinate and cooperate with Owner and Architect in providing information necessary for required LEED rating.

1.05 QUALITY ASSURANCE

- A. Obtain each type of hardware (latch and lock sets, hinges, closers, exit devices, etc.) from a single manufacturer.
- B. Supplier Qualifications: A recognized architectural door hardware supplier, with warehousing facilities in the project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this project and that employs an experienced architectural hardware consultant (AHC) who is available to Owner, Architect, and Contractor, at reasonable times during the course of the Work, for consultation.
 - 1. Responsible for detailing, scheduling and ordering of finish hardware.
 - 2. Meet with Owner to finalize keying requirements and to obtain final instructions in writing.
 - 3. items found defective within warranty periods.
- C. Hardware Installer: Company specializing in the installation of commercial door hardware with five years documented experience.
- D. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and tested by UL or Warnock Hersey for given type/size opening and degree of label. Provide proper latching hardware, door closers, approved-bearing hinges and seals whether listed in the Hardware Schedule or not.
 - 1. Where emergency exit devices are required on fire-rated doors, (with supplementary marking on doors' UL labels indicating "Fire Door to be Equipped with Fire Exit Hardware") provide UL label on exit devices indicating "Fire Exit Hardware".
- E. Exit Doors: Operable from inside with single motion without the use of a key or special knowledge or effort.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Coordinate delivery of packaged hardware items to the appropriate locations (shop or field) for installation.
- B. Hardware items shall be individually packaged in manufacturers' original containers, complete with proper fasteners. Clearly mark packages on outside to indicate contents and locations in hardware schedule and in work.
- C. Provide locked storage area for hardware, protect from moisture, sunlight, paint, chemicals, etc.
- D. Inventory door hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.

1.07 WARRANTY

- A. Provide warranties of respective manufacturers' regular terms of sale from day of final acceptance as follows:
 - 1. Locksets: (3) years.
 - 2. Electronic Locks: One (1) year.
 - 3. Closers: Thirty (30) --except electronic closers shall be two (2) years.
 - 4. Exit devices: Three (3) years.
 - 5. All other hardware: Two (2) years.

1.08 MAINTENANCE

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

1.09 PRE-INSTALLATION CONFERENCE

- A. Convene a pre-installation conference at least one week prior to beginning work of this section.
- B. Attendance: Architect, Construction Manager, Contractor, Security Contractor, Hardware Supplier, Installer, and Project Inspector.
- C. Agenda: Review hardware schedule, products, installation procedures and coordination required with related work. .

PART 2 – PRODUCTS

2.01 MANUFACTURERS

<u>Item</u>	<u>Manufacturer</u>	<u>Acceptable Substitutes</u>
A. Hinges	Ives	Hager, Stanley, McKinney
B. Locks, Latches & Cylinders	Schlage	Or Approved Equal
C. Exit Devices	Von Duprin	Or Approved Equal
D. Closers	LCN	Or Approved Equal
E. Door Operators	Dorma	Or Approved Equal

F. Push, Pulls & Protection Plates	Ives	Trimco, BBW, DCI
G. Flush Bolts	Ives	Trimco, BBW, DCI
H. Dust Proof Strikes	Ives	Trimco, BBW, DCI
I. Coordinators	Ives	Trimco, BBW, DCI
J. Stops	Ives	Trimco, BBW, DCI
K. Overhead Stops	Glynn-Johnson	Or Approved Equal
L. Thresholds	National Guard	Pemko, Zero
M. Seals & Bottoms	National Guard	Pemko, Zero

2.02 MATERIALS

- A. Hinges: Exterior out-swinging door butts shall be non-ferrous material and shall have stainless steel hinge pins. All doors to have non-rising pins.
1. Hinges shall be sized in accordance with the following:
 - a. Height:
 - 1) Doors up to 42" wide: 4-1/2" inches.
 - 2) Doors 43" to 48" wide: 5 inches.
 - b. Width: Sufficient to clear frame and trim when door swings 180 degrees.
 - c. Number of Hinges: Furnish 3 hinges per leaf to 7'-5" in height. Add one for each additional 2 feet in height.
 2. Furnish non-removable pins (NRP) at all exterior out-swing doors and interior key lock doors with reverse bevels.
- B. Floor Closers: Shall be equipped with compression springs, cam and roller operating mechanism and a one piece spindle-cam for maximum operating performance and longevity.
- C. Pivots: High strength forgings and castings with precision bearings for smooth operation. Positive locking vertical adjustment mechanism to allow installer to precisely position the door and balance the load.
- D. Extra Heavy duty Commercial Mortise Locks: Schlage "L" Series as scheduled with "17" Style Lever and "A" Style Rose.
1. Locksets to comply with ANSI A156.13, Series 1000, Operational Grade 1 and Security Grade 1 with all standard trims. Locksets shall also comply with UL10C Positive Pressure requirements
 2. Lock case shall be manufactured with heavy 12 gauge steel with fully wrapped design. Lock cases with exposed edges are not acceptable. Lock case shall be multi-functional allowing transformation to a different function without opening lock case.
 3. Latchbolt shall have 3/4" throw and be non-handed, field reversible without opening the lock case. Solid latchbolts and / or plastic anti-friction devices are not acceptable.
 4. The deadbolt, when used, shall be 1" throw stainless steel with a 3/4" internal engagement when fully extended.
 5. All trim shall be through-bolted with the spring cages supporting the trim attached to the lock cases to prevent torquing.

6. Levers to have independent rotation in both directions. Exterior lever assembly to be one-piece design attached by threaded bushing. Interior lever assembly shall be attached by screwless shank
 7. Thru-bolt lever assemblies through the door for positive interlock. Locks using a through the door spindle for attachment are not acceptable. Spindles shall be independent, designed to "break-away" at a maximum of 75psi torque.
 8. Hand of lock chassis to be changeable by simply moving one screw from one side to the case to the other and pulling and reversing the latchbolt.
 9. Cylinders to be secured by a cast stainless steel, dual retainer. Locks utilizing screws and / or stamped retainers are not acceptable.
- E. Exit devices: Von Duprin as scheduled.
1. Provide certificate by independent testing laboratory that device has completed over 1,000,000 cycles and can still meet ANSI/BHMA A156.3 - 2001 standards.
 2. All internal parts shall be of cold-rolled steel with zinc dichromate coating.
 3. Mechanism case shall have an average thickness of .140".
 4. Compression spring engineering.
 5. Non-handed basic device design with center case interchangeable with all functions.
 6. All devices shall have quiet return fluid dampeners.
 7. All latchbolts shall be deadlocking with 3/4" throw and have a self-lubricating coating to reduce friction and wear.
 8. Device shall bear UL label for fire and or panic as may be required.
 9. All surface strikes shall be roller type and utilize a plate underneath to prevent movement.
 10. Lever Trim: "Breakaway" design, forged brass or bronze escutcheon with a minimum of .130" thickness, match lockset lever design.
 11. Removable Mullions: Removable with single turn of building key. Securely reinstalled without need for key.
 12. Furnish glass bead kits for vision lites where required.
 13. All Exit Devices to be sex-bolted to the doors.
 14. Panic Hardware shall comply with CBC Section 1008.1.9 and shall be mounted between 30" and 44" above the finished floor surface.
- F. Closers: LCN as scheduled. Place closers inside building, stairs, room, etc.
1. Door closer cylinders shall be of high strength cast iron construction with double heat treated pinion shaft to provide low wear operating capabilities of internal parts throughout the life of the installation. All door closers shall be tested to ANSI/BHMA A156.4 test requirements by a BHMA certified testing laboratory. A written certification showing successful completion of a minimum of 10,000,000 cycles must be provided.
 2. All door closers shall be fully hydraulic and have full rack and pinion action with a shaft diameter of a minimum of 11/16 inch and piston diameter of 1 inch to ensure longevity and durability under all closer applications.
 3. All parallel arm closers shall incorporate one piece solid forged steel arms with bronze bushings. 1-9/16" steel stud shoulder bolts, shall be incorporated in regular arms, hold-open arms, arms with hold open and stop built in. All other closers to have forged steel main arms for strength, durability, and aesthetics for versatility of trim accommodation, high strength and long life.
 4. Closers shall be installed to permit doors to swing 180 degrees.
 5. All closers shall utilize a stable fluid withstanding temperature range of 120 degrees F. to -30 degrees F. without requiring seasonal adjustment of closer speed to properly close the door.

6. Provide the manufactures drop plates, brackets and spacers as required at narrow head rails and special frame conditions. NO wood plates or spacers will be allowed.
 7. Maximum effort to operate closers shall not exceed 5 lbs., such pull or push effort being applied at right angles to hinged doors. Compensating devices or automatic door operators may be utilized to meet the above standards. When fire doors are required, the maximum effort to operate the closer may be increased but shall not exceed 15 lbs. when specifically approved by fire marshal. All closers shall be adjusted to operate with the minimum amount of opening force and still close and latch the door. These forces do not apply to the force required to retract latch bolts or disengage other devices that hold the door in a closed position. Door shall take at least 3 seconds to move from an open position of 70 degrees to a point of 3 inches from the latch jamb.
 8. Provide sex-bolted or through bolt mounting for all door closers.
- G. In-Ground Door Operators: Dorma as scheduled.
- H. Flush Bolts & Dust Proof Strikes: Automatic Flush Bolts shall be of the low operating force design. Utilize the top bolt only model for interior doors where applicable and as permitted by testing procedures.
1. Manual flush bolts only permitted on storage or mechanical openings as scheduled.
 2. Provide dust proof strikes at openings using bottom bolts.
- I. Door Stops:
1. Unless otherwise noted in Hardware Sets, provide floor type with appropriate fasteners. Where wall type cannot be used, provide floor type. If neither can be used, provide overhead type.
 2. Do not install floor stops more than four (4) inches from the face of the wall or partition (CBC Section 11B-307).
 3. Overhead stops shall be made of stainless steel and non-plastic mechanisms and finished metal end caps. Field-changeable hold-open, friction and stop-only functions.
- J. Protection Plates: Fabricate either kick, armor, or mop plates with four beveled edges. Provide kick plates 10" high and 2" LDW. Sizes of armor and mop plates shall be listed in the Hardware Schedule. Furnish with machine or wood screws of bronze or stainless to match other hardware.
- K. Thresholds: As Scheduled and per details.
1. Thresholds shall not exceed 1/2" in height, with a beveled surface of 1:2 maximum slope.
 2. Set thresholds in a full bed of butyl-rubber or polyisobutylene mastic sealant complying with requirements in Division 7 "Thermal and Moisture Protection".
 3. Use 1/4" fasteners, red-head flat-head sleeve anchors (SS/FHSL).
 4. Thresholds shall comply with CBC Section 11B-204.1.
- L. Seals: Provide silicone gasket at all rated and exterior doors.
1. Fire-rated Doors, Resilient Seals: UL10C Classified complies with NFPA 80 & NFPA 252. Coordinate with selected door manufacturers' and selected frame manufacturers' requirements.
 2. Fire-rated Doors, Intumescent Seals: Furnished by selected door manufacturer. Furnish fire-labeled opening assembly complete and in full compliance with UL10C Classified complies with NFPA 80 & NFPA 252. Where required,

intumescent seals vary in requirement by door type and door manufacture -- careful coordination required.

3. Smoke & Draft Control Doors, Provide UL10C Classified complies with NFPA 80 & NFPA 252 for use on "S" labeled Positive Pressure door assemblies.
- M. Door Shoes & Door Top Caps: Provide door shoes at all exterior wood doors and top caps at all exterior out-swing doors.
- N. Silencers: Furnish silencers for interior hollow metal frames, 3 for single doors, 2 for pairs of doors. Omit where sound or light seals occurs, or for fire-resistive-rated door assemblies.

2.03 KEYING

- A. Furnish a masterkey system as directed by the owner or architect.
- B. A detailed keying schedule is to be prepared by the owner and/or architect in consultation with a representative of the lock manufacturer. Each keyed cylinder on every keyed lock is to be listed separately showing the door #, key group (in BHMA terminology), cylinder type, finish and location on the door.
- C. Establish a new masterkey system for this project as directed by the keying schedule.
- D. Furnish all cylinders in the Schlage Full Size Interchangable Core (FSIC). Pack change keys independently (PKI)
- E. Furnish construction keying for doors requiring locking during construction.
- F. Furnish mechanical keys as follows:
 1. Furnish 2 cut change keys for each different change key code.
 2. Furnish 1 uncut key blank for each change key code.
 3. Furnish 6 cut masterkeys for each different masterkey set.
 4. Furnish 3 uncut key blanks for each masterkey set.
 5. Furnish 2 cut control keys cut to the top masterkey for permanent I/C cylinders.
 6. Furnish 1 cut control key cut to each SKD combination.
- G. Furnish Key System Management Software (SM01-287 Windows on CD)
- H. Furnish Schlage Padlocks and the cylinders to tie them into the masterkey system for gates, storage boxes, utility valve security, roof hatches and roll-up doors keyed as directed in the keying schedule.

2.04 FINISHES

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

2.05 FASTENERS

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

PART 3 – EXECUTION

3.01 INSPECTION

- A. Verify that doors and frames are square and plumb and ready to receive work and dimensions are as instructed by the manufacturer.
- B. Beginning of installation means acceptance of existing conditions.
- C. Fire-Rated Door Assembly Inspection: Upon completion of the installation, all fire door assemblies shall be inspected to confirm proper operation of the closing device and latching device and that only the manufacturer's furnished fasteners are used for installation and that it meets all criteria of a fire door assembly per NFPA 80 (Standard for Fire Doors and Other Opening Protectives) 2007 Edition. A written record shall be maintained and transmitted to the Owner to be made available to the Authority Having Jurisdiction (AHJ). The inspection of the swinging fire doors shall be performed by a certified FDAI (Fire Door Assembly Inspector) with knowledge and understanding of the operating components of the type of door being subjected to the inspection. The record shall list each fire door assembly throughout the project and include each door number, an itemized list of hardware set components at each door opening, and each door location in the facility.

3.02 INSTALLATION

- A. Install hardware in accordance with manufacturer's instructions and requirements of DHI.
- B. Use the templates provided by hardware item manufacturer.
- C. Mounting heights for hardware shall be as recommended by the Door and Hardware Institute. Operating hardware will to be located between 30" and 44" AFF.
- D. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- E. Drill and countersink units that are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- F. Set thresholds for exterior doors in full bed of butyl-rubber sealant.

- G. If hand of door is changed during construction, make necessary changes in hardware at no additional cost.
- H. Hardware Installer shall coordinate with security contractor to route cable to connect electrified locks, panic hardware and fire exit hardware to power transfers or electric hinges at the time these items are installed so as to avoid disassembly and reinstallation of hardware.
- I. Hardware Installer shall also be present with the security contractor when the power is turned on for the testing of the electronic hardware applications. Installer shall make adjustments to solenoids, latches, vertical rods and closers to insure proper and secure operation.
- J. All wiring for electro-mechanical hardware mounted on the door shall be connected through the power transfer and terminated in the interface junction box specified for in the Electrical Section.
- K. Conductors shall be minimum 18 gage stranded, multicolored. A minimum 12 in. loop of conductors shall be coiled in the interface junction box. Each conductor shall be permanently marked with its function.
- L. If a power supply is specified in the hardware sets, all conductors shall be terminated in the power supply. Make all connections required for proper operation between the power supply and the electro-mechanical hardware. Provide the proper size conductors as specified in the manufacturer's technical documentation.

3.03 ADJUST AND CLEAN

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

3.04 HARDWARE LOCATIONS

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

3.05 FIELD QUALITY CONTROL

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

3.06 SCHEDULE

- A. The items listed in the following schedule shall conform to the requirements of the foregoing specifications.
- B. The Door Schedule on the Drawings indicates which hardware set is used with each door.

Manufacturers Abbreviations (Mfr.)

ADA	=	Adams Rite Mfg.	Aluminum Door Hardware
BLU	=	Blumcraft	Panic Hardware for Glass Doors
DCI	=	Door Controls International	Auto Flush Bolts & Coordinators
DRM	=	Dorma	Floor Closers
GLY	=	Glynn-Johnson Corporation	Overhead Door Stops
IVE	=	Ives	Hinges, Pivots, Bolts, Coordinators, Dust Proof Strikes, Kick Plates, Door Stops & Silencers
LCN	=	LCN	Door Closers
NGP	=	National Guard Products	Thresholds, Gasketing & Weather-stripping
SCE	=	Schlage Electronics	Electronic Door Components
SCH	=	Schlage Lock Company	Locks, Latches & Cylinders
VON	=	Von Duprin	Exit Devices
FS	=	Forms & Surfaces	Door Pulls

HARDWARE GROUP NO. 01 - Double Storefront Door (Card Access) (**Auto Operator**)

QTY		DESCRIPTION	CATALOG NUMBER	FINIS	MFR
				H	
2	EA	PIVOT SET	7215 SET	626	IVE
4	EA	INTERMEDIATE PIVOT	7215 INT	626	IVE
2	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL+-3547A-EO-ADJ10	626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL+-3547A-NL-OP-ADJ10-388	626	VON
1	EA	POWER SUPPLY	PS914 900-2RS	LGR	VON
1	EA	FLOOR CLOSER	BTS80/A LESS COVER PLT	626	DRM
1	EA	AUTO OPERATOR	ED 400-IG	626	DRM
4	EA	ACTUATOR, BOLLARD MOUNT	8310-836T	630	LCN
2	EA	STAINLESS STEEL BOLLARD	ADA-STAINLESS-TOWER	630	PEDISTAL -CEO
1	EA	MORTISE CYLINDER	20-001 114	626	SCH
2	EA	DOOR PULL	DP2084 18" C.C.	630	FS
2	EA	OH STOP	100S	630	GLY
1	EA	THRESHOLD ASSEMBLY	TYPE 1 X 713FC	AL	NGP

CARD READER, DOOR CONTACTS & WIRING FURNISHED BY ACCESS CONTROL SUPPLIER
 WEATHER-STRIPPING FURNISHED WITH DOOR & FRAME ASSEMBLY.

HARDWARE GROUP NO. 02 - Single Storefront Door (Card Access) **(Auto Operator)**

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	PIVOT SET	7215 SET	626	IVE
2	EA	INTERMEDIATE PIVOT	7215 INT	626	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL+-3547A-NL-OP-ADJ10-388	626	VON
1	EA	POWER SUPPLY	PS914 900-2RS	LGR	VON
1	EA	AUTO OPERATOR	ED 400-IG	626	DRM
4	EA	ACTUATOR, BOLLARD AND WALL MOUNT	8310-836T	630	LCN
1	EA	STAINLESS STEEL BOLLARD	ADA-STAINLESS-TOWER	630	PEDISTAL -CEO
1	EA	MORTISE CYLINDER	20-001 114	626	SCH
1	EA	DOOR PULL	DP2084 18" C.C.	630	FS
1	EA	OH STOP	100S	630	GLY
1	EA	THRESHOLD ASSEMBLY	TYPE 1 X 713FC	AL	NGP

CARD READER, DOOR CONTACTS & WIRING FURNISHED BY ACCESS CONTROL SUPPLIER
WEATHER-STRIPPING FURNISHED WITH DOOR & FRAME ASSEMBLY.

HARDWARE GROUP NO. 03 – Single Hollow Metal Door (Card Access)

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HW HINGE	BB1168 4.5" X 4.5"	US26D	HGR
1	EA	ELECTRIC HW HINGE	BB1168 4.5" X 4.5" ETW-8	US26D	HGR
1	EA	EL STOREROOM LOCK	L9080TEL 17A	626	SCH
1	EA	FSIC CORE	23-030 OPEN	626	SCH
1	EA	SURFACE CLOSER	4040XP EDA	689	LCN
1	EA	WALL STOP	WS406/407CVX	626	IVE
1	SET	SEALS	S88 D21	USD	PEM

CARD READER, DOOR CONTACTS & WIRING FURNISHED BY ACCESS CONTROL SUPPLIER

HARDWARE GROUP NO. 04 - Single Storefront Door (Card Access)

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	PIVOT SET	7215 SET	626	IVE
2	EA	INTERMEDIATE PIVOT	7215 INT	626	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL+-3547A-NL-OP-ADJ10-388	626	VON
1	EA	POWER SUPPLY	PS914 900-2RS	LGR	VON
1	EA	OVERHEAD CONCEALED CLOSER	RTS 88 BFE	626	DRM
1	EA	MORTISE CYLINDER	20-001 114	626	SCH
1	EA	DOOR PULL	DP2084 18" C.C.	630	FS
1	EA	OH STOP	100S	630	GLY
1	EA	THRESHOLD ASSEMBLY	TYPE 1 X 713FC	AL	NGP

HARDWARE GROUP NO. 05 - Single Storefront Door (Exit Only)

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	PIVOT SET	7215 SET	626	IVE
2	EA	INTERMEDIATE PIVOT	7215 INT	626	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	PANIC HARDWARE	RX-35A-EO-ALK	626	VON
1	EA	OVERHEAD CONCEALED CLOSER	RTS 88 BFE	626	DRM
1	EA	MORTISE CYLINDER	20-001 114	626	SCH
1	EA	OH STOP	100S	630	GLY
1	EA	THRESHOLD ASSEMBLY	TYPE 1 X 713FC	AL	NGP

HARDWARE GROUP NO. 06 – Single Hollow Metal Door (Roof Screen)

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HW HINGE	BB1168 4.5" X 4.5"	US26D	HGR
1	EA	PASSAGE SET	ND10S	626	SCH

END OF SECTION

SECTION 08 8000

GLASS AND GLAZING

PART 1 - GENERAL

1.1 SUBMITTALS:

- A. Submit the following in accordance with Section 01 3000:
 - 1. Product Data, Laminated and Insulating Glass: Submit manufacturer's specifications and installation instructions. For insulating units, certify compliance with standards listed.
 - 2. Submit samples where revisions to Contract Documents are requested.
 - 3. Submit samples of production run tinted glass to confirm match with samples at office of Architect.

1.2 QUALITY ASSURANCE:

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: "GANA Glazing Manual" and GANA "Sealant Manual".
 - 2. LSGA Publications: "LSGA Design Guide."
 - 3. SIGMA Publications: TM-3000 "Vertical Glazing Guidelines" .
- B. Safety (Tempered and Laminated) Glass: Provide label on each piece showing compliance with ANSI Z 97.1.
- C. Provide safety glazing in hazardous areas as defined by the UBC and UBC Standard 24-2: Safety Glazing.
- D. Wired Glass: Tested and Listed by UL for "fire resistance".
- E. Insulating Glass:
 - 1. Provide insulating glass units permanently marked either on spacers or at least one component lite of units with appropriate certification label of the Insulating Glass Certification Council.
 - 2. Manufacturer of Insulating Glass: A firm recognized and experienced in the production of hermetically sealed glazing units, which warrants its products against failure of the seal and against other material and workmanship failures of the insulated glass units.
 - 3. Allow for Thermal Loads on insulating units resulting from not less than an ambient temperature range of 120 degrees F., which may cause a material temperature range of 180 degrees F.
 - 4. Obtain all primary glass products from a single manufacturer for each type of insulating glass unit.
- F. Obtain elastomeric materials only from manufacturers who will, if required, send a qualified technical representative to project site, for the purpose of advising the glazier of proper procedures and precautions for the use of the materials.

1.3 WARRANTIES:

- A. General: Refer to the General and Supplementary Conditions of the Contract.
 - 1. Show endorsement of glazier/installer on all warranties.
 - 2. General Contractor's responsibilities for these warranties are described in the General and Supplementary Conditions.
 - 3. Repairs or replacements during the warranty period required by acts of God (which exceed performance requirements), alterations, abuse of work, vandalism and other causes beyond the Contractor's control will be completed by the Contractor at Owner's discretion and paid for by the Owner at prevailing rates.
- B. Warranty Period During Which Installation of Replacement Materials is Included: 2 years after date of Substantial Completion.
- C. Insulating Glass: Submit written warranty agreeing to replace insulating glass units which fail to maintain hermetic seal of the air space or which show deterioration of coatings or colors, or deteriorate in any other manner, due to failure of materials or workmanship, for 10 years after the date of manufacture. After initial replacement period, furnish glass F.O.B. job site. Attach manufacturer's warranty.
- D. Glass and Glazing: Submit written warranty agreeing to repair or replace glass and glazing materials which fail to perform as specified, including leakage of water; or failure in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, or general durability; or deteriorate in any other manner not clearly specified by submitted manufacturer's data as an inherent quality of the material for the exposure indicated.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS:

- A. Primary Glass: Provide primary glass which complies with ASTM C 1036, including requirements indicated by reference to type, class, quality, and if applicable, form, finish, mesh and pattern.
 - 1. Clear Float Glass: Type I, (transparent glass, flat), Class 1, Quality q3 (glazing select).
 - 2. Tinted Float Glass: Type I, (transparent glass, flat) Class 2 (tint heated absorbing and light reducing), Quality q3 (glazing select).
- B. Heat-Treated Glass:
 - 1. Provide heat-strengthened and tempered glass which complies with ASTM C 1048, including requirements indicated by reference to kind, condition, type, quality, class, and, if applicable, form, finish, and pattern.
 - 2. Manufacture heat-treated glass by horizontal (roller hearth) process with roll wave distortion parallel with bottom edge of glass as installed, unless otherwise indicated.
- C. Sizes:
 - 1. Fabricate glass to sizes required for glazing openings indicated, with edge clearances and tolerances complying with recommendations of glass manufacturer.
 - 2. Thickness: 1/4 inch; or thicker as indicated or recommended by glass manufacturer for application indicated.

- D. Plastic Interlayer: Provide glass fabricator's standard, 0.060" minimum, polyvinyl butyral interlayer for laminating panes of glass, with a proved record of showing no tendency to bubble, discolor or lose physical or mechanical properties after laminating and installation, in clear or colors and of thickness indicated.
- E. Non-Insulating Glass: Provide where specifically indicated, of component glass materials as specified, 1/4 inch thick or as indicated.

2.2 INSULATING GLASS UNITS:

- A. General: Provide preassembled units consisting of dual seal organically sealed panes of glass enclosing a hermetically sealed dehydrated air space and complying with ASTM E 774 for performance classification indicated as well as with other requirements specified for glass characteristics, air space, sealing system, sealant, spacer material, corner design and desiccant. Where not specified, provide manufacturer's standard units qualifying for warranty specified.
- B. For properties of individual glass panes making up units, refer to product requirements specified elsewhere in this section applicable to types, classes, kinds and conditions of glass products indicated.
- C. Provide heat-treated panes of kind and at locations indicated or, if not indicated, provide heat-strengthened panes where recommended by manufacturer for application indicated and tempered where indicated or where safety glass is designated or required by the UBC.
- D. Performance Classification per ASTM E 774: Class A.
- E. Thickness of Each Pane: As indicated, typically 1/4" where required for size.
- F. Air Space Thickness: 1/2".
- G. Sealing System: Manufacturer's standard.
- H. Label each unit to show which face is to be exposed to the exterior, unless fabrication is the same from both faces. Place label on inside face.

2.3 GLAZING MATERIALS:

- A. General: Provide black exposed glazing materials, unless another color is indicated, or unless another color is selected by Architect from manufacturer's standard colors. Provide hardness of materials as recommended by the manufacturer for the required application and condition of installation in each case. Provide only compounds, which are known (proven) to be fully compatible with surfaces contacted.
- B. Silicone Rubber Glazing Sealant: Silicone rubber, one-part elastomeric sealant. Provide acid-type (GE 1200 or Dow 999A) for non-porous channel.
- C. Polyethylene Glazing Tape (for use at overhead glazing): Self-adhesive, non-staining, plastomeric foam tape, intended for 25% compression, formed and coiled on release paper; Sealant Specialists (reportedly represented by Latta Associates) SST 20 or approved equal.

- D. Molded Neoprene Glazing Gaskets: Molded or extruded neoprene gaskets of the profile and hardness required for watertight construction; comply with ASTM D 2000 designation 2BC 415 to 3BC 620, black.
- E. Setting Blocks: Neoprene, 70-90 shore A durometer hardness, with proven compatibility with sealants used.
- F. Spacers: Neoprene, 40-50 shore A durometer hardness, with proven compatibility with sealants used.
- G. Compressible Filler Rod: Closed-cell or waterproof-jacketed rod stock of synthetic rubber or plastic foam, proven to be compatible with sealants used, flexible and resilient, with 5-10 psi compression strength for 25% deflection.
- H. Cleaners, Primers and Sealers: Type recommended by sealant manufacturer.

2.5 FABRICATION:

- A. Edge Work at Exposed Edges:
 - 1. Provide beveled edges where indicated with ground or satin finish and uniformly beveled edges.

PART 3 - EXECUTION

3.1 STANDARDS AND PERFORMANCE:

- A. Provide watertight and airtight installation of each piece of glass. Each installation must withstand normal temperature changes and wind loading, without failure of any kind, including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glazing materials and other defects in the work.
- B. Protect glass from edge damage at all times during handling, installation, and subsequent operation of the glazed components of the work.
- C. Glazing channel dimensions are intended to provide for necessary bite on the glass, minimum edge clearance and adequate sealant thicknesses, with reasonable tolerances. The glazier is responsible for correct glass size for each opening, within the tolerances and necessary dimensions established.
- D. Comply with combined recommendations of glass manufacturer and manufacturer of sealants and other materials used in glazing, except where more stringent requirements are shown or specified, and except where manufacturer's technical representatives direct otherwise.
- E. Do not attempt to cut, seam, nip or abrade insulating glass or glass which is tempered.
- F. Cut and install insulating and tinted glass as recommended in "Technical Services Report No. 104C" by PPG Industries, or similar report by other glass manufacturer.

3.2 PREPARATION:

- A. Clean glazing channel, or other framing members to receive glass, immediately before glazing. Remove coatings, which are not firmly bonded to the substrate. Remove lacquer from metal surfaces wherever elastomeric sealants are used.

- B. Apply primer or sealer to joint surfaces wherever recommended by sealant manufacturer.

3.3 GLAZING:

- A. Install setting blocks of proper size at quarter points of sill rabbet.
- B. Provide spacers inside and out, and of proper size and spacing, for all glass sizes larger than 50 united inches, except where gaskets are used for glazing.
- C. Force sealants into channel to eliminate air pockets and voids (other than expansion voids) and to ensure complete "wetting" or bond of sealant to glass and channel surfaces.
- D. Tool exposed surfaces of glazing sealants and compounds to provide a substantial "wash" away from the glass.
- E. Clean and trim excess glazing materials from the glass and stops or frames promptly after installation, and eliminate stains and discolorations.
- F. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage to ensure that gasket will not "walk" out when subjected to movement. Anchor gasket to stop with matching ribs, or by proven adhesives, including embedment of gasket tail in cured heel bead.
- G. Install pressurized tapes to protrude slightly out of the channel, so as to eliminate dirt and moisture pockets.

3.4 CURE AND PROTECTION:

- 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 glass and glazing sealants and compounds during the construction period, so that they will be without deterioration or damage (other than normal weathering) at the time of Owner's acceptance.
- C. Prevent glass damage due to alkaline wash from green concrete surfaces and similar sources of possible damage.
- D. Protect exterior glass from breakage immediately upon installation. Do not apply markers of any type to surfaces of glass.

3.5 SCHEDULE - EXTERIOR GLASS MATERIALS

- A. Glass Type A: 1 inch thick; Viracon VRE8-38 HS Insulating glass: ¼" Evergreen VRE8-38 HS w / ½" Airspace, ¼" Clear HS. Heat strengthened or fully tempered as required. Glass Type A shall be NFRC certified
- B. Glass Type B: 1 inch thick; Viracon VRE8-38 HS Insulating glass, ¼" Evergreen VRE8-38 HS w / ½" Airspace, ¼" Clear HS with a custom colored ceramic frit opacifier to the No. 4 surface. Heat strengthened or fully tempered as required.
- C. Glass Type No. C: 1/4 inch thick; Starphire w/ double-coat 0-1060 Primary White Paint applied to the #2 surface. Heat strengthened or fully tempered as required.

- D. Glass Type No. D: 1 inch thick; Viracon 1/4" HS Insulating glass: 1/4" Evergreen uncoated HS w/ 1/2" Airspace, 1/4" Clear HS. Heat strengthened or fully tempered as required.
- E. Glass Type No. E: 1/4 inch thick; Viracon Evergreen uncoated HS glass. Fully tempered as required. (At main entry doors and site entry doors).
- F. Glass Type F: 1/4 inch thick; Viracon 1/4" VRE8-38 HS. Fully tempered as required. (At the entry doors to the Stairways).
- G. Glass Type No. G: 13/16 inch total thickness Viracon clear laminated glass with fritted pattern to be selected by Architect.
- H. Glass Type No. H: 1/2 inch thick fully tempered; Viracon Evergreen uncoated HS glass. (At the entry wall).

END OF SECTION

SECTION 09 2116

GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal stud wall framing.
- B. Shaft wall system.
- C. Acoustic insulation.
- D. Gypsum wallboard.
- E. Exterior gypsum sheathing.
- F. Joint treatment and accessories.

1.02 RELATED SECTIONS

- A. Section 07 2113 – Blanket Insulation: Acoustic insulation.
- B. Section 07 9200 - Joint Sealers: Acoustic sealant.
- C. Section 05 4000 – Cold-Formed metal Framing

1.03 SYSTEM DESCRIPTION

- A. Shaft Wall: Configure and install components as required to achieve the following performance levels:
 - 1. Air Pressure Within Shaft: Intermittent loads of 5 lbf/sq ft with maximum mid-span deflection of L/240.
 - 2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E 413, based on tests conducted in accordance with ASTM E 90.
- B. Rated and non-rated partitions: metal stud framing and gypsum wall board as scheduled on drawings.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.
- C. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.
- D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- E. LEED Submittals:
 - 1. For gypsum wallboard, submit documentation of recycled content and location of manufacture.

1.05 QUALITY ASSURANCE

- A. Perform in accordance with ASTM C 840. Comply with requirements of GA-600 for fire-rated assemblies.

1.06 REGULATORY REQUIREMENTS

- A. Conform to applicable code for fire rated assemblies as indicated on drawings.

PART 2 PRODUCTS

2.01 METAL FRAMING MATERIALS

- A. Manufacturers - Metal Framing, Connectors, and Accessories:
 - 1. Dietrich Metal Framing; Product: www.dietrichindustries.com.
 - 2. Western Metal: www.wmlinc.com.
 - 3. California Expanded Metal Products Co.(CEMCO: www.cemcosteel.com).
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Non-Load-bearing Framing System Components: ASTM C 645; galvanized sheet steel, of size and properties necessary to comply with ASTM C 754 for the spacing indicated, with maximum deflection of wall framing of L/360 at 5 psf.
 - 1. Studs: "C" shaped with flat or formed webs.
 - 2. Runners: U shaped, sized to match studs.
- C. Shaft Wall Studs and Accessories: ASTM C 645; galvanized sheet steel, of size and properties necessary to comply with ASTM C 754 and specified performance requirements.
- D. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and fastened as indicated on drawings.

2.02 GYPSUM BOARD MATERIALS

- A. Manufacturers:
 - 1. G-P Gypsum Corporation: www.gp.com/gypsum.
 - 2. National Gypsum Company: www.nationalgypsum.com.
 - 3. USG: www.usg.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Gypsum Wallboard: ASTM C 1396/C 1396M. Sizes to minimize joints in place; ends square cut.
 - 1. Fire Resistant Type: Complying with Type X requirements; UL or WH rated.
 - a. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X.
 - b. Thickness: 5/8 inch.
 - c. Edges: Tapered.
- C. Gypsum Shaftwall or Coreboard: ASTM C 1396/C 1396M; Type X core; sizes to minimize joints in place; 1 inch thick; square, tongue and groove, or double beveled edges, ends square cut.

2.03 EXTERIOR GYPSUM SHEATHING

- A. Sheathing to receive roofing:
 - 1. Acceptable product: G-P Gypsum Corporation 5/8" DensDeck Prime Roof Board (Type X).
 - a. Composition: Glass mat faced gypsum with nonasphaltic, highly filled proprietary heat-cured coating on one side.
 - b. Size: Nominal 4' x 8', 4' x 4'. Edges: Square.
 - c. Thickness: 5/8" DensDeck Prime Roof Board (Type X).
 - d. Fire Resistance:
 - 1) Flame spread 0, smoke developed 0, when tested in accordance with ASTM E 84. Noncombustible when tested in accordance with ASTM E 136.
 - 2) 5/8" DensDeck Prime Roof Board:(Type X) UL-classified.
 - (a) Code alternate to 15 minute thermal barrier as tested to UL 1256.
- B. Sheathing not to receive roofing:
 - 1. Acceptable Products: 5/8" DensGlass Gold Fireguard® Exterior Sheathing
 - a. Composition: Gypsum sheathing manufactured in accordance with ASTM C 1177 with glass mats both sides and long edges, water-resistant treated core.

- b. Size: 5/8" (15.9mm) thick x 4' x 8', 9' or 10'
- c. Fire resistance:
 - 1) Noncombustible when tested in accordance with ASTM E 136.
 - 2) Flame spread 10, smoke developed 0, when tested in accordance with ASTM E 84.
 - 3) Type X as defined in ASTM C 1396.

2.04 ACCESSORIES

- A. Acoustic Insulation: ASTM C 665; preformed glass fiber, friction fit type, unfaced. Thickness: 6 inch.
- B. Acoustic Sealant: As specified in Section 07 9200.
- C. Finishing Accessories: ASTM C 1047, galvanized steel or rolled zinc, unless otherwise indicated.
 - 1. Types: As detailed or required for finished appearance.
- D. Joint Materials: ASTM C 475 and as recommended by gypsum board manufacturer for project conditions.
 - 1. Ready-mixed vinyl-based joint compound.
- E. Screws: ASTM C 1002; self-piercing tapping type; cadmium-plated for exterior locations.
- F. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.02 SHAFT WALL INSTALLATION

- A. Shaft Wall Framing: Comply with manufacturer's installation instructions.
 - 1. Fasten runners to structure with short leg to finished side, using appropriate power-driven fasteners at not more than 24 inches on center.
 - 2. Install studs at spacing required to meet performance requirements.
- B. Shaft Wall Liner: Cut panels to accurate dimension and install sequentially between special friction studs.
 - 1. Seal perimeter of shaft wall and penetrations with acoustical sealant.

3.03 FRAMING INSTALLATION

- A. Metal Framing: Comply with ASTM C 754 and manufacturer's instructions.
- B. Studs: Space studs at 24 inches on center unless noted otherwise on drawings.
 - 1. Extend partition framing to structure in all locations.
 - 2. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs with continuous bridging.
- C. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
- D. Blocking: Install blocking for support of hardware and elevator components. Secure 16 ga flat plate steel straps to studs.

3.04 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install as follows:
 - 1. Place one bead continuously on substrate before installation of perimeter framing members.
 - 2. Place continuous bead at perimeter of each layer of gypsum board.
 - 3. In non-fire-rated construction, seal around all penetrations by conduit, pipe, ducts, and rough-in boxes.

3.05 GYPSUM BOARD EXTERIOR GYPSUM SHEATHING INSTALLATION

- A. Comply with ASTM C 840 and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
- C. Double-Layer Non-Rated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.
- D. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of listing authority.
- E. Exterior Gypsum Sheathing: Install in strict accordance with manufacturer's instruction.
- F. Installation on Metal Framing: Use screws for attachment of all gypsum board.

3.06 CEILING FRAMING INSTALLATION

- A. Install in accordance with ASTM C754; GA-201 and GA-216.
- B. Coordinate location of hangers with other Work.
- C. Install ceiling framing independent of walls, columns, and above ceiling work.
- D. Where studs form framing system for gypsum board ceilings, adjust wall framing members to align with required spacing of ceiling framing members. Reinforce ceiling framing with black iron as required.
- E. Attach ceiling runner securely to acoustical ceiling track where ceiling framing extends to ceiling only in accordance with manufacturer's instructions.
- F. Reinforce openings in ceiling suspension system which interrupt main carrying channels or furring channels, with lateral channel bracing. Extend bracing minimum 24 inches past each end of openings.
- G. Laterally brace entire suspension system.
- H. Coordinate installation of acoustical materials per details and Acoustical Consultant's recommendations.

3.07 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials and as indicated.

3.08 JOINT TREATMENT

- A. Finish gypsum board in scheduled areas in accordance with levels defined in ASTM C 840 and as scheduled below.
- B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 - 1. Feather coats of joint compound so that camber is maximum 1/32 inch.
 - 2. Taping, filling and sanding is not required at base layer of double layer applications where not required to achieve any level of rated construction scheduled.

3.09 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

3.10 FINISH LEVEL SCHEDULE

- A. Level 2: Utility areas.
- B. Level 4: All other walls.

END OF SECTION 09 2116

SECTION 09 9000

PAINTS AND COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints and stains.
- C. See Schedule - Surfaces to be Finished, at end of Section.

1.02 DEFINITIONS

- A. Conform to ASTM D 16 for interpretation of terms used in this section.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on all finishing products, including VOC content.
- C. Samples: Submit two painted samples, illustrating selected colors and textures for each color and system selected. Submit on tempered hardboard, 9 x 12 inch (200 x 300 mm) in size.
- D. Certification: By manufacturer that all paints and coatings comply with VOC limits specified.
- E. LEED Submittals:
 - 1. Credit EQ 4.2: Submit product data and material safety data sheets (MSDS) that indicates material compliance with Green Seal GS-11 and the VOC levels as required by Section 01355 LEED Requirements.
- F. LEED Report: VOC content of all interior opaque coatings actually used.
- G. Manufacturer's Instructions: Indicate special surface preparation procedures.
- H. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years experience.

1.05 REGULATORY REQUIREMENTS

- A. Conform to applicable code for VOC requirements for products and finishes.

1.06 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Do not apply exterior coatings during rain, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- C. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- D. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

1.08 EXTRA MATERIALS

- A. See Section 01 6000 - Product Requirements, for additional provisions.
- B. Supply 1 gallon of each color; store where directed.
- C. Label each container with color in addition to the manufacturer's label.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Paints:
 - 1. Base Manufacturer: ICI Paints North America: www.icipaintsinna.com.
 - 2. Kelly Moore: www.kellymoore.com.
 - 3. Benjamin Moore & Co: www.benjaminmoore.com.
- B. Substitutions: See Section 01600 - Product Requirements.

2.02 PAINTS AND COATINGS - GENERAL

- A. Paints and Coatings: Ready mixed, except field-catalyzed coatings. Prepare pigments:
 - 1. To a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating.
 - 2. For good flow and brushing properties.
 - 3. Capable of drying or curing free of streaks or sags.
- B. Volatile Organic Compound (VOC) Content:
 - 1. Provide coatings that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - b. Architectural coatings VOC limits of State in which the project is located.
 - c. USGBC LEED-NC Rating System, Version 2.2, EQ Credit 4.2; for interior wall and ceiling finish (all coats), anti-corrosive paints on interior ferrous metal, clear wood stains and finishes, sanding sealers, other sealers, shellac, and floor coatings.
 - 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- C. Chemical Content: The following compounds are prohibited:
 - 1. Aromatic Compounds: In excess of 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).

2. Acrolein, acrylonitrile, antimony, benzene, butyl benzyl phthalate, cadmium, di (2-ethylhexyl) phthalate, di-n-butyl phthalate, di-n-octyl phthalate, 1,2-dichlorobenzene, diethyl phthalate, dimethyl phthalate, ethylbenzene, formaldehyde, hexavalent chromium, isophorone, lead, mercury, methyl ethyl ketone, methyl isobutyl ketone, methylene chloride, naphthalene, toluene (methylbenzene), 1,1,1-trichloroethane, vinyl chloride.

2.03 ACCESSORY MATERIALS

- A. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified; commercial quality.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive Work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 1. Plaster and Gypsum Wallboard: 12 percent.
 2. Interior Wood: 15 percent, measured in accordance with ASTM D 4442.
 3. Concrete Floors: 8 percent.
- E. Measure pH level of concrete slab at least 30 days after placement to confirm pH level < 10. Should pH level be > 10, notify Architect and paint manufacturer.

3.02 PREPARATION

- A. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- B. Surfaces: Correct defects and clean surfaces which affect work of this section. Remove or repair existing coatings that exhibit surface defects.
- C. Marks: Seal with shellac those which may bleed through surface finishes.
- D. Impervious Surfaces: Remove mildew by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- E. Concrete and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- F. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.
- G. Plaster Surfaces to be Painted: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- H. Aluminum Surfaces to be Painted: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.

- I. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- J. Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.
- K. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
- L. Interior Wood Items to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.
- M. Exterior Wood to Receive Opaque Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior calking compound after prime coat has been applied. Back prime concealed surfaces before installation.
- N. Exterior Wood to Receive Transparent Finish: Remove dust, grit, and foreign matter; seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes with tinted exterior calking compound after sealer has been applied. Prime concealed surfaces.
- O. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.
- P. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

- A. Apply products in accordance with manufacturer's instructions.
- B. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.
- E. Sand wood surfaces lightly between coats to achieve required finish.
- F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

3.04 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Refer to Section 15500 for schedule of color coding of equipment, duct work, piping, and/or conduit.
- B. Paint shop-primed equipment, where indicated.
- C. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- D. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.05 CLEANING

- A. Collect waste material which may constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 SCHEDULE - SURFACES TO BE FINISHED

- A. Do Not Paint or Finish the Following Items:
 - 1. Items fully factory-finished unless specifically noted.
 - 2. Fire rating labels, equipment serial number and capacity labels.
 - 3. Stainless steel items.
- B. Paint the surfaces described below under Schedule - Paint Systems.
- C. Mechanical and Electrical: Use paint systems defined for the substrates to be finished.
 - 1. Paint all insulated and exposed pipes occurring in finished areas to match background surfaces, unless otherwise indicated.
 - 2. Paint shop-primed items occurring in finished areas.
 - 3. Paint interior surfaces of air ducts and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
 - 4. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
- D. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.

3.07 SCHEDULE - PAINT SYSTEMS

- A. Gypsum Board: Finish all surfaces exposed to view.
 - 1. Interior Ceilings and Bulkheads: GI-OP-3L, flat.
 - 2. Interior Walls: GI-OP-3L, eggshell.
- B. Wood: Finish all surfaces exposed to view.
 - 1. Interior trim and frames: WI-OP-3L, semi-gloss.
 - 2. Interior paneling: WI-OP-3L, semi-gloss.
- C. Steel Doors and Frames: Finish all surfaces exposed to view; MI-OP-3A, gloss.
- D. Steel Fabrications: Finish all surfaces exposed to view.
 - 1. Exterior: ME-OP-3L, semi-gloss; finish all surfaces, including concealed surfaces, before installation.
 - 2. Interior: MI-OP-3L, semi-gloss.
- E. Aluminum: Finish all surfaces exposed to view.
 - 1. Exterior: MaE-OP-3L.
 - 2. Interior: Mgl-OP-3L.
- F. Galvanized Steel: Finish all surfaces exposed to view.
 - 1. Exterior: MgE-OP-3L.
 - 2. Interior: Mgl-OP-3L.
- G. Shop-Primed Metal Items: Finish all surfaces exposed to view.
 - 1. Finish the following items:
 - a. Elevator pit ladders.
 - b. Exposed surfaces of steel stair rails.
 - c. Mechanical equipment.
 - d. Electrical equipment.
 - 2. Exterior: ME-OP-2L.
 - 3. Interior: MI-OP-2L.

3.08 PAINT SYSTEMS – INTERIOR

- A. Paint WI-OP-3L - Wood, Opaque, Latex, 3 Coat:
 - 1. One coat of water-based primer sealer; Prep and Prime Odor-less Interior Water-Based Primer Sealer - LM 9116.

2. Semi-gloss: Two coats of latex enamel; LM 9200 - Lifemaster 2000 Interior Semi-gloss.
 3. Eggshell: Two coats of finish paint; LM 9300 - Lifemaster 2000 Interior Eggshell.
 4. Flat: Two coats of latex; LM 9100 - Lifemaster 2000 Interior Flat.
- B. Paint WI-TR-V - Wood, Transparent, Varnish, No Stain:
1. One coat sealer.
 2. Satin: One coat of varnish; Woodpride Interior Waterborne Aquacrylic Satin Varnish, 1802-0000.
- C. Paint MI-OP-3L - Ferrous Metals, Unprimed, Latex, 3 Coat:
1. One coat of Waterborne acrylic primer; 4020 Direct to Metal Primer & Flat Finish
 2. Gloss: Two coats of enamel; Devflex 4208QD Waterborne Gloss Enamel.
 3. Semi-gloss: Two coats of enamel; Devflex 4206QD Waterborne Semi-Gloss Interior/Exterior Enamel.
- D. Paint MI-OP-2L - Ferrous Metals, Primed, Latex, 2 Coat:
1. Touch-up with latex primer.
 2. Gloss: Two coats of latex enamel; Devflex 4208QD Waterborne Gloss Enamel.
 3. Semi-gloss: Two coats of enamel; Devflex 4206QD Waterborne Semi-Gloss Interior/Exterior Enamel.
- E. Paint MGI-OP-3L - Galvanized Metals, Latex, 3 Coat:
1. One coat etching primer.
 2. One coat galvanic primer; 4020PF Devflex DTM Flat Interior\Exterior Waterborne Primer and Finish.
 3. Gloss: Two coats of latex enamel; Devflex 4208QD Waterborne Gloss Enamel.
 4. Semi-gloss: Two coats of latex enamel; Devflex 4206QD Waterborne Semi-Gloss Interior/Exterior Enamel.
- F. Paint MAI-OP-3L - Aluminum, Unprimed, Latex, 3 Coat:
1. One coat etching primer.
 2. Gloss: Two coats of latex enamel; Devflex 4208QD Waterborne Gloss Enamel.
 3. Semi-gloss: Two coats of latex enamel; Devflex 4206QD Waterborne Semi-Gloss Interior/Exterior Enamel.
- G. Paint GI-OP-3LA - Gypsum Board/Plaster, Acrylic Co-Polymer, 3 Coat:
1. One coat of water-based primer sealer; Prep and Prime Odor-less Interior Water-Based Primer Sealer - LM 9116.
 2. Semi-gloss: Two coats of latex enamel; LM 9200 - Lifemaster 2000 Interior Semi-gloss.
 3. Eggshell: Two coats of finish paint; LM 9300 - Lifemaster 2000 Interior Eggshell.
 4. Flat: Two coats of latex; LM 9100 - Lifemaster 2000 Interior Flat.

END OF SECTION 09 9000

SECTION 09 9600

HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. High performance coatings for Stairs and railings, exterior guardrails and all exposed exterior steel fabrications.

1.02 REFERENCES

- A. SSPC-SP 6 - Commercial Blast Cleaning; Society for Protective Coatings; 2000 (Ed. 2004).

1.03 PERFORMANCE REQUIREMENTS

- A. Provide only products having lower volatile organic compound (VOC) content than required by the South Coast Air Quality Management District Rule No.1168.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating coating materials.
- C. Samples: Submit two samples 9 x 12 inch in size illustrating colors for selection.
- D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.
- B. Applicator Qualifications: Company specializing in performing the work of this section with minimum five years documented experience.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Do not install materials when temperature is below 55 degrees F or above 90 degrees F.
- B. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.
- C. Restrict traffic from area where coating is being applied or is curing.

1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for bond to substrate.

1.08 MAINTENANCE PRODUCTS

- A. Provide 1 gallon of each color of each type of coating specified, for Owner's maintenance use.
- B. Label each container with manufacturer's name, product number, color number, and room names and numbers where used.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. High-Performance Coatings:
 - 1. Tnemec Company, Inc: www.tnemec.com.
 - 2. Substitutions: Section 01 6000 - Product Requirements.

2.02 MATERIALS

- A. Coatings - General: Provide complete multi-coat systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated; number of coats specified does not include primer or filler coat.
 - 1. Maximum volatile organic compound (VOC) content: As required by applicable regulations.
 - 2. Colors: Selected from manufacturer's standard colors.
- B. Urethane Coating: Two coats, two-part, aliphatic moisture-curing polyurethane, gloss finish.
 - 1. Primer for ferrous metal: Series 90-97 Tnemec Zinc. DFT 2.5 to 3.5 mil.
 - 2. Intermediate Coat: Series V69F-Color, Hi-Build Epoxoline II. DFT 4.0 to 6.0 mils.
 - 3. Finish Coat: Endura-Shield W. B. Series 1080-Color. DFT 2.0 to 3.0 mils.
 - 4. Finish Color: As selected by Architect.
- C. Shellac: Pure, white type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that substrate surfaces are ready to receive work as instructed by the coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.

3.02 PREPARATION

- A. Clean surfaces of loose foreign matter.
- B. Remove substances that would bleed through finished coatings. If unremovable, seal surface with shellac.
- C. Remove finish hardware, fixture covers, and accessories and store.
- D. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent.
 - 1. All galvanized surfaces shall be cleaned per SSPC-SP1 Solvent Cleaning followed by abrasive blast cleaning in compliance with ASTM D 6386-99(2005) Section 5.4.1, providing a surface profile of 1.0 to 1.5 mils.
 - 2. When blasting is not possible, bare galvanized shall be Solvent Cleaned per SSPC-SP1 followed by SSPC-SP2 Hand Tool Cleaning and / or SP3 Power Tool Cleaning, followed by chemical etching with Great Lakes Laboratories' Clean 'n Etch, Henkel's Galvaprep 5 or equal per manufacturer's instructions.
- E. Ferrous Metal:
 - 1. Solvent clean.
 - 2. Remove loose rust, loose mill scale, and other foreign substances using blast cleaning according to SSPC-SP 6.
- F. Protect adjacent surfaces and materials not receiving coating from overspray; mask if necessary to provide adequate protection. Repair damage.

3.03 PRIMING

- A. Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.

3.04 COATING APPLICATION

- A. Apply coatings in accordance with manufacturer's instructions, to thicknesses specified.
- B. Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

3.05 CLEANING

- A. Collect waste material which may constitute a fire hazard, place in closed metal containers, and remove daily from site.
- B. Clean surfaces immediately of overspray, splatter, and excess material.
- C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

3.06 PROTECTION OF FINISHED WORK

- A. Protect elements adjacent to the work of this section from damage and disfigurement.

END OF SECTION

SECTION 12 9300

SITE FURNISHINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Seating.
 - 2. Bicycle racks.
 - 3. Bicycle lockers.
- B. Related Requirements:
 - 1. Division 03 Section "Cast-in-Place Concrete" for installing pipe sleeves cast and installing anchor bolts cast in concrete footings.
 - 2. Division 31 Section "Earth Moving" for excavation for installing concrete footings.

1.3 ACTION SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For site furnishings to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 SEATING

- A. Products: Refer to product indicated on Drawings.

2.2 BICYCLE RACKS

- A. Products: Refer to product indication on Drawings.
 - 1. Style: As indicated on Drawings.
 - 2. Installation Method: As indicated on Drawings.
 - 3. Finish and color: As indicated on Drawings.

2.3 BICYCLE LOCKERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings
- B. Bicycle Locker Construction:

1. Lock: Key lock with internal locking bar
 - a. Provide four keys.
2. Capacity: As indicated on Drawings.
3. Installation Method: Locker anchored at finished grade to substrate indicated
4. Locker Configuration: As indicated on Drawings.
5. Finish and Color: As indicated on Drawings.

2.4 MATERIALS

- A. Steel and Iron: Free of surface blemishes and complying with the following:
 1. Plates, Shapes, and Bars: ASTM A 36/A 36M.
 2. Steel Pipe: Standard-weight steel pipe complying with ASTM A 53/A 53M, or electric-resistance-welded pipe complying with ASTM A 135/A 135M.
 3. Tubing: Cold-formed steel tubing complying with ASTM A 500/A 500M.
 4. Mechanical Tubing: Cold-rolled, electric-resistance-welded carbon or alloy steel tubing complying with ASTM A 513, or steel tubing fabricated from steel complying with ASTM A 1011/A 1011M and complying with dimensional tolerances in ASTM A 500/A 500M; zinc coated internally and externally.
 5. Sheet: Commercial steel sheet complying with ASTM A 1011/A 1011M.
- B. Anchors, Fasteners, Fittings, and Hardware: Manufacturer's standard, corrosion-resistant-coated or noncorrodible materials; commercial quality, tamperproof, vandal and theft resistant, concealed, recessed, and capped or plugged.
- C. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M; recommended in writing by manufacturer, for exterior applications.
- D. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound; resistant to erosion from water exposure without needing protection by a sealer or waterproof coating; recommended in writing by manufacturer, for exterior applications.

2.5 GENERAL FINISH REQUIREMENTS

- A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.

- B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.
- C. Install site furnishings level, plumb, true, and securely anchored at locations indicated on Drawings.
- D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.
- E. Posts Set into Voids in Concrete: Form or core-drill holes for installing posts in concrete to depth recommended in writing by manufacturer of site furnishings and 3/4 inch larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.
- F. Pipe Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

END OF SECTION

SECTION 142100
ELECTRIC TRACTION ELEVATORS

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SECTION 142100
ELECTRIC TRACTION ELEVATORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Traction elevators as follows:
 - 1. Two (2) Gearless Passenger Elevators, Cars 1 and 2.
- B. Products Installed But Not Furnished Under This Section:
 - 1. CCTV camera provisions
 - 2. Car interior finishes
- C. Related Requirements:
 - 1. Division 01 Section "Temporary Facilities and Controls" for temporary use of elevators for construction purposes.
 - 2. Division 03 Section "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.

1.2 DEFINITIONS

- A. Terms used are defined in the latest edition of the Safety Code for Elevators and Escalators, ASME A17.1.

1.3 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.
- B. Accessibility Requirements: Comply with 2010 ADA standards for Accessible Design and with ICC A117.1.
- C. Seismic Performance: Elevator system shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and the state of California and shall comply with elevator safety requirements for seismic risk Zone 2 or greater in ASME A17.1/CSA B44.
 - 1. The term "withstand" means the system will remain in place without separation of any parts when subjected to the seismic forces specified.
 - 2. Provide earthquake equipment required by ASME A17.1/CSA B44.
 - 3. Provide seismic switch required by SEI/ASCE 7.
 - 4. Design earthquake spectral response acceleration short period (Sds) for Project: Per Construction Documents.
 - 5. Occupancy Category: Per Construction Documents
 - 6. Project Seismic Design Category: Per Construction Documents.
 - 7. Elevator Component Importance Factor (Ip): Per Construction Documents.

1.4 SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for car enclosures, hoistway entrances, and operation, control, and signal systems. Include product data for signal fixtures, lights, graphics, Braille plates, and details of mounting provisions.

- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and large-scale details indicating openings at each landing, equipment space layout, coordination with building structure, relationships with other construction, and locations of equipment.
 - 2. Include large-scale layout of car operating panel.
 - 3. Indicate maximum dynamic and static loads imposed on building structure at points of support and maximum and average power demands.
 - 4. Power Confirmation Information: Include motor horsepower, code letter, starting current, full-load running current, and demand factor. Provide maximum and average power consumption.
- C. Samples for Initial Selection: For finishes involving surface treatment, paint or color selection.
- D. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes:
 - 1. Samples of sheet materials: 3" (75 mm) square.
 - 2. Running trim members: 4" (100 mm) lengths.
- E. Operation and Maintenance Data:
 - 1. For elevators to include in emergency, operation, and maintenance manuals.
 - 2. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.
- F. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
- G. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard five (5)-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.5 QUALITY ASSURANCE

- A. Compliance with Regulatory Agencies: Comply with most stringent applicable provisions of following codes, laws, and/or authorities, including revisions and changes in effect:
 - 1. Safety Code for Elevators and Escalators, ASME A17.1
 - 2. Guide for Inspection of Elevators, Escalators, and Moving Walks, ASME A17.2
 - 3. Elevator and Escalator Electrical Equipment, ASME A17.5
 - 4. National Electrical Code, NFPA 70
 - 5. Americans with Disabilities Act, ADA A117.1
 - 6. Local Fire Authority
 - 7. Requirements of most stringent provision of local authority having jurisdiction.
 - 8. Life Safety Code, NFPA101, and California Code of Regulations Title 19

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver material in Contractor's original unopened protective packaging.
- B. Store material in original protective packaging. Prevent soiling, physical damage, or moisture damage.
- C. Protect equipment and exposed finishes from damage and stains during transportation and construction.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
- B. Failures include, but are not limited to: operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
- C. Warranty Period: One (1) year from date of Substantial Completion.

1.8 MAINTENANCE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall provide twelve (12) months full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 1. Perform maintenance during normal working hours.
 - 2. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of ninety minutes or less.
 - 3. Construction contract will include initial maintenance service beginning at Substantial Completion. Owner/General Contractor cannot deduct.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
 - 1. KONE Inc.
 - 2. Otis Elevator Co.
 - 3. ThyssenKrupp Elevator.

2.2 ELEVATORS

- A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturer's standard components shall be used, as included in standard elevator systems and as required for complete system.
- B. Gearless Machine Room Less (MRL) Passenger Elevators Description:
 - 1. Elevator Identification: Cars 1 and 2
 - 2. Capacity: 3500 lbs.
 - 3. Class of Loading: Class A
 - 4. Contract Speed: 200 fpm
 - 5. Roping: 1:2 Underslung
 - 6. Machine: Gearless
 - 7. Machine Location: Overhead machine room less
 - 8. Duplex selective collective
 - 9. Stops: 3 Front, 0 Rear
 - 10. Openings: 3 Front, 0 Rear
 - 11. Minimum Clear Inside Car: 6'-8" Wide X 5'-5" Deep
 - 12. Entrance Size: 3'-6" Wide X 7'-0" High
 - 13. Entrance Type: Single-speed, side-opening

14. Door Operation: High speed, heavy-duty door operator. Minimum opening speed: 2½ fps
15. Door Protection: Infrared full screen device with differential timing, nudging, and interrupted beam time
16. Safety: Flexible guide clamp-type B, car
17. Guide Rails: Planed steel tees
18. Buffers: Spring
19. Car Enclosure:
 - a. As specified, stationary returns car station.
 - b. Steel shell as specified plus car interior finishes provided under this section.
 - c. Pad buttons or hooks and vinyl-covered pads, Car 2.
20. Signal Fixtures: LED illumination. Contractor's standard design, vandal-resistant assembly.
 - a. Hall and Car Pushbutton Stations:
 - 1) Single hall pushbutton riser
 - 2) Single car operating panel.
 - 3) Vandal resistant car and hall pushbuttons.
 - b. Car Position Indicators:
 - 1) Digital in car station with car direction arrows.
 - c. Hall Car Position Indicator: Digital type with car direction arrows at the lobby level only, contractors standard flush mount design.
 - d. Hall Registration Stations:
 - 1) One station at the main landing.
 - 2) One station at typical floors.
 - 3) Manufacturers standard device.
21. Communication System:
 - a. Self-dialing, vandal-resistant, push-to-call, two-way communication system with recall, tracking, and voiceless communication.
22. Additional Features:
 - a. Hoistway access switches, top and bottom floors.
 - b. Anti-nuisance feature.
 - c. Security provisions, All Cars.
 - d. CCTV provisions, All Car.
 - e. Sill support angles.
 - f. Firefighters' telephone jack.
 - g. Seismic devices and operation.
 - h. System diagnostic means and instructions.

2.3 MATERIALS

- A. Steel:
 1. Sheet Steel (Furniture Steel for Exposed Work): Stretcher-leveled, cold-rolled, commercial quality carbon steel, complying with ASTM A366, matte finish.
 2. Sheet Steel (for Unexposed Work): Hot-rolled, commercial quality carbon steel, pickled and oiled, complying with ASTM A568/A568M-03.
 3. Structural Steel Shapes and Plates: ASTM A36.
- B. Stainless Steel: Type 302 or 304 complying with ASTM A240, with standard tempers and hardness required for fabrication, strength, and durability. Apply mechanical finish on fabricated work in the locations shown or specified, Federal Standard and NAAMM nomenclature, with texture and reflectivity required to match Architect's sample. Protect with adhesive paper covering.
 1. No. 4 Satin: Directional polish finish. Graining directions as shown or, if not shown, in longest dimension.
- C. Aluminum: Extrusions per ASTM B221; sheet and plate per ASTM B209.

- D. Plastic Laminate: ASTM E84 Class A and NEMA LD3.1, Fire-Rated Grade (GP-50), Type 7, 0.050" ±.005" thick, color and texture as follows:
 - 1. Exposed Surfaces: Color and texture selected by Architect.
 - 2. Concealed Surfaces: Contractor's standard color and finish.
- E. Paint: Clean exposed metal parts and assemblies of oil, grease, scale, and other foreign matter and factory paint one shop coat of standard rust-resistant primer. Galvanized metal need not be painted.
- F. Prime Finish: Clean all metal surfaces receiving a baked enamel paint finish of oil, grease, and scale. Apply one coat of rust-resistant primer followed by a filler coat over uneven surfaces. Sand smooth and apply final coat of primer.
- G. Baked Enamel Finish: Prime finish per above. Unless specified "prime finish" only, apply and bake three additional coats of enamel in the selected solid color.

2.4 CAR AND GROUP PERFORMANCE

- A. Car Speed: ± 3% of contract speed under any loading condition.
- B. Car Capacity: Safely lower, stop and hold 125% of rated load.
- C. Car Stopping Zone: ±1/4" under any loading condition.
- D. Door Times: Seconds from start to fully open or fully closed:
 - 1. Cars 1 and 2: Door open: 2.3 seconds. Door close: 4.0 seconds.
- E. Car Floor-to-Floor Performance Time: Seconds from start of doors closing until doors are 3/4 open (1/2 open for side opening doors) and car level and stopped at next successive floor under any loading condition or travel direction (12' typical floor height):
 - 1. Cars 1 and 2: 12 seconds.
- F. Car Ride Quality:
 - 1. Acceleration and Deceleration: Smooth constant and not less than 2.5 feet/second² with an initial ramp between 0.5 and 0.75 second.
 - 2. Sustained Jerk: Not more than 6 feet/second³.
 - 3. Horizontal and vertical acceleration within car during all riding and door operating conditions. Not more than 20 mg peak to peak (adjacent peaks) in the 1-10 Hz range.
 - 4. Measurement Standards: Measure and evaluate ride quality consistent with ISO 18738, using low pass cutoff frequency of 10 Hz.
- G. Noise and Vibration Control:
 - 1. Airborne Noise: Measured noise level of elevator equipment and its operation shall not exceed 60 dBA inside car under any condition including door operation and car ventilation exhaust blower on its highest speed. Limit noise level in the equipment space relating to elevator equipment and its operation to no more than 80 dBA. All dBA readings to be taken 3'-0" off the floor and 3'-0" from the equipment using the "A" weighted scale.
 - 2. Vibration Control: All elevator equipment shall be mechanically isolated from the building structure and other components to minimize the possibility of objectionable noise and vibrations being transmitted to occupied areas of the building.

2.5 OPERATION

A. Group Automatic, Cars 1 and 2:

1. Approved microprocessor-based, group dispatch, car, and motion control systems as follows:
 - a. KONE: KCM831
 - b. Otis: GCS
 - c. ThyssenKrupp: TAC 50-04
 - d. Mitsubishi: AI-2100N
2. Include as a minimum, the following features:
 - a. Operate cars as a group, capable of balancing service and providing continuity of group operation with one or more cars removed from the system.
 - b. Register service calls from pushbuttons located at each floor and in each car. Slow cars and stop automatically at floors corresponding to registered calls. Make stops at successive floors for each direction of travel irrespective of order in which calls are registered except when bypassing hall calls to balance and improve overall service; stop only one car in response to a particular hall call. Assign hall calls to specific cars and continually review and modify those assignments to improve service. Simultaneous to initiation of slowdown of a car for a hall call, cancel that call. Render hall pushbutton ineffective until car doors begin to close after passenger transfer. Cancel car calls in the same manner.
 - c. Operate system to meet changing traffic conditions on a service demand basis. Include provisions for handling traffic that may be heavier in either direction, intermittent, or very light. As traffic demands change, automatically and continually modify group and individual car assignment to provide the most-effective means to handle current traffic conditions. Provide means to sense long-wait hall calls and preferentially serve them. Give priority to coincidental car and hall calls in hall call assignment. Accomplish car direction reversal without closing and reopening doors.
 - d. Use easily reprogrammable system software. Design basic algorithm to optimize service based on equalizing system response to registered hall calls and equalizing passenger trip time to shortest possible time.
 - e. Serve floors below main floor in a manner that logically minimizes delay in passing or stopping at main floor in both directions of travel. Provide means to force a stop at the main floor when passing to or from lower levels.
 - f. Required Features:
 - 1) Dispatch Protection: Backup dispatching shall function in the same manner as the primary dispatching.
 - 2) Delayed Car Removal: Automatically remove delayed car from group operation.
 - 3) Position Sensing: Update car position when passing or stopping at each landing.
 - 4) Hall Pushbutton Failure: Provide multiple power sources and separate fusing for pushbutton risers.
 - 5) Communication link: Provide serial or duplicate communication link for all group and individual car computers.

B. Other Items:

1. Load Weighing: Provide means for weighing car passenger load. Control system to provide dispatching at main floor in advance of normal intervals when car fills to capacity. Provide hall call by-pass when the car is filled to preset percentage of rated capacity and traveling in down direction. Field adjustment range: 10% to 100%.
2. Anti-Nuisance Feature: If car loading relative to weight in car is not commensurate with number of registered car calls, or activation of door protection device is not commensurate with number of registered car calls, cancel car calls.

3. Independent Service: Provide controls for operation of each car from its pushbuttons only. Close doors by constant pressure on desired destination floor button or door close button. Open doors automatically upon arrival at selected floor.
- C. Firefighters' Service: Provide equipment and operation in accordance with code requirements.
 - D. Automatic Car Stopping Zone: Stop car no more than 1/4" above or below the landing sill. Maintain stopping accuracy regardless of load in car, direction of travel, distance between landings, hoist rope slippage or stretch.
 - E. Motion Control: Microprocessor-based AC variable-voltage, variable frequency with digitally encoded closed-loop velocity feedback suitable for operation specified and capable of providing smooth, comfortable car acceleration, retardation, and dynamic braking. Limit the difference in car speed between full load and no load to not more than $\pm 3\%$ of the contract speed.
 - F. Door Operation: Automatically open doors when car arrives at main floor. At expiration of normal dwell time, close doors.
 - G. Standby Lighting and Alarm: Car mounted battery unit with solid-state charger to operate alarm bell and car emergency lighting. Battery to be rechargeable with minimum five-year life expectancy. Provide constant pressure test button in service compartment of car operating panel.
 - H. Standby Power Operation: Upon loss of normal power, adequate standby power will be supplied via building electrical feeders to start and run one car in each group.
 1. Automatically return car(s), nonstop to designated floor, open doors for approximately 3.0 seconds, close doors, and park car. During return operation, car and hall call pushbuttons shall be inoperative. As car(s) park, system shall immediately select the next car until all cars have returned to the designated floor. If a car fails to start or return within 30 seconds, system shall automatically select the next car in the group to return.
 2. When all operable car(s) have returned to the designated floor, one car in each group shall be designated for automatic operation. When demand exists for 30 seconds and designated car fails to start, next available car in the group shall be automatically selected for operation.
 3. Provide control logic, conduit, and wiring to provide required sequences, between all cars and groups.
 4. Successive Starting: When normal power is restored or there has been a power interruption, individual cars in each bank shall restart at five-second intervals.
 - I. Card/Proximity Reader Security System: Provide provisions inside Cars 1 and 2 for reader unit. Mount reader unit as directed by Architect and make cross connects to card reader terminal interface and relays in equipment space. Provide filler plate glass panel to match card slot size or proximity reader size and car return panel finish, including direction of graining, where card slot or proximity reader cutout is not initially utilized. Elevator control systems shall provide output signal of selected floor to facilitate system tracking of floor access.

2.6 EQUIPMENT SPACE EQUIPMENT

- A. Arrange equipment in spaces shown on drawings.
- B. Gearless Traction Hoist Machine:
 1. AC induction or P.M.S.M. ACV³F gearless traction type motor with brakes, drive sheave, and deflector sheave mounted in proper alignment on a common, isolated bedplate.
 2. Provide bedplate blocking to elevate secondary or deflector sheave above equipment space floor.

3. Provide hoist machine mounted direct drive, digital, closed-loop velocity encoder.
- C. Solid State Power Conversion and Regulation Unit: Provide solid-state, alternating current, variable voltage, variable frequency (ACV³F), IGBT converter/inverter Power Factor1 drive.
1. Design unit to limit current, suppress noise, and prevent transient voltage feedback into building power supply. Provide internal heat sink cooling fans for the power drive portion of the converter panels. Conform to IEEE standards 519-1992 for line harmonics and switching noise.
 2. Mechanically isolate unit to minimize noise and vibration transmission.
 3. Provide isolation transformers, filter networks, and choke inductors.
 4. Suppress solid-state converter noises, radio frequency interference, and eliminate regenerative transients induced into the mainline feeders or the building standby power generator.
 5. Supplemental direct-current power for the operation of hoist machine brake, door operator, dispatch processor, signal fixtures, etc., from separate static power supply.
 6. ACV³F Drives shall be regenerative and utilize IGBT converter/inverter and dynamic braking during overhauling condition.
- D. Encoder: Direct drive, solid-state, digital type. Update car position at each floor and automatically restore after power loss.
- E. Controller: UL/CSA labeled.
1. Compartment: Securely mount all assemblies, power supplies, chassis switches, relays, etc., on a substantial, self-supporting steel frame. Completely enclose equipment with covers. Provide means to prevent overheating.
 2. Relay Design: Magnet operated with contacts of design and material to insure maximum conductivity, long life, and reliable operation without overheating or excessive wear. Provide wiping action and means to prevent sticking due to fusion. Contacts carrying high inductive currents shall be provided with arc deflectors or suppressors.
 3. Microprocessor Hardware:
 - a. Provide built-in noise suppression devices that provide a high level of noise immunity on all solid-state hardware and devices.
 - b. Provide power supplies with noise suppression devices.
 - c. Isolate inputs from external devices (such as pushbuttons) with opto-isolation modules.
 - d. Design control circuits with one leg of power supply grounded.
 - e. Safety circuits shall not be affected by accidental grounding of any part of the system.
 - f. System shall automatically restart when power is restored.
 - g. System memory shall be retained in the event of power failure or disturbance.
 - h. Equipment shall be provided with Electro Magnetic Interference (EMI) shielding within FCC guidelines.
 4. Wiring: CSA labeled copper for factory wiring. Neatly route all wiring interconnections and securely attach wiring connections to studs or terminals.
 5. Permanently mark components (relays, fuses, PC boards, etc.) with symbols shown on wiring diagrams.
- F. Auxiliary Disconnect: Provide controller or machine mounted auxiliary, lockable "open" disconnect.
- G. Sleeves and Guards: Provide 4" steel angle guards around cable or duct slots through floor slabs or grating. Provide rope and smoke guards for sheaves, cables, and cable slots in equipment space.
- H. Governor: Centrifugal-type, car driven pit mounted with pull-through jaws and bi-directional shutdown switches. Provide required bracketing and supports for attachment to building

structure. Provide ladders and platforms with handrails and toeboards for governor access. Provide remote reset capability.

- I. Emergency Brake: Provide means to prevent ascending car over-speed and unintended car movement.

2.7 HOISTWAY EQUIPMENT

- A. Guide Rails: Planed steel T-sections for car and counterweight of suitable size and weight for the application, including seismic reactions, including brackets for attachment to building structure. Provide rail backing and intermediate counterweight tie brackets. No additional structural points of attachment other than those shown on the Contract Documents will be provided.
- B. Buffers: Spring type with blocking and support channels.
- C. Sheaves: Machined grooves and sealed bearings. Provide mounting to machine beams, machine bedplate, car and counterweight structural members, or building structure.
- D. Counterweight: Steel frame with metal filler weights. Provide Type "B" safety device.
- E. Counterweight Guide Shoes: Spring dampened roller guide shoes.
- F. Counterweight Guard: Metal guard in pit.
- G. Governor Rope and Encoder Tape Tensioning Sheaves: Mount sheaves and support frame on pit floor or guide rail. Provide frame with guides or pivot point to enable free vertical movement and proper tension of rope and tape.
- H. Suspension Means:
 - 1. 8 x 19 or 8 x 25 Seale construction, traction steel type. Fasten with staggered length, adjustable, spring isolated wedge type shackles.
 - 2. Polyurethane coated, flat belt with imbedded steel cables.
- I. Terminal Stopping: Provide normal and final devices.
- J. Electrical Wiring and Wiring Connections:
 - 1. Conductors and Connections: Copper throughout with individual wires coded and connections on identified studs or terminal blocks. Use no splices or similar connections in wiring except at terminal blocks, control compartments, or junction boxes. Provide 10% spare conductors throughout. Run spare wires from car connection points to individual elevator controllers in the equipment space.
 - 2. Conduit: Galvanized steel conduit, EMT, or duct. Flexible conduit length not to exceed 3'-0". Flexible heavy-duty service cord may be used between fixed car wiring and car door switches for door protective devices.
 - 3. Traveling Cables: Flame and moisture-resistant outer cover. Prevent traveling cable from rubbing or chafing against hoistway or equipment within hoistway.
 - a. Provide five pair of shielded wires of minimum 18 gauge for card reader.
 - b. Provide one RG-6/U coaxial CCTV cable and two pair of shielded 18 gauge wire within traveling cable from car controller to car top junction box, plus 3'-0" excess loop at both ends.
 - c. Provide two pair of 18 gauge wire for CCTV power.
 - d. Provide four pair of spare shielded communication wires in addition to those required to connect specified items.
 - e. Tag spares in equipment space. Provide cables from controller to car top.

4. Auxiliary Wiring: Provide conduit, wiring and connections for fire alarm initiating devices, emergency two-way communication system, firefighters' phone jack, paging speaker, CCTV, digital video display, security system and card reader interface terminals and relays, intercom, and announcement speaker and/or background music from space junction box to each car controller in equipment space.

K. Entrance Equipment:

1. Door Hangers: Two-point hanger roller with neoprene roller surface and suspension with eccentric upthrust roller adjustment.
2. Door Tracks: Bar or formed, cold-drawn removable steel tracks with smooth roller contact surface.
3. Door Interlocks: Operable without retiring cam. Paint interlock box flat black.
4. Door Closers: Spring, spirator, or jamb/strut mounted counterweight type. Design and adjust to insure smooth, quiet mechanical close of doors.

- L. Floor Numbers: Stencil paint 4" high floor designations in contrasting color on inside face of hoistway doors and hoistway fascia visible from within car.

2.8 HOISTWAY ENTRANCES

- A. Complete entrances bearing fire labels from a certified testing laboratory approved by authority having jurisdiction.
- B. Frames: 14 gauge hollow metal at all floors. Bolted and lapped head to jamb assembly at all floors. Clad frames with finish material indicated in finish schedule Item 2.3, B., at all floors. Provide Arabic floor designation/Braille plates, centered at 60" above finished floor, on both side jambs of all entrances. Provide plates at main egress landing with "Star" designation. For designated emergency car, provide "Star of Life" cast designation plates at height of 78"-84" above finished floor on both side jambs at all floors. Braille indications shall be below Arabic floor designation. Provide cast floor designation/Braille plates as manufactured by SCS or Entrada with permanent rear fasteners.
- C. Door Panels: 16 gauge steel, sandwich construction without binder angles. Provide a minimum of two gibs per panel, one at leading and one at trailing edge with gibs in the sill groove entire length of door travel. Construct door panels with interlocking, stiffening ribs.
- D. Sight Guards: 14 gauge, same material and finish as hoistway entrance door panels. Construct without sharp edges.
- E. Sills: Extruded aluminum.
- F. Sill Supports: Structural or formed steel designed to support door sill based upon car loading classification. Mount to eliminate need for grout under the sill.
- G. Fascia, Toe Guards and Hanger Covers: 14 gauge furniture steel with Contractor's standard finish.
- H. Struts and Headers: Provide all support of entrances and related material to building structure. Provide door open bumpers on entrances equipped with vertical struts.
- I. Elevator Identification Signage: Provide alpha-numerical car label at designated floor. Provide metal plate, finish to match designated fixture finish.
- J. Finish of Frames and Doors: Satin finish stainless steel.
1. Cars 1 and 2: All Floors

- K. Hoistway Access:
 - 1. Hoistway Access Switches: Mount in wall at top and bottom floors. Provide switch faceplate.

2.9 CAR EQUIPMENT

- A. Frame: Welded or bolted, rolled or formed steel channel construction to meet load classification specified.
- B. Safety Device: Type "B," flexible guide clamp.
- C. Platform: Isolated type, constructed of steel, or steel and wood that is fireproofed on underside. Design and construct to accommodate load classification requirements. Provide Class "A" construction for passenger elevators.
- D. Platform Apron: Minimum 14 gauge steel, reinforced and braced to car platform with Contractor's standard finish.
- E. Guide Shoes: Roller type with three or more spring dampened, sound-deadening rollers per shoe. Maximum roller rotation speed: 350 r.p.m.
- F. Finish Floor Covering: Furnished under other sections.
 - 1. Passenger Cars 1 and 2: Accommodate a minimum 2" floor thickness. Allow 400 lbs. for floor weight.
- G. Sills: One piece extrusion with extruded extension between car entrance columns to face of car front return. Extruded extension to match finish of sill.
 - 1. Cars 1 and 2: Aluminum.
- H. Door Panels: 16 gauge steel, sandwich construction without binder angles. Provide a minimum of two gibs per panel, one at leading and one at trailing edge with gibs in the sill groove entire length of door travel. Construct door panels with interlocking, stiffening ribs.
- I. Door Hangers: Two-point suspension. Hanger roller with non-metallic surface and eccentric roller adjustment.
- J. Door Track: Bar or formed, cold-drawn removable steel track with smooth roller contact surface.
- K. Door Header: Construct of minimum 12 gauge steel, shape to provide stiffening flanges.
- L. Door Electrical Contact: Prohibit car operation unless car door is closed. Provide car door interlock to prevent opening of car doors outside the unlocking zone.
- M. Door Clutch: Heavy-duty clutch, linkage arms, vane assembly and pickup rollers or cams to provide positive, smooth, quiet door operation. Design clutch so car doors can be closed, with hoistway doors open.
- N. Restricted Opening Device: Provide mechanical car-door restrictor to prevent opening of doors when outside unlocking zone.
- O. Door Operator: High speed, heavy-duty door operator capable of opening doors at no less than 2.5 f.p.s. Accomplish reversal in no more than 2½" of door movement. Provide solid-state door control with closed loop circuitry to constantly monitor and automatically adjust door operation based upon velocity, position, and motor current. Provide a minimum of four controller-based

motion profiles, per floor, per door, to maintain consistent, smooth, and quiet door operation at all floors, regardless of door weight or varying air pressure.

P. Door Reversing Device:

1. Infrared Reopening Device:
 - a. Black fully enclosed device with full screen infrared matrix or multiple beams extending vertically along leading edge of each door panel to minimum height of 7'-0" above finished floor. Device shall prevent doors from closing and reverse doors at normal opening speed if beams are obstructed while doors are closing, except during nudging operation. In event of device failure, provide for automatic shutdown of car at floor level with doors open.
2. Nudging Operation: After beams of door control device are obstructed for a predetermined time interval (minimum 20.0-25.0 seconds), warning signal shall sound and doors shall attempt to close with a maximum of 2.5 foot pounds kinetic energy. Activation of the door open button shall override nudging operation and reopen doors.
3. Interrupted Beam Time: When beams are interrupted during initial door opening, hold door open a minimum of 3.0 seconds. When beams are interrupted after the initial 3.0 second hold open time, reduce time doors remain open to an adjustable time of approximately 1.0-1.5 seconds after beams are reestablished.
4. Differential Door Time: Provide separately adjustable timers to vary time that doors remain open after stopping in response to calls.
 - a. Car Call: Hold open time adjustable between 3.0 and 5.0 seconds.
 - b. Hall Call: Hold open time adjustable between 5.0 and 8.0 seconds. Use hall call time when car responds to coincidental calls.

Q. Car Operating Panel:

1. Passenger:
 - a. One car operating panel with faceplate, consisting of a metal box containing the vandal resistant operating fixtures, mounted behind the car stationary front return panel. Faceplate shall be hinged and constructed of No. 4 satin finish, stainless steel.
 - b. Provide manually operated stop switch within Firefighters' Phase II compartment
 - c. Provide "door open" button to stop and reopen doors or hold doors in open position.
 - d. Provide "door close" button to activate door close cycle. Cycle shall not begin until normal door dwell time for a car or hall call has expired, except firefighters' operation.
 - e. Locked panel including Phase II fire access switch and hidden floor buttons, call cancel button, door open, door close, switch, stop switch, light jewel, fire communication jack within locked panel, for fire officer use and use of car on independent service only.

R. Car Top Control Station: Mount to provide safe access and utilization while standing on car top.

S. Work Light and Duplex Plug Receptacle: GFCI protected outlet at top and bottom of car. Include on/off switch and lamp guard. Provide additional GFCI protected outlet on car top for installation of car CCTV.

T. Communication System:

1. Two-way communication instrument in car with automatic dialing, tracking, and recall features, with shielded wiring to car controller in equipment space. Provide dialer with automatic rollover capability with minimum two numbers.
 - a. Actuate two-way communication via "Help" button.
 - b. Button or adjacent light jewel shall illuminate and flash when call is acknowledged.
 - c. Button shall match car operating panel pushbutton design.

- d. Provide "Help" button tactile symbol, engraved signage, and Braille adjacent to button mounted integral with car front return panel.
2. Firefighters' communication jack in car and firefighters' panel jack bezel shall match adjacent controls.
3. Provide two-way communication between car, equipment space and/or hoistway lobbies if required.

2.10 CAR ENCLOSURE

- A. Passenger Elevator: Provide complete as specified herein.
 1. Shell: Reinforced 14 gauge furniture steel formed panels with baked enamel interior finish as selected. Apply sound-deadening mastic to exterior. Provide concealed ventilation cutouts.
 2. Canopy: Reinforced 12 gauge furniture steel formed panels with lockable, contacted, hinged emergency exit. Interior finish white color reflective baked enamel.
 3. Front Return Panels and Integral Entrance Columns: Reinforced 14 gauge furniture steel clad with minimum 16 gauge satin finish stainless steel. Swing entire unit on substantial pivot points (minimum three) for service access to car operating panel. Locate pivot points to provide full swing of front return panel without interference with side wall finish or handrail. Secure in closed position with concealed three-point latch. Provide firefighters' and service compartments with recessed flush cover and cutouts for operating switches, etc.
 4. Front Return Panels: Reinforced 14 gauge furniture satin finish stainless steel clad with minimum 16 gauge with cutouts for applied car operating panel and other equipment.
 5. Transom: Reinforced 14 gauge furniture steel clad with minimum 16 gauge satin finish stainless steel full width of enclosure.
 6. Car Door Panels: Reinforced minimum 16 gauge furniture satin finish stainless steel clad with minimum 18 gauge. Same construction as hoistway door panels.
 7. Base: Baked enamel with concealed ventilation cutouts.
 8. Interior Wall Finish: Removable panels, faced and edged, with color core plastic laminate, color and finish as selected.
 9. Ventilation: Morrison Products, Inc. three-speed model SOE No. 06-01055 exhaust blower mounted to car canopy on isolated rubber grommets. Exhaust blower shall meet noise and vibration criteria.
 10. Lighting: Provide LED fixtures with wiring and hookup. Coordinate with emergency lighting requirements.
 11. Suspended Ceiling: Six-section satin finish stainless steel panels with lighting cutouts in each panel.
 12. Handrails: Minimum 1¼" diameter stainless steel tubular grab bar with backing plates and captive nuts across rear wall and side walls. rails through car walls from back and mount on 1½" deep solid round stainless steel standoff spacers no more than 18" O.C. Return handrail/guardrail ends to car walls.
 13. Pads and Buttons or Hooks, Car 2: Three-piece removable pads. Two pads covering side walls and adjacent front returns and one covering rear wall. Provide cutouts to access main car operating panel.

2.11 HALL CONTROL STATIONS

- A. Pushbuttons: Provide one riser with flush mounted faceplates. Include pushbuttons for each direction of travel that illuminate to indicate call registration. Include approved engraved message and pictorial representation prohibiting use of elevator during fire or other emergency as part of faceplate. Pushbutton design shall match car operating panel pushbuttons. Provide vandal resistant pushbutton and light assemblies. Provide LED illumination.
- B. Phase I Fire Service fixture, including keyswitch, engraved operating instructions and illuminating jewel. Provide illuminating jewels indicating standby power status.

2.12 SIGNALS

- A. Car Direction Lantern, All Cars:
 1. Provide at each entrance to indicate travel direction of arriving car. Provide flush-mounted car lantern in all car entrance columns.
 2. Illuminate up or down LED lights and sound tone once for up and twice for down direction.
 3. Sound level shall be adjustable from 20-80 dBA measured at 5'-0" in front of hall control station and 3'-0" off floor.
 4. Car direction lenses shall be arrow shaped with faceplates.
 5. Lenses shall be minimum 2½" in their smallest dimension.
- B. Hall Position Indicator, All Cars: Alpha-numeric digital indicator containing floor designations and direction arrows a minimum of 2½" high to indicate floor served and direction of car travel. Mount integral with hall lanterns at lobby level only.
- C. Faceplate Material and Finish: Satin finish stainless steel, all fixtures. Tamper resistant fasteners for all fastenings exposed to the public.
- D. Floor Passing Tone: Provide an audible tone of no less than 20 decibels and frequency of no higher than 1500 Hz, to sound as the car passes or stops at a floor served.
- E. Voice Synthesizer: Provide electronic device with easily reprogrammable message and female voice to announce car direction, floor, emergency exiting instructions, etc.

2.13 INTERCOM AND DISTRESS SIGNAL SYSTEM

- A. General: Provide intercommunication system for All Cars if required. Include all wiring between elevator hoistways and control panels. Include the following stations:

Station Location	Type Station	Selection Buttons to Call
Elevator Equipment Space	Master	Control Panels, All Cars
Cars (All)	Remote	Lobby Control Panel

- B. Basic Equipment:
 1. Amplifier providing static-free voice transmission with adequate volume and minimum distortion at all stations, with pre-amplifier capable of receiving voice and music inputs from building and emergency building communication system.
 2. Activation of emergency building communication system overrides all other conversations and permits one-way conversation to all master stations in system.
 3. Master Stations:
 - a. Speaker-microphone combination and/or handset for two-way communication.
 - b. Selection buttons to enable communication with all master stations. Maintain continual reception of hands-free reply from station when a selected button is depressed.
 - c. Two-Position "Talk/Listen" Button: Press to talk; release to listen.
 - d. Illuminate "in use" light when any master station is being used.
 - e. Reset button to make system available for use by any master station.
 - f. Volume control knob for adjustment of incoming volume.
 - g. Button to establish communications with all stations.
 - h. Distress light in lobby panel that illuminates when "push to call" button or alarm button in car is actuated. Energize distress light and buzzer or chime until intercom selection button for that car has been depressed. Sound buzzer or chime in lobby panel simultaneously with illumination of distress light.

4. Remote Stations:
 - a. Station in car shall be activated by "Help" two-way communication button.
 - b. Actuate two-way communication via "Help" button. Button or adjacent light jewel shall illuminate and flash when call is acknowledged. Button shall match car operating panel pushbutton design. Provide "Help" button tactile symbol, engraved signage, and Braille adjacent to button mounted integral with car front return panel.
 - c. Locate car microphone and speaker or transceiver/speaker combination in car canopy.
- C. Station Housings:
 1. House master station in equipment space in a metal compartment with baked enamel finish. Attach to the group elevator supervisory control panel or wall mount. Provide communication handset with 25'-0" long cord.
 2. Provide control center master intercoms with No. 4 satin finish stainless steel faceplates, and engraved operating instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to beginning installation of equipment examine hoistway and equipment space areas. Verify no irregularities exist that affect execution of work specified.
- B. Do not proceed with installation until work in place conforms to project requirements.

3.2 INSTALLATION

- A. Install all equipment in accordance with Contractor's instructions, referenced codes, specification, and approved submittals.
- B. Install equipment space equipment with clearances in accordance with referenced codes and specification.
- C. Install all equipment so it may be easily removed for maintenance and repair.
- D. Provide any required hoisting/safety beams. Remove if beams are encroaching on code clearances prior to final acceptance.
- E. Install all equipment to afford maximum accessibility, safety, and continuity of operation.
- F. Remove oil, grease, scale, and other foreign matter from all equipment and apply one coat of field-applied machinery enamel for all equipment and metal work installed that does not have a factory applied paint or architectural finish. Neatly touch up damaged factory-painted surfaces with original paint color to protect factory finished surfaces against corrosion.
- G. Clean all architectural finishes and replace or restore any surfaces damaged during construction to like new condition.

3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.

- B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

3.4 ADJUSTING

- A. Install rails plumb and align vertically with tolerance of 1/16" in 100'-0". Secure joints without gaps and file any irregularities to a smooth surface.
- B. Static balance car to equalize pressure of guide shoes on guide rails. Dynamically balance car and counterweight.
- C. Lubricate all equipment in accordance with Contractor's instructions.
- D. Adjust motors, power conversion units, brakes, controllers, leveling switches, limit switches, stopping switches, door operators, interlocks, and safety devices to achieve specified performance levels.

3.5 CLEANING

- A. Keep work areas orderly and free from debris during progress of project. Remove packaging materials on a daily basis.
- B. Remove all loose materials and filings resulting from work.
- C. Clean equipment space equipment and floor.
- D. Clean hoistways, car, car enclosure, entrances, operating and signal fixtures.
- E. Clean pit equipment and floor.

3.6 TEST RESULTS:

- A. Under any load obtain specified contract speed, performance times, stopping accuracy without re-leveling, and ride quality to satisfaction of Consultant. Tests may be conducted under no load, balanced load, and full load conditions.
- B. Consultant may test temperature rise in motor windings limited to 50° Celsius above ambient. A full-capacity one hour running test, stopping at each floor for ten seconds in up and down directions, may be required.
- C. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate elevators.
- D. Check operation of each elevator with Owner's personnel present before date of Substantial Completion. Determine that operation systems and devices are functioning properly.

3.7 PROTECTION

- A. Temporary Use: Comply with the following requirements for each elevator used for construction purposes:
 1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
 2. Provide strippable protective film on entrance and car doors and frames.
 3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.

4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
5. Do not load elevators beyond their rated weight capacity.
6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
7. Engage Elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items which cannot be refinished in the field to the shop, make required repairs, and refinish entire unit, or provide new units as required.

END OF SECTION

SECTION 20 0000

GENERAL MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 REFERENCE

- A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.2 DESCRIPTION

- A. Intent of drawings and Specifications is to obtain complete systems, tested, adjusted, and ready for operation.
- B. Except as otherwise defined in greater detail, the terms "provide", "furnish" and "install" as used in Division 20, 21, 22 and 23 Contract Documents shall have the following meanings:
 - 1. "Provide" or "provided" shall mean "furnish and install".
 - 2. "Furnish" or "furnished" does not include installation.
 - 3. "Install" or "installed" does not include furnishing.
- C. Include incidental details not usually shown or specified, but necessary for proper installation and operation.
- D. Check, verify and coordinate work with drawings and specifications prepared for other trades. Include modifications, relocations or adjustments necessary to complete work or to avoid interference with other trades.
- E. Information given herein and on drawings is as exact as could be secured but is not guaranteed. Do not scale drawings for exact dimensions.
- F. Where Architectural features govern location of work, refer to architectural drawings.
- G. Contractor may install additional piping, fittings and valves, not shown on drawings, for testing purposes or for convenience of installation. Where such materials are installed, they shall comply with specifications and shall be sized to be compatible with system design. Remove such installed materials when they interfere with design conditions or as directed by Architect.

1.3 RELATED WORK

- A. Utility Services:
 - 1. Determine utility connection requirements and include in Base Bid all costs to Owner for utility service.
 - 2. Include costs for temporary service, temporary routing of piping or any other requirements of a temporary nature associated with utility service.
- B. Temporary Services:
 - 1. Division 01 - Temporary Facilities and Controls.
- C. Continuity of Service:
 - 1. No service shall be interrupted or changed without permission from Architect and Owner. Obtain written permission before any work is started.
 - 2. When interruption of services is required, Architect, Owner, and other concerned parties shall be notified and shall determine a time.

- D. Demolition:
1. Division 02 - Selective Demolition.
 2. Perform demolition as required to accomplish new work.
 3. Accomplish work in neat workmanlike manner to minimize interference, annoyance or inconvenience such work might impose on Owner or other Contractors.
 4. Unless otherwise noted, remove from premises materials and equipment removed in demolition work.
 5. Equipment noted to be removed and turned over to Owner, shall be delivered to Owner at place and time Owner designates.
 6. Where materials are to be turned over to Owner or reused and installed by Contractor, it shall be Contractor's responsibility to maintain condition of materials and equipment equal to that existing before work began. Repair or replace damaged materials or equipment at no additional cost to Owner.
 7. Where demolition work interferes with Owner's use of premises, schedule work through Architect, Owner and with other Contractors to minimize inconvenience to Owner. Architect must approve schedule before Contractor begins such Work.
- E. Concrete Work:
1. Provide cast-in-place concrete as required by Contract Documents unless otherwise noted.
 2. Concrete shall comply with Division 03 - Concrete.
 3. Provide anchor bolts, metal shapes and templates required to be cast in concrete or used to form concrete for support of mechanical equipment.
- F. Painting:
1. Painting of mechanical equipment will be done under Division 09 unless specified otherwise or unless equipment is to be furnished with factory applied finish coats.
 2. Furnish equipment with factory applied prime finish unless otherwise specified.
 3. If factory finish on equipment furnished by Contractor is damaged in shipment or during construction, refinish equipment to satisfaction of Architect.
 4. Furnish one can of touch up paint for each factory-applied coat of product.

1.4 REQUIREMENTS OF REGULATORY AGENCIES

- A. Rules and regulations of Federal, State and Local Authorities and utility companies, in force at time of execution of Contract shall become part of this specification.

1.5 REFERENCE STANDARDS

- A. Agencies or publications referenced herein refer to the following:
- | | | |
|-----|--------|--|
| 1. | AGA | American Gas Association |
| 2. | AMCA | Air Movement and Control Association |
| 3. | ANSI | American National Standards Institute |
| 4. | AHRI | Air-Conditioning, Heating and Refrigeration Institute |
| 5. | ASHRAE | American Society of Heating Refrigerating and Air Conditioning Engineers |
| 6. | ASPE | American Society of Plumbing Engineers |
| 7. | ASSE | American Society of Sanitary Engineering |
| 8. | AWS | American Welding Society |
| 9. | AWWA | American Water Works Association |
| 10. | ASME | American Society of Mechanical Engineers |
| 11. | ASTM | American Society for Testing and Materials |
| 12. | CDA | Copper Development Association |
| 13. | CISPI | Cast Iron Soil Pipe Institute |
| 14. | FMG | FM Global |
| 15. | FS | Federal Specifications |
| 16. | IEEE | Institute of Electrical and Electronics Engineers |

17.	MCA	Mechanical Contractors Association
18.	MSS	Manufacturers Standardization Society
19.	NEC	National Electrical Code
20.	NEMA	National Electrical Manufacturers Association
21.	NFPA	National Fire Protection Association
22.	NIST	National Institute of Standards & Technology
23.	NSF	National Sanitation Foundation
24.	NSPI	National Spa and Pool Institute
25.	OSHA	Occupational Safety and Health Administration
26.	PDI	Plumbing and Drainage Institute
27.	SMACNA	Sheet Metal and Air Conditioning Contractors National Association
28.	UL	Underwriters Laboratories, Inc.
29.	WQA	Water Quality Association

- B. Work shall be in accordance with latest edition of codes, standards or specifications unless noted otherwise.

1.6 SUBMITTALS

- A. Shop Drawings (Product Data):
1. Refer to Division 01 - Submittal Procedures.
 2. Note that for satisfying submittal requirements for Divisions 20, 21, 22 or 23, "Product Data" is usually more appropriate than true "Shop Drawings" as defined in Division 01. However, the expression "Shop Drawings" is generally used throughout Specification.
 3. Submit shop drawings for equipment and systems as requested in the respective specification sections. Submittals that are not requested may not be reviewed.
 4. Specifically mark general catalog sheets and drawings to indicate specific items submitted and its correlation to specific designation for product in drawings.
 5. Specifically indicate proper identification of equipment by name and/or number, as indicated in specification and shown on drawings.
 6. When manufacturer's reference numbers are different from those specified, provide correct cross-reference numbers for each item. Clearly mark and note submittals accordingly.
 7. Submit complete record of required components when fixtures, equipment and items specified include accessories, parts and additional items under one designation.
 8. Include composite wiring diagrams for electrically powered equipment and devices.
 9. Submit equipment room layouts drawn to scale, including equipment, piping, accessories and clearance for maintenance.
 10. Where submittals cover products containing non-metallic materials, include "Material Safety Data Sheet" (MSDS) from manufacturer stating physical and chemical properties of components and precautionary considerations required.
 11. Submit shop drawings or product data as soon as practicable after signing contracts. Submittals must be approved before installation of materials and equipment.
 12. Submittals that are not complete, not permanent or not properly checked by Contractor will be returned without review.
- B. Certificates and Inspections:
1. Obtain and pay for inspections required by authorities having jurisdiction and deliver certificates approving installations to Owner unless otherwise directed.
- C. Operation and Maintenance Manuals:
1. Refer to Division 01 - Operation and Maintenance Data.
 2. Upon completion of Work but before final acceptance of system, submit to Architect for approval, 3 copies of operation and maintenance manuals in loose-leaf binders. If "one copy" is larger than 2" thick or consists of multiple volumes, submit only one set initially for review. After securing approval, submit 3 copies to Owner.

3. Organize manuals by specification section number and furnish table of contents and tabs for each piece of equipment or system.
4. Fire protection system shall be separately bound.
5. Manuals shall include the following:
 - a. Copies of Shop Drawings.
 - b. Manufacturer's operating and maintenance instructions. Include parts lists of items or equipment, with component exploded views and part numbers. Where manufacturer's data includes several types or models, designate applicable type or model.
 - c. CD ROM's of O&M data with exploded parts lists where available.
 - d. Phone numbers and addresses of local parts suppliers and service companies.
 - e. Internet/WEB page addresses where applicable.
 - f. Wiring diagrams.
 - g. Startup and shutdown procedures.
 - h. Composite electrical diagrams.
 - i. Flow diagrams.
 - j. Lubrication instructions.
 - k. Factory and field test records (Refer to Test and Balancing in Part 3 of this section.)
 - l. Air and water balance reports.
 - m. Additional information, diagrams or explanations as designated under respective equipment or systems specification sections.
6. Instruct Owner's representative in operation and maintenance of equipment. Instruction shall include complete operating cycle on all apparatus.
7. Furnish O&M Manuals and instructions to Owner prior to request for final payment.

D. Record Documents:

1. Refer to General Conditions of Contract, and Division 01 - Project Record Documents. Prepare complete set of record drawings in accordance with Division 01.
2. Use designated set of prints of Contract Documents as prepared by Architect to mark-up for record drawing purposes.

1.7 JOB CONDITIONS

A. Building Access:

1. Arrange for necessary openings in building to allow for admittance of all apparatus.

B. Electrical Coordination:

1. Contractors for Divisions 20, 21, 22 and 23 shall provide the following items as specified under their respective Division(s) (Division 20, 21, 22 and 23):
 - a. Motors.
 - b. Electrically powered equipment.
 - c. Electrically controlled equipment.
 - d. Starters, where specified.
 - e. Variable frequency drives, where specified.
 - f. Control devices, where specified.
 - g. Temperature Control wiring.
 - h. Wiring diagrams to Electrical Contractor for apparatus indicating external connection and internal controls.
 - i. Disconnect devices furnished with units (VFDs, chillers, prepackaged control devices, etc.)
 - 1). Devices shall have an interrupting rating not less than that of the upstream overcurrent device as shown on electrical drawings.
 - 2). Equipment electrical connection points shall be labeled with listed electrical short circuit current rating (SCCR). SCCR shall not be less than interrupting rating of upstream overcurrent device as shown on electrical drawings. SCCR shall be

marked on equipment control enclosure in accordance with UL508, or other acceptable, accredited third-party testing agency standards.

2. Electrical Contractor will provide the following devices required for control of motors or electrical equipment, unless noted otherwise.
 - a. Starters.
 - b. Disconnect devices.
 - c. Control devices:
 - 1). Pushbuttons.
 - 2). Pilot lights.
 - 3). Contacts.
 - d. Conduit, boxes and wiring for power wiring.
 - e. Conduit, boxes and wiring for control wiring, except temperature control wiring.
3. Electrical Contractor will make connections, from power source to starter or variable frequency drive and from starter or variable frequency drive, where specified, to motor for ready to operate.
4. Where starters or other similar control devices are furnished by this contractor, they shall be installed by this contractor and wired by Electrical Contractor.
5. Should any change in size, hp rating, voltage, or means of control be made to any motor or other electrical equipment after Contracts are awarded, this contractor shall immediately notify Electrical Contractor of change. Additional costs due to these changes shall be responsibility of this contractor.

C. Cutting and Patching:

1. Refer to General Conditions of the Contract, and Division 01 - Cutting and Patching.
2. Perform cutting and patching required for complete installation of systems, unless otherwise noted. Patch and restore work cut or damaged to original condition. This includes openings remaining from removal or relocation of existing system components.
3. Provide materials required for patching unless otherwise noted.
4. Do not pierce beams or columns without permission of Architect and then only as directed. If openings are required through walls or floors where no sleeve has been provided, hole shall be core drilled to avoid unnecessary damage and structural weakening.
5. Where alterations disturb lawns, paving, walks, etc., replace, repair or refinish surfaces to condition existing prior to commencement of work. This may include areas beyond construction limits.

D. Housekeeping and Cleanup:

1. Refer to Division 01 - Closeout Procedures.
2. As work progresses and/or as directed by Architect, periodically remove waste materials from building and leave area of work broom clean. Upon completion of Work, remove tools, scaffolding, broken and waste materials, etc., from site.

1.8 WARRANTY

- A. Refer to Division 01 for general warranty requirements.
- B. Refer to technical sections for warranty requirement for each system.
 1. Where no warranty requirements are called out, warrant as called out in Division 01 for 1 year after acceptance by Owner equipment, materials, and workmanship to be free from defect.
- C. Warrant that systems will operate without objectionable noise, vibration and uncontrolled expansion.
- D. Repair, replace or alter systems or parts of systems found defective at no extra cost to Owner.

- E. In any case, wherein fulfilling requirements of any warranty, if this contractor disturbs any work warranted under another contract, this contractor shall restore such disturbed work to condition satisfactory to Architect and warranty such restored work to same extent as it was warranted under such other contract.
- F. Warranty shall include labor, materials, and travel time.

PART 2 - PRODUCTS

2.1 PRODUCT SUBSTITUTIONS

- A. Refer to Division 01 - Product Requirements.

PART 3 - EXECUTION

3.1 GENERAL

- A. Verify elevations and dimensions prior to installation of materials.

3.2 DELIVERY, STORAGE, HANDLING, AND PROTECTION

- A. Deliver products to the site under provisions of Division 01.
- B. Store and protect products under provisions of Division 01.
- C. Store in clean, dry space.
- D. Maintain factory wrapping or provide cover to protect units from dirt, water, construction debris, and traffic.
- E. Handle in accordance with manufacturer's written instructions.
- F. Handle carefully to avoid damage to components, enclosure, and finish. Lift only with lugs provided for the purpose.
- G. Protect openings in equipment until connected to system to prevent entry of foreign materials.

3.3 EXCAVATION AND BACKFILL

- A. Refer to Division 31 - Earthwork.
- B. Provide excavation and backfill for underground work unless otherwise indicated. Blasting is not allowed on this project without written permission of Architect and Owner.
- C. Backfill trenches beneath concrete floor and stair slabs within building and beneath concrete slabs, walks, stairs and drives at exterior of building with gravel fill and compact to same density as surrounding area.

3.4 FLOOR, WALL, ROOF AND CEILING OPENINGS

- A. Coordinate location of openings, chases, furred spaces, etc., with appropriate Contractors. Provide sleeves and inserts that are to be built into structure during progress of construction.
- B. Remove temporary sleeves, if used to form openings, prior to installation of permanent materials. Utilize minimum 24 ga galvanized sheet metal for permanent sleeves unless otherwise noted.

- C. Provide Schedule 40 carbon steel pipe with integral water stop for steel sleeves required in interior floor slabs.
- D. Submit to Structural Engineer for review and approval size and location of core-drilled holes prior to execution.
- E. Submit product data and installation details for penetrations of building structure. Include schedule indicating penetrating materials (metal pipe, plastic pipe, conduit, etc.), sizes of each, opening sizes and sealant products intended for use.
- F. Submit complete penetration layout drawings showing openings in building structural members including floor slabs, bearing walls, shear walls, etc. Indicate and locate, by dimension, all required openings, including those sleeved, formed or core drilled. Drawings shall be approved prior to preparing openings in structural member.
- G. Provide minimum 1" clearance around penetration openings intended for pipe. Where fire resistant penetrations are required, size openings in accordance with written recommendations of firestopping systems manufacturer.
- H. Openings for underground pipes passing through foundations or under footings shall have minimum clearance of 1-1/2" to concrete. Do not disturb footing bearing soil.
- I. Openings for underground pipe passing through on grade concrete slabs shall have minimum 1/4" clearance to concrete. Seal openings with urethane caulk.
- J. Openings for insulated piping shall be sized based on outside diameter of insulation when it is specified or detailed to be continuous through opening.
- K. Openings for duct penetrations shall be no more than 1/2" larger on all sides than size of duct or duct including duct insulation, if applicable. Where firestopping systems are required at penetrations, size in accordance with recommendations of firestopping systems manufacturer, but opening shall not exceed 1" average clearance on all sides. Openings for ducts with fire dampers shall be in accordance with fire damper installation requirements.
- L. Duct penetrations through concrete floors in mechanical rooms containing liquid heat exchangers and/or pumps shall have 2" high water stopped curbs surrounding openings. This applies to mechanical rooms above the lowest floor level.
- M. Seal non fire-rated floor penetrations with non-shrink grout equal to Embecco by Master Builders, or urethane caulk, as appropriate.
- N. Seal non fire-rated wall openings with urethane caulk.
- O. Where penetrations occur through exterior walls into building spaces, use sleeves with integral water stop. For piping having outer surface temperature less than 150°F, use plastic (HDPE) sleeves, similar to PSI Link-Seal Model CS, rated to 150°F. For piping having outer surface temperature 150°F or higher, or where steel sleeves are shown or walls are fire rated, use steel sleeves with hot dip galvanizing, similar to PSI Link-Seal Model WS. Seal annular space between sleeves and pipe with Thunderline "Link-Seal" modular wall and casing seals, or sealing system by another manufacturer approved as equal by Engineer. Where "Link-Seals" are used with insulated pipe, insulation shall be butted against seals on both sides. Sealing system shall utilize Type 316 stainless steel bolts, washers and nuts.
- P. In lieu of openings as specified herein penetration systems as manufactured by Pro Set may be used, including sleeve couplings and plug.

- Q. If total Pro Set system with Water Guard "CR" is used, opening shall not need additional water proofing or riser clamps.
- R. Finish and trim penetrations as shown on details and as specified.
- S. Provide chrome or nickel plated escutcheons where piping passes through walls, floors or ceilings and is exposed in finished areas. Size escutcheons to fit pipe and pipe covering for finished appearance. Finished areas shall not include mechanical/electrical rooms, janitors' closets, storage rooms, etc., unless suspended ceilings are specified.
- T. Trim duct penetrations exposed in finished areas with 2" wide galvanized or aluminum trim collars properly sized to fit duct. Collars shall be same gauge as duct, prime finish unless noted otherwise. Finished areas shall not include mechanical rooms, janitors' closets, storage rooms, etc., unless suspended ceilings are specified.

3.5 EQUIPMENT SHUTOFF VALVES

- A. Provide shutoff valves at equipment connected to piping system. Refer to valve section or system section for requirements of valve type.

3.6 EQUIPMENT ACCESS

- A. Install piping, conduit and accessories to permit access to equipment for maintenance. Relocate piping, equipment or accessories to provide access at no additional cost to Owner.
- B. Install equipment with sufficient maintenance space for removal, repair or changes to equipment. Provide ready accessibility to equipment without moving other future or installed equipment or system components.
- C. Access doors in walls, chases, or inaccessible ceilings will be provided under Division 08 - Access Doors and Frames, unless otherwise indicated. Access doors for valves, shock stops or other equipment shall provide access for servicing, repairs, and/or maintenance.
- D. Provide necessary coordination and information to the Trade Contractor under Division 08 - Access Doors and Frames. This information shall include required locations, sizes, and rough-in dimensions.
- E. Provide access doors in walls, chases or above inaccessible ceilings for valves, shock stops, unions or equipment/devices requiring access for servicing, repairs or maintenance, unless otherwise noted. Access frames and doors shall be as manufactured by Milcor, Incorporated, or similar, of style applicable to surface. Provide access doors used in fire rated construction with UL Label. Provide steel, prime coated access doors unless otherwise specified. Provide stainless steel doors in ceramic tile walls, toilet rooms, locker rooms and in areas subject to excessive moisture. Provide access doors of sufficient size to allow complete maintenance. Coordinate location of access doors with General Contractor and rough-in equipment accordingly.

3.7 EQUIPMENT SUPPORTS

- A. Provide supporting steel not indicated on drawings as required for installation of equipment and materials including angles, channels, beams, hangers, etc.

3.8 EQUIPMENT GUARDS

- A. Provide equipment guards over belt driven assemblies, pump shafts, exposed fans, and elsewhere as indicated in this Specification or required by Code.
- B. Paint equipment guards bright yellow.

- C. Equipment guards shall comply with OSHA requirements.

3.9 SUPPORT PROTECTION

- A. In occupied areas, mechanical rooms and areas requiring normal maintenance access, guard certain equipment to protect personnel from injury.
- B. Provide minimum 1/2" thick Armstrong Armaflex insulation or similar product applied with Armstrong 520 adhesive on lower edges of equipment and mechanical supporting devices suspended less than 7 ft above floors, platforms or catwalks in these areas.
- C. Protect threaded rod or bolts at supporting elements as described above. Trim threaded rod or bolts such that they do not extend beyond supporting element.

3.10 LEAD SHIELDING

- A. Wherever installation of this Contractor's equipment destroys radiologic integrity of wall, floor, or ceiling, this Contractor shall be responsible to provide suitable lead shielding to restore that integrity. Coordinate these requirements with General Contractor.

3.11 TEST AND BALANCING

- A. Tests for equipment, ductwork and piping systems shall be performed as specified in their respective specification sections in accordance with technical requirements noted.
- B. Provide equipment required for testing, including fittings for additional openings required for test apparatus.
- C. All ductwork and piping inspections and testing shall be successfully completed and approved before application of covering materials.
- D. When equipment or systems fail to meet minimum test requirements, replace or repair defective work or material as necessary and repeat inspection and test until equipment or systems meet test requirements. Make repairs with new materials. Caulking of holes or threaded joints is not allowed.
- E. Contractor is responsible for certifying in writing equipment and system test results. Certification shall include identification of portion of system tested, date, time, test criteria, test medium and pressure used, duration of test and name and title of person signing test certification document.
- F. Maintain copies of certified test results, including those for any failed tests, at project site. At completion of project, include copies of test records and certifications in O&M Manuals.
- G. Balancing of various systems shall be in accordance with associated specification sections in addition to requirements noted herein.
- H. If exterior domestic water supply also serves as source for fire protection systems, either exterior or interior or both, it shall be tested according to fire protection system requirements as specified in applicable Specification Section.

3.12 START-UP

- A. Systems and equipment shall be started, tested, adjusted and turned over to Owner ready for operation. This includes "Owner-Furnished, Contractor-Installed" (OFI) and "Contractor-Furnished, Contractor-Installed" (CFI) systems and equipment.

- B. Follow manufacturer's pre-start-up check-out, start-up, trouble shooting and adjustment procedures.
- C. Contractor shall provide services of technician/mechanic knowledgeable in start-up and check-out of types of systems and equipment on project.
- D. Provide start-up services by manufacturer's representative where specified or where Contractor does not have qualified personnel.
- E. Coordinate start-up with all trades.

3.13 LUBRICATION

- A. Upon completion of work and before turning over to Owner, clean and lubricate bearings except sealed and permanently lubricated bearings. Use only lubricant recommended by manufacturer.
- B. Contractor is responsible for maintaining lubrication of mechanical equipment under this Contract until Work is accepted by Owner.

3.14 CLEANING

- A. Clean systems after installation is complete.
- B. Clean piping and ductwork both internally and externally to remove dirt, plaster dust or other foreign materials. When external surfaces of piping are rusted, clean and restore surface to original condition.
- C. Clean pipeline strainers to restore them to original condition or replace with new strainer elements.
- D. Clean equipment and plumbing fixtures as recommended by manufacturers.
- E. Replace throwaway or replaceable media air filters used during construction period with new filters or new filter media after construction has been completed and before building is turned over to Owner. Filter replacement shall be as hereinafter specified.
- F. Blow and clean dirt, plaster dust and other foreign matter from coils, terminal devices, diffusers, registers and grilles.
- G. Thoroughly clean equipment of stains, paint spots, dirt and dust. Remove temporary labels not used for instruction or operation.
- H. Provide additional cleaning of individual piping systems and apparatus as hereinafter specified.

END OF SECTION

SECTION 20 05200
EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section lists methods and materials for trench excavation and backfill for plumbing piping systems inside and outside the building.
- B. For information on soil conditions, refer to Geotechnical Investigation for Roche Molecular Diagnostics Building 730, Report No. 234269, prepared by TRC and dated July 13, 2015. Copies of the report are available from the Owner's Construction Manager.

1.2 RELATED WORK

- A. Division 31 – Earthwork.

1.3 REFERENCE

- A. Work under this Section is subject to requirements of Contract Documents including General Conditions of Contract, Supplementary Conditions, and sections under Division 01 General Requirements.

1.4 SUBMITTALS

- A. List of materials to be used for backfill.

PART 2 - PRODUCTS

2.1 FILL MATERIAL

- A. Type 1 Fill:
 - 1. Material from excavation separated from materials, which do not compact by tamping and rolling. No stones larger than 3" and no building, organic, corrosive or frozen materials.
- B. Type 2A Fill:
 - 1. Sand or gravel materials with none larger than 2" and of that portion passing #4 sieve less 5% to pass #200 sieve.
- C. Type 2B Fill:
 - 1. Sand or gravel materials with none larger than 1/2" and of that portion passing #4 sieve less 5% to pass #200 sieve.
- D. Type 3 Fill:
 - 1. Gravel of rounded to subangular shape, screened, which will pass 0.75" sieve and retained on #4 sieve.
- E. Type 4 Fill:
 - 1. Pit run rock or gravel with maximum stone size of 1".
- F. Type 5 Fill:
 - 1. Pea gravel, screened, which will pass 0.375" sieve and retained on #4 sieve.

- G. Type 6 Fill:
 - 1. Soils Engineer approved fill material, backfilled and compacted beneath building footprint.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Establish grade lines and locations of mains and manholes. Provide necessary stakes and batter boards.
- B. Verify invert elevations of existing utilities prior to excavation for new utility piping.

3.2 EXCAVATION

- A. Provide excavation for all underground work, including piping, manholes, catch basins, tanks, concrete structures, etc., unless otherwise shown or specified. Lay piping in open trench except when Architect gives written permission for tunneling.
- B. Include all necessary clearing; tree removal; grubbing; pavement removal; substructure removal such as walls, footings and piers and all incidental work such as tunneling, sheet piling, shoring, underpinning, pumping, bailing and transportation. Coordinate excavation extending beyond construction limits with Construction Manager and Owner.
- C. Blasting is not allowed on this project without written permission of Architect and Owner.
- D. Remove all excess excavation material from site unless directed otherwise.
- E. Use mechanical methods to remove rock in trenches for piping systems.
- F. Include rock excavation in the Bid unless otherwise indicated.

3.3 PIPE INSTALLATION

- A. Keep underground piping to proper line and grade and sealed at all times to prevent entrance of animals or foreign matter.
- B. Provide bracing and sheet piling as necessary to support trenches. Comply with Local Regulations, applicable provisions of OSHA Regulations on trenching, or with provisions of "Manual of Accident Prevention in Construction" published by Associated General Contractors of America.
- C. Under no circumstances lay pipe or install appurtenances in water. Keep trench free from water until pipe joint material has hardened.
- D. Presence of ground water in soil or necessity of sheet piling or bracing trenches shall not constitute condition for which any increase may be made in Contract price, except when sheet piling is left in place on written order of Owner, Contract price will be adjusted.
- E. Cut off sheet piling left in place not less than 2" below new finished grade. Do not remove sheet piling until trench is substantially backfilled.
- F. Place underground piping outside and inside building in open excavated trenches. Where trench bottom does not contain stones larger than 1" in size or where bedrock is not encountered, trench may be excavated to final pipe grade. Where bedrock or stones larger than 1" is encountered, excavate entire length of trench to depth 4" below final pipe grade elevation and provide 4" of pipe bedding material compacted to minimum of 90% Standard Proctor Density consisting of Type 2B,

3 or 5 fill to establish final pipe grade. Shape bedding for clearance for all joints and fittings, tamped in place and graded evenly to insure uniform bearing for full length of pipe. Do not support piping by blocking, planking or mounding of bedding material.

3.4 BACKFILL

A. Exterior:

1. Backfill outside building including all piping beyond construction limits only after piping and appurtenances have been inspected, recorded, tested and approved. Backfill around pipe by hand to depth of 12" above top of pipe with Type 2B, 3 or 5 fill in 6" layers. Take care not to disturb pipe or damage pipe coating. Do not use Type 3 fill where it will come in contact with polyethylene encasement specified in Section 21 1114 - Exterior Fire Suppression Piping Systems and Section 22 1114 - Exterior Services. Compact backfill thoroughly with compactor of suitable weight or with approved mechanical tamper. No flooding or jetting with water is allowed.
2. Place backfill from 12" above pipe in layers not exceeding 8" in depth with Type 1 fill. Compact backfill material to the same density as surrounding area prior to that of excavation.
3. When excavating through areas which are to become walks, roads, driveways or parking areas of concrete, bituminous or exposed gravel surfacing or such areas are existing to remain; backfilling from 12" above pipe to subgrade shall be with Type 2A, 2B, 3 or 4 fill. Backfill in 12" layers and compact with mechanical means to density 95% modified proctor. Frequency of compaction testing shall be determined by testing consultant, based on site conditions, materials and workmanship.
4. When excavation occurs on public property or areas beyond property line, all excavation, pipe laying, backfilling, grading and surfacing shall conform as herein specified, except additional requirements for public utility or other authorities shall be complied with when in order. Check with each utility and incorporate cost of any additional requirements in Base Bid.

B. Interior:

1. Backfill inside building only after piping and appurtenances have been inspected and approved. Backfill to 12" above pipe with Type 2B, 3 or 5 fill in 6" layers. Remainder of backfill shall be Type 2A, 2B, 3, 4, or 6 fill in 12" layers.
2. Install lines passing under foundations with minimum of 1-1/2" clearance to concrete and insure there is no disturbance of bearing soil.

3.5 ROCK EXCAVATION

- A. Consider material over one cubic yard in size encountered during excavation as rock. Rock excavation will be paid as extra if it cannot be removed by 200 net hp crawler tractor with ripper attachment all in good running condition and operated by an experienced individual.
- B. Excavate rock to 4" below intended pipe invert.

3.6 FINISHING

- A. On completion of trenching and backfilling operations, restore grades to original elevation or to new subgrade elevation.
- B. When trenching is through existing areas or beyond constructions limits, replace surfaces to existing conditions.

- C. In landscaped areas use 6" of topsoil and sod to match existing elevations, or as otherwise approved by Landscape Architect.

END OF SECTION

SECTION 20 0700

MECHANICAL SYSTEMS INSULATION

PART 1 - GENERAL

1.1 REFERENCE

- A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.2 DESCRIPTION

- A. Provide insulating materials and accessories as required for mechanical systems as specified below.
- B. Insulating products delivered to construction site shall be labeled with manufacturer's name and description of materials.

1.3 DEFINITIONS

- A. Concealed areas, where indicated in this Section, shall apply to shafts, furred spaces and space above finished ceilings, inaccessible tunnels and crawl spaces. All other areas, including walk-through tunnels, shall be considered as exposed.
- B. Unless otherwise indicated, unit of thermal conductivity is Btu·in/(h·ft²·°F).
- C. Interstitial spaces are considered as concealed areas.

1.4 SUBMITTALS

- A. Shop Drawings for each piping system for all pipe sizes, each ductwork system, and all equipment including, but not limited to, the following:
 - 1. Manufacturer's name
 - 2. Schedule of insulating materials
 - 3. Insulation material and thickness
 - 4. Jacket
 - 5. Adhesives
 - 6. Fastening methods
 - 7. Fitting materials
 - 8. Intended use of each material
 - 9. Manufacturer's data sheets indicating density, thermal characteristics, temperature ratings
 - 10. Insulation installation details (manufacturer's installation instruction/details, Contractor's installation details, MICA plates where applicable)
 - 11. Literature data sheet from sealants and adhesive manufacturers stating VOC compliance with USGBC LEED IEQ 4.1.
 - 12. Literature data sheet from coatings and mastics (including lagging adhesives) manufacturers stating VOC compliance with USGBC LEED IEQ 4.2.
 - 13. All other appropriate data

1.5 DELIVERY, STORAGE AND HANDLING

- A. Insulation material shall be delivered to project site in original, unbroken factory packaging labeled with product designation and thickness. Shipment of materials from manufacturer to installation location shall be in weather-tight transportation. Protect insulation materials from

moisture and weather during storage and installation. Protect insulation material against long exposure to UV light from sun.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Insulation:
 - 1. Owens Corning, Johns Manville, Manson, Knauf or CertainTeed similar to product indicated except where product of manufacturers not listed above is specifically identified for special type of insulation.
- B. Coatings, Mastics, Sealants and Adhesives:
 - 1. Foster, Childers, Vimasco, Miracle or Pittsburgh Corning

2.2 MATERIALS

- A. Products used for or related to air conditioning and ventilating systems shall conform to NFPA 90A possessing flame spread index of not over 25 and smoke developed index no higher than 50.
- B. Unless otherwise indicated, all products, material itself or on composite basis, shall have flame spread index not more than 25 and smoke developed index not more than 50, when tested in accordance with ASTM E-84 or UL723.
- C. Pipe insulation which is not located in air plenum may have flame spread rating not over 25 and smoke developed rating no higher than 450 when tested in accordance with UL 723 and ASTM E84.
- D. Outdoor insulation may have flame spread rating not over 75 and smoke developed rating not higher than 450.
- E. Insulation applied on stainless steel shall meet requirements of ASTM C795 and NRC 1.36.

2.3 INSULATION

- A. Insulation materials shall be fire retardant, moisture and mildew resistant, vermin proof, and suitable to receive jackets, adhesives and coatings as indicated.
- B. Glass fiber insulation shall be of inert inorganic material, non-corrosive to mechanical surfaces.
- C. Insulating cement shall be Quick-Cote by PK Insulation MFG Co. or Ryder GP, with dry density of no more than 38 lb/ft³ thermal conductivity of 0.96 at 400°F mean temperature, and service temperature to 1200°F.
- D. Filling and finishing cement shall be Super-Stik by PK Insulation MFG Co., or Ryder MW, with dry density of no more than 24 lb/ft³, thermal conductivity of 0.74 at 500°F mean temperature, and service temperature to 1900°F.
- E. Type A Insulation (Closed Cell Elastomeric Thermal Insulation):
 - 1. Minimum nominal density of 6 lb/ft³, thermal conductivity not more than 0.25 at 75°F mean temperature, maximum water vapor transmission of 0.06 perm-inch and suitable for temperatures from -70 to 220°F, Armacell Model AP/Armaflex, K-Flex USA, or Aeroflex Model Aerocel.

- F. Type C Insulation (Ceramic Fiber):
1. Formed from alumina and silica materials, nominal 8 lb/ft³ density, suitable for temperature to 2000°F continuous, thermal conductivity not more than 0.73 at 1000°F mean temperature, equal to Morgan Thermal Ceramics Superwool Plus.
- G. Type F Insulation (Flexible Glass Fiber):
1. Minimum density of 0.75 lb/ft³ with thermal conductivity of not more than 0.29 at 75°F mean temperature, and suitable for temperatures to 250°F. Owens Corning "All Service Duct Wrap", Johns Manville Microlite EQ Type 75.
- H. Type FR Insulation (Fire Resistive Duct Wrap):
1. Wrap material shall have fire resistive rating of 2 h and shall be Fire Master Fast Wrap XL duct wrap by Thermal Ceramics or similar products by Unifrax or 3M. Wrap shall be 1-1/2" thick, service range up to 2000°F and R-value per ASTM C518, 4.15 per inch at 70°F.
 2. Wrap shall have the following requirements:
 - a. Through-penetration firestop systems for air ducts, ASTM E814, 2 h F and T Rating.
 - b. Non-combustibility, ASTM E136
 - c. ISO-6944, Fire Resistance Tests - Ventilation Ducts
- I. Type G Insulation (Cellular Glass):
1. 100% cellular glass cells with no organic material, noncombustible, 0.00 perm-inch permeability, 7.5 lb/ft³ average density, compression strength 90 psi, thermal conductivity of not more than 0.31 at 50°F mean temperature and service temperature of 900°F. Pittsburgh Corning Foamglas or approved equal.
- J. Type H Insulation (High Temperature Block or Pipe):
1. Hydrous calcium silicate, suitable for temperatures to 1200°F, thermal conductivity not more than 0.50 at 400°F, dry density 13 lb/ft³ minimum and compressive strength 100 psi. Industrial Insulation Group (formerly Johns Manville), Thermo-12 Gold.
- K. Type KG Insulation (Kitchen Grease Duct Wrap):
1. Wrap material shall be suitable for kitchen grease duct wrap meeting IMC 2006 and shall be Fire Master Fast Wrap XL by Thermal Ceramics or similar products by Unifrax or 3M. Wrap shall be two layers, each 1-1/2" thick maximum, service range up to 2000°F and R-value per ASTM C518, 4.15 per inch at 70°F.
 2. Wrap shall have the following requirements:
 - a. Through-penetration firestop systems for air ducts, ASTM E814, 2 h F and T Ratings.
 - b. Passes ASTM E2336 test standard, shall have ICC ESR.
 3. Duct access doors shall be furnished by duct wrap manufacture as part of duct wrap system. Access doors shall pass ASTM E2336 test standard.
- L. Type M Insulation (Mineral Wool Pipe Covering):
1. Mineral fiber premolded pipe insulation, in accordance with ASTM C-547, Type II, Grade A, nominal 8 lb/ft³ density, water resistant, non-wicking, suitable for continuous temperature through 800°F, thermal conductivity not more than 0.31 at 200°F and 0.41 at 400°F mean temperature, Roxul ProRox PS 960, or IIG MinWool-1200.
- M. Type P Insulation (Expanded Polyisocyanurate):
1. Continuously molded rigid polyisocyanurate foam insulation meeting requirements of ASTM C-591, with thermal conductivity of not more than 0.19 at 75°F mean temperature, minimum nominal density of 2 lb/ft³, minimum compressive strength of 24 psi, maximum water vapor transmission of 4.0 perm-inch, maximum water absorption of 2% by volume, and suitable for temperature of plus 300°F down to -297°F. Insulation shall have factory-applied jacket with SSL. Trymer 2000 XP by ITW or approved equal.

- N. Type PP Insulation (Phenolic):
 1. Rigid closed cell, minimum nominal density of 2.2 lb/ft³, thermal conductivity of not more than 0.13 at 75°F, minimum compressive strength of 31 psi and maximum water vapor permeability 0.117 perm-inch, maximum water absorption of .5% by volume, rated for service range of -290°F to 250°F.
 2. Koolphen K phenolic foam insulation by Kooltherm Insulation, Resolco Insulphen rigid phenolic insulation by Resolco Inc., or Trymer Green by ITW Insulation.
- O. Type R Insulation (Rigid Glass Fiber):
 1. Minimum nominal density of 3 lb/ft³ with thermal conductivity of not more than 0.23 at 75°F mean temperature.
 2. Pipe insulation shall be premolded type in accordance with ASTM C547 Type I, suitable for temperatures to 850°F, Johns Manville Micro-Lok, Owens Corning Fiberglas ASJ/SSL-II or Knauf Earthwool 1000° pipe insulation.
 3. Duct and equipment insulation shall be in accordance with ASTM C612, Type IA and IB, suitable for temperatures to 450°F, Johns Manville Spin-Glas Type 814, Owens Corning Type 703.
 4. Pipe and tank wrap faced with specified jacket may be used for equipment and round ducts insulation, provided that it meets all insulation characteristics requirements stated above and maintains same R-value as specified.
- P. Type RR Insulation (Rigid Glass Fiber):
 1. Minimum nominal density of 6 lb/ft³ with thermal conductivity of not more than 0.22 at 75°F mean temperature. Insulation shall be suitable for temperatures to 450°F. Minimum compressive strength at 10% deformation shall be 200 lb/ft², Johns Manville Spin-Glas Type 817 or Owens Corning 705.
 2. GA4000 Polyisocyanurate Insulation by Celotex may be used for Type RR insulation specified for exterior rectangular ductwork, provided minimum thickness is 3/4" and R-value is not less than R-value specified.
 3. Pipe and tank wrap faced with specified jacket may be used for equipment and round duct insulation, provided that it meets all insulation characteristics requirements stated above and maintains same R-value as specified.
- Q. Type S Insulation (Extruded Polystyrene):
 1. Rigid closed cell, minimum nominal 1.6 lb/ft³ density, thermal conductivity not more than 0.26 at 75°F mean temperature, minimum compressive strength of 20 psi based on 10% deflection, maximum water vapor transmission 1.5 perm-inch, water absorption 0.5% by volume, rated for service range of -290°F to 165°F.
 2. Manufacturers: Dow Chemical Styrofoam brand insulation Billet or approved equal
- R. Type T Insulation (Mineral Fiber Fireproofing):
 1. Nominal 8 lb/ft³ density with fire hazard classification flame spread of no more than 15, and smoke development of 0, thermal conductivity of not more than 0.23 at 75°F mean temperature, rated for service temperature to 1200°F. US Gypsum Thermafiber, Roxul or Fibrex duct insulation.

2.4 JACKETS

- A. Jacket puncture resistances shall be based on ASTM D-781 test methods. Vapor barrier permeance ratings shall be based on ASTM E-96 Procedure A.
- B. Type A-1 Jacket (Aluminum Roll Jacketing):
 1. Factory fabricated 0.016" thick, ASTM B209, Type 3003 or 3105, stucco embossed aluminum jacket with integrally bonded moisture barrier. Moisture barrier shall consist of 40

- pound kraft paper coated with minimum 1 mil thick polyethylene film or 3 layers of polymer films with total thickness of 3 mil
2. Fitting covers shall be factory fabricated from not lighter than 0.024" thick, Type 3003 or 1100 aluminum.
 3. Jacketing system shall be similar to ITW Pabco/Childers or Insul-Mate by RPR Products, Inc.
- C. Type D-1 Jacket:
1. Heavy-duty, fire retardant material with glass fiber reinforcing. Jackets shall have neat, white Kraft finish suitable for painting, with beach puncture resistance of 50 units minimum. Vapor barrier shall be adhered to inner surface of jacket. Permeance shall not exceed 0.02 perm. Owens Corning "ASJ", Johns Manville "AP".
- D. Type D-2 Jacket:
1. Glass fiber reinforced foil Kraft laminate with permeance not exceeding 0.02 perm and beach puncture resistance 25 units minimum. Owens Corning "FRK", Johns Manville "FSK".
- E. Type D-3 Jacket:
1. Self-adhering, multiple laminated waterproofing material with reflective aluminum foil, high density polymer films and minimum 40 mil rubberized asphalt waterproofing compound, similar to Peel and Seal or Flex Clad 400 by MFM Building Products Corp. or Alumaguard 60 by Polyguard or Alumaguard LT all weather.
 2. Venture Clad 1577 CW, Alumaguard Lite or Foster Vaporfas 62-05
 - a. Jackets shall be minimum 5 ply laminated, weather proofing material with acrylic adhesive capable of installation with no additional mechanical attachments, 0.00 water vapor permeance rating per ASTM E-96, mold inhibitors incorporated and UV stable.
 - b. Jackets shall have [white][embossed aluminum][embossed white][tedlar] finish.
- F. Type E-2 Jacket:
1. Heat sealable, multi-ply laminate consisting of layer of asphalt, glass fiber reinforcement, second layer of asphalt, aluminum foil layer, third layer of asphalt, and polyester outer film. Pittsburgh Corning Pittwrap. Minimum total thickness shall be 125 mils.
 2. Self-sealing, non-metallic sheet consisting of special bituminous resin reinforced with woven glass fabric and 1 mil thick aluminum film. Pittsburgh Corning Pittwrap SS. Minimum total thickness shall be 70 mils.
- G. Type E-3, Jacket
1. Self-sealing, modified bituminous membrane reinforced with glass fabric and 1 mil thick aluminum film. Pittsburgh Corning Pittwrap CW Plus. Minimum total thickness shall be 50 mils.
- H. Type P-1 Jackets:
1. Heavy-duty, fire retardant material with glass fiber reinforcing and self-sealing lap. Jacket shall have neat, white Kraft finish suitable for painting, with burst strength of 1.5 Joules(50 beach units) minimum and tensile strength 45 lbs/in minimum. Vapor barrier shall be adhered to inner surface of jacket. Permeance shall not exceed 0.02 perm. Owens Corning "ASJ-SSL", Johns Manville "ASJ" and Knauf ASJ+.

- I. Type P-2 Jackets:
 - 1. Jackets shall be minimum 5 ply laminated, weather proofing material with acrylic adhesive capable of installation with no additional mechanical attachments, 0.00 water vapor permeance rating per ASTM E-96, mold inhibitors incorporated and UV stable, Venture Clad 1577 CW or Alumaguard Lite.
 - 2. Jackets shall have [aluminum][white][embossed aluminum][embossed white][tedlar] finish.
- J. Type S-1 Jacket (Protective Insulation Shield):
 - 1. Factory fabricated 0.01" thick, ASTM A-240, 304 stainless steel, 2B mill finish jacket with integrally bonded polykraft moisture barrier, complete with integral longitudinal Pittsburgh Z-Lock-Seam.
 - 2. Jacketing system shall be equal to Childers Lock-On.
- K. Type S-2 Jacket:
 - 1. Saran Vapor Retarder Film with self-sealing lap (SSL), ASTM C-755 and C-1136, 6 mil thickness. Permeance shall not exceed 0.01 perms, equal to Dow Saran 540 CX.
 - 2. Elbows, fittings, valves and butt joints shall be wrapped with 3 layers of Dow Saran 520 Vapor Retarder tape.
 - 3. Provide PVC jacket (Type V-1) over Saran tapes for exposed elbows, fittings and valves.
- L. Type V-1 Jacket:
 - 1. Fire retardant and UV resistant PVC in minimum [20 mil (0.02")][30 mil (0.03")] thickness consisting of preformed fitting covers, preformed end terminations, and sheet material for straight runs of pipe. Jacketing system shall be suitable for indoor and outdoor application in temperature range of -35°F to 150°F. Material when installed according to manufacturer's instructions shall provide complete vapor barrier and readily cleanable surface while meeting Federal CGMP requirements.
 - 2. Jacketing system shall be equal to Johns Manville Zeston/Perma-Weld System or Speedline Smoke Safe. Similar product by PROTO will be acceptable.

2.5 ADHESIVES, MASTIC, COATINGS, SEALANTS, AND REINFORCING MATERIALS

- A. Adhesives and sealants shall comply with the South Coast Air Quality Management District (SCAQMD) Rule #1168; VOC limits shall comply with Indoor Environmental Quality Section, Credit IEQ-4.1.
- B. Coatings and mastics shall comply with VOC limits set forth by Green Seal BS-11 and comply with the South Coast Air Quality Management District (SCAQMD) Rule #113; VOC limits shall comply with Indoor Environmental Quality Section, Credit IEQ-4.2.
- C. Products shall be compatible with surfaces and materials on which they are applied, and shall be suitable for use at operating temperatures of systems to which they are applied.
- D. Products shall be fire retardant, moisture resistant and mildew resistant and vermin proof.
- E. Vapor Barrier Mastic: Below ambient insulation. Water vapor permeance shall be less than 0.08 perms at 45 mils dry film thickness per ASTM F1249.
 - 1. Foster 30-65 Vapor Fas
 - 2. Childers CP-34
 - 3. Vimasco 749
- F. Weather Barrier Breather Mastic: Above ambient insulation. Permeance shall be greater than 1.0 perms at 1/16" dry film thickness per ASTM E96.
 - 1. Foster 46-50 Weatherite
 - 2. Childers CP-10/CP-11 Vi Cryl
 - 3. Vimasco WC-5

- G. Lagging Adhesive/Coatings: Indoors applications used in conjunction with canvas/glass cloth.
 - 1. Foster 30-36
 - 2. Childers CP-50 AMV1
 - 3. Vimasco 713
- H. Metal jacketing sealant for aluminum jacketing:
 - 1. Foster 95-44 Elastolar
 - 2. Childers CP-76 Chil Byl
 - 3. Pittsburgh Corning 727
- I. Insulation joint sealant for Type P, Type PP, and Type G insulation:
 - 1. Foster 95-50 Flextra
 - 2. Childers CP-76 Chil Byl
 - 3. Pittsburgh Corning CW Sealant
- J. Glass fiber fabric reinforcing shall be 10 x 10 mesh similar to Childers Chil Glas #10 or Foster Mast A Fab.
- K. Wire mesh reinforcing shall be 22 ga, 1" galvanized.
- L. Insulation cement shall be ANSI/ASTM C195, hydraulic setting mineral wool.
- M. Finishing cement shall be ASTM C449.
- N. Butt joint and longitudinal joint adhesive for Type A insulation shall be Armstrong 520, Rubatex 373, Childers CP-82 or Foster 85-75.
- O. Weather-resistant protective finish for Type A insulation shall be equal to Armstrong WB Armaflex finish or Foster 30-64 elastomeric coating.

2.6 METAL BANDS AND WIRES

- A. Aluminum bands shall be 0.5" x 0.020" up to 48" diameter and 0.75" x 0.020" over 48" diameter.
- B. Stainless steel bands shall be 0.5" x 0.015" or 0.75" x 0.015".
- C. Stainless steel wires shall be 16 ga.

2.7 INSULATION FASTENERS

- A. Insulation fasteners shall be cup head weld pins, galvanized low carbon steel, minimum 12 ga (0.105") pins.
- B. Washer edge shall be beveled.
- C. Fasteners shall be stainless steel for stainless steel ductwork application.
- D. Insulation fasteners using adhesive are not allowed.

2.8 REMOVABLE INSULATING BLANKETS

- A. Custom designed removable, reusable, flexible, blanket thermal insulation system.
- B. Acceptable Manufacturers: Thermal Energy Products, Inc., Advanced Thermal Corp., Temptec and Remco Technology, Inc.

- C. Removable insulation system shall be custom designed for each individual item to provide close contour fit. Overlapping seams and gaps are not acceptable.
- D. Removable insulation shall be designed to overlap adjoining pipe insulation by 2".
- E. Insulation: Minimum 2" thick, 2.4 lb/ft³ density, 1000 °F continuous service temperature thermal insulating wool; Owens Corning Fiberglass or equal.
- F. Interior and Exterior Fabric: Minimum weight 17.5 oz/sq yd silicone rubber coated fiberglass cloth.
- G. Securement: Blanket seams shall be closed with buckle and strap assembly (D ring closure).
- H. Identification/Tagging: Label each removable insulation device with plastic or 304 stainless steel tag with raised letters. Tag as directed by Owner.

2.9 ACOUSTICAL BARRIER MATERIALS

- A. Acoustical barrier material shall be similar to Kinetics Model KNM-100ALQ. Barrier material shall have acoustic ratings of STC-28, 1.0 lb/ft² nominal density, flame spread index less than 25, smoke developed index less than 50, and minimum continuous operating range from 40 °F to 220 °F.
- B. Minimum sound transmission loss at each octave band shall be as follows:

<u>Sound Transmission Loss (dB)</u>					
<u>Octave Band Center Frequency (Hz)</u>					
125	250	500	1000	2000	4000
13	16	24	33	43	49

PART 3 - EXECUTION

3.1 APPLICATION

- A. Provide insulation and jackets as indicated in the following schedule. The schedule applies to both exposed and concealed applications unless noted otherwise:

<u>Service</u>	<u>Jacket Type</u>	<u>Insulation Type</u>	<u>Piping System</u>				
			<u>Insulation Thickness According to Pipe Size</u>				
			3/4" and less	1" - 1-1/4"	1-1/2" - 3"	4" - 6"	8" and Larger
Heating Hot Water (105-140 °F)	P-1	R	1"	1"	1-1/2"	1-1/2"	1-1/2"
Heating Hot Water (141-200 °F)	P-1	R	1-1/2"	1-1/2"	2"	2"	2"
Heating Hot Water (201-250 °F)	P-1	R	2-1/2"	2-1/2"	2-1/2"	3"	3"
Heated Glycol	P-1	R	1-1/2"	1-1/2"	2"	2"	2"
Chilled Water	P-1	R	1"	1"	1-1/2"	1-1/2"	2"
Chilled Water	-	A	1"	1"	1-1/2"	1-1/2"	2"
Chilled Water	S-2	P	1"	1"	1"	1"	1-1/2"
Chilled Water	S-2	PP	1"	1"	1"	1"	1-1/2"

Piping System

<u>Service</u>	<u>Jacket Type</u>	<u>Insulation Type</u>	<u>Insulation Thickness According to Pipe Size</u>				
			3/4" and less	1" - 1-1/4"	1-1/2" - 3"	4" - 6"	8" and Larger
Chilled Water (Inside AHU housing)	V-1	PP	1"	1"	1"	1"	1-1/2"
Chilled Water (Interior)	P-1	G	1"	1-1/2"	2"	2"	2-1/2"
Chilled Water (Exterior)	P-2	P	1"	1"	1"	1"	1-1/2"
Chilled Water (Exterior)	P-1 & A-1	S	1"	1-1/2"	1-1/2"	2"	2"
Chilled Water (Underground - direct buried)	E-3	G	1-1/2"	1-1/2"	2"	2"	2-1/2"
Domestic Potable Cold Water	P-1	R	1"	1"	1"	1"	1"
(Type A Insulation is an option)	--	A	3/4"	3/4"	3/4"	3/4"	3/4"
Domestic Potable Hot Water and Hot Water Return (105-140°F)	P-1	R	1"	1"	1-1/2"	1-1/2"	1-1/2"
	--	A	1"	1"	1-1/2"	NA	NA
			(Type A insulation is an option.)				
Domestic Potable Hot Water and Hot Water Return (141-200°F)	P-1	R	1-1/2"	1-1/2"	1-1/2"	1-1/2"	1-1/2"
Tempered Water	P-1	R	1"	1"	1-1/2"	1-1/2"	1-1/2"
Storm and overflow piping including roof drain body.	P-1	R	NA	1"	1"	1"	1"
	--	A	NA	3/4"	3/4"	3/4"	NA
			(Type A insulation is an option.)				
Clearwater Waste	P-1	R	1"	1"	1"	1"	1"
	--	A	3/4"	3/4"	3/4"	3/4"	NA
			(Type A insulation is an option.)				
Piping Provided with Heat Tracing	P-1	R	1"	1-1/2"	2"	2"	2"
Insulation thickness shall be the greater thickness specified for piping system or thickness specified above.							
Insulated Exterior Piping			Unless otherwise indicated, provide protective insulation shield (Type A-1 jacket) in addition to pipe insulation and jacket specified in this schedule.				

Piping System

<u>Service</u>	<u>Jacket Type</u>	<u>Insulation Type</u>	<u>Insulation Thickness According to Pipe Size</u>				
			3/4" and less	1" - 1-1/4"	1-1/2" - 3"	4" - 6"	8" and Larger
Insulated Piping Subject to Abuse as Indicated on Drawings			Provide Type H insulation for hot piping and Type P insulation for cold piping with V-1 jacket in lieu of specified insulation/jacket with same insulation thickness.				

Ductwork/Equipment System

<u>Service</u>	<u>Jacket Type</u>	<u>Insulation Type</u>	<u>Insulation Thickness</u>
OA Ducts Exposed	D-1 or D-2	R	2"
OA Ducts Concealed	D-2	R	2"
Mixed Air (Outside Air & Return Air Ducts & Plenum)	D-1	R	1-1/2"
Supply Ducts Exposed	D-1	R	1-1/2"
Supply Ducts Concealed	D-2	F	2"
Exhaust or Relief Ducts from Control or BD Damper to Outside Wall or Roof	D-1	R	1-1/2"
Return and Relief Ducts in Equipment Rooms	D-1	R	1-1/2"
Return Ducts	D-2	F	2"
Supply Ducts Exterior	D-3	RR	2"
Return Ducts Exterior	D-3	RR	2"
Exhaust Ducts Exterior	D-3	RR	2"
Exhaust Ducts Downstream from Heat Recovery Units - Exposed	D-1	R	1"
Exhaust Ducts Downstream from Heat Recovery Units - Concealed	D-2	F	2"
Kitchen Grease Exhaust Ducts	---	KG	(Refer to Part 2)
Ductwork Covered with 2 h Rated Wrap	---	FR	(Refer to Part 2)
Heat Recovery Units	D-1	R	1"
Breechings	E-1	H	3"
Breechings	P-1	R	2"

- B. Type F insulation with Type D-2 jacket may be used in lieu of Type R insulation with Type D-1 jacket for ductwork located 6 ft or higher above floor in mechanical equipment rooms. Horizontal ducts that are not completely 6 ft above floor shall be insulated with Type R insulation as specified for its entirety.

3.2 INSTALLATION - GENERAL

- A. All insulation installation methods shall be performed in accordance with the latest edition of National Commercial and Industrial Insulation Standards published by MICA (Midwest Insulation Contractors Association) and manufacturer's installation instructions, except as modified in this Section of specifications.

- B. Install products with good workmanship, with smooth and even surfaces. Use full-length factory-furnished material where possible. Do not use scrap pieces.
- C. Apply insulation only on clean, dry surfaces, after all rust and scale have been removed and testing of systems has been completed. Do not insulate any section of system that must be pressure tested until after it has been successfully tested. Any removal and reinstallation to correct system defects prior to end of guarantee period shall be accomplished at no expense to Owner.
- D. Install insulating materials with necessary joints and terminations, to permit easy access and removal of equipment sections where inspection, service or repair is required, and to allow for expansion.
- E. Where possible longitudinal joints in jackets shall face toward wall or ceiling.
- F. Apply insulation to each pipe or duct individually. Common insulation applied to adjacent pipes or ducts will not be accepted.
- G. Unless otherwise indicated, pipe and duct insulation shall be continuous through walls and floors.
- H. Where multiple layers of insulation are used, stagger and secure each layer with metal bands.
- I. Where penetrations occur through fire-rated walls, partitions, or floors, provide fire seal as specified in Section 20 0000 - General Mechanical Requirements.
- J. Insulate water piping within casework up to penetration of casework pipe chase at fixture stop. Insulate water piping within walls up to pipe penetration through the wall at fixture stop when serving wall-mounted fixtures. Termination of insulation shall be in neat and workman like manner with insulation jacket cap.
- K. Insulate the following systems for complete vapor barrier protection:
 - 1. Chilled Water
 - 2. Refrigerant
 - 3. Cooling coil condensate drain
 - 4. Storm
 - 5. Clearwater Waste
 - 6. Cold Water
 - 7. All insulated ductwork
 - 8. All equipment with surface temperature below 65°F
- L. Apply Type A insulation for insulation and jackets requiring vapor barrier protection where specified insulations are cut for mounting sensors, control devices, parts of valves, devices or components which extend out from specified insulation to prevent condensation.

3.3 GLASS FIBER FABRIC COVERING (TYPE E-1 JACKET)

- A. Glass fiber fabric shall be fitted without wrinkles.
- B. Glass fiber fabric shall be sized immediately upon application with lagging adhesive and shall be capable of drying within 6 h.
- C. Apply adhesive and coating in accordance with manufacturer's recommendations.
- D. All seams shall overlap not less than 2".

3.4 PIPING, VALVE AND FITTING INSULATION

- A. Apply insulation to pipe, unions, flanges, fittings, valves and piping specialties with butt joints and longitudinal seams closed tightly. Valve insulation shall cover entire valve body including bonnets and packing nuts.
- B. Laps on factory-applied jackets shall be 2" minimum width firmly cemented with lap adhesive, or shall be pressure sealing type lap.
- C. Cover joints with factory furnished tape (3" minimum width) to match jacket. Cement firmly with lap adhesive. On systems requiring a vapor barrier (ASJ), vaporeseal all longitudinal and butt joints ASJ/Saran seams with 4" wide coat of vapor barrier mastic.
- D. Where staples are used, they shall be on 6" maximum centers. When used for systems requiring vapor barrier, cover lap and staples with finish coat of vapor barrier mastic.
- E. For finishing of insulated pipe fittings and valves where surface temperature of insulation is not higher than 125°F, one piece PVC fitting covers, minimum thickness of 20 mil, may be used. Fitting covers located in mechanical rooms within 8 ft above floor shall be 30 mil thickness. Johns Manville Zeston 2000 PVC, PROTO Fitting Covers, or similar by other manufacturers listed. Where fitting and valve insulation requires vapor barrier, seal joints of PVC covers with vapor barrier adhesives. Insulation type, R-value and density of insulation used at fittings shall match those of adjacent piping. Install insulation at pipe fittings and valves completely prior to applying PVC covers.
- F. Stove pipe style insulation on elbows (Detail A on Plate 2-200 of MICA 7th Edition) is not allowed. It may be used for closed cell elastomeric insulation.
- G. Where terminations of pipe insulation are required, insulation shall have tapered ends, built up and finished as specified for fittings.
- H. For pipes 1-1/2" and smaller, install specified pipe insulation and jacket continuous through hanger or support locations. Install insulation protection shields to protect insulation from compressing.
- I. For pipes 2" and larger, where manufactured pre-insulated pipe supports are used at hanger or support locations, extend insulation to insulated pipe supports. Where vapor barrier is required, this Contractor shall be responsible for continuity of vapor barrier at insulated pipe supports. Use 3" wide vapor barrier tape on hot and cold systems at pipe supports.
- J. For Contractor-fabricated anchors, secure insulation directly to pipe surface and extend insulation up anchor for distance of 4 times insulation thickness. For pre-insulated anchors, cover entire surface of anchors with Type A insulation. Where applicable, take special care to assure vapor seal at anchor.
- K. Where mechanical grooved pipe connections are used in piping system, insulate couplings as specified for pipe.
- L. Piping, fittings and valves not to be insulated:
 - 1. Heating hot water piping inside fin tube radiation enclosures
 - 2. Control valves and balancing valves for heating terminal devices
 - 3. Valves furnished with removable insulation/jacket
 - 4. Steam system traps

3.5 EQUIPMENT INSULATION

- A. For equipment requiring Type H, Type M or Type C insulation such as breechings, stacks, exhaust pipes and mufflers, apply insulation to equipment and secure with stainless steel bands with tightly butted joints as recommended by manufacturer. Where multiple layers of insulation are required, stagger and secure each layer with stainless steel bands.
- B. Install removable insulation where access is required for cleaning, repair and inspection, including pump heads and strainers. Construct removable insulation with Type A insulation for cold equipment and Type R insulation with V-1 jacket for hot equipment. Do not apply bonding adhesive to equipment surface.
- C. Provide removable insulating blankets on expansion joints.
- D. Do not insulate over equipment nameplates or ASME stamps. Bevel and seal insulation at these locations.
- E. Water chiller insulation shall include insulation of evaporator shell, water boxes and other miscellaneous piping and/or equipment as directed by equipment supplier. Provide removable insulation with Type A insulation at chiller water boxes. Verify that chillers are fully charged with refrigerant before insulating.
- F. Equipment not to be insulated:
 - 1. Equipment furnished with factory insulation.

3.6 DUCTWORK AND COMPONENTS

- A. Apply duct insulation evenly over duct surface. Unless otherwise indicated, insulation and jacket shall run continuously between duct and duct supports. Maintain insulation thickness specified over duct reinforcing members.
- B. For support points of rectangular or oval ducts supported by trapeze hangers, place weight-supporting insulation at bottom of duct over trapeze. Weight supporting insulation inserts shall be minimum 6" long with same thickness as insulation specified and shall be Type G, H or P insulation. Size inserts based on compression strength and weight being supported.
- C. For support points of round ducts smaller than 16" diameter, weight-supporting insulation is not required for either rigid or flexible glass fiber insulation.
- D. For support points of round ducts 16" diameter and larger, place weight-supporting insulation between duct and strap or trapeze. Weight-supporting insulation shall be minimum 6" long with same thickness as insulation specified and shall be Type G, H or P insulation. Size inserts based on compression strength and weight being supported.
- E. Flexible glass fiber insulation may be installed outside of support for round ducts 24" diameter or smaller, provided that vapor barrier integrity is maintained at rod penetration.
- F. Secure flexible glass fiber insulation (Type F) to underside of horizontal rectangular or oval ductwork 24" in width or greater and on vertical sides of horizontal and vertical ductwork with weld pin not over 18" on center and within 3" of butt joint or edge.
- G. Secure rigid glass fiber insulation (Type R or Type RR) to all sides of horizontal and vertical rectangular or oval ductwork with weld pin. Install pins as required to secure, but not less than 12" on center for underside and sides of ducts and 24" on center for top of ducts, and within 3" of butt joint or edge.

- H. Fastening insulation anchors to ductwork with adhesives is not allowed. Where weld pin fasteners are used, install them without damage to interior galvanized surface. Where weld pin fasteners cannot be used, use other type of fasteners such as metal bands.
- I. Where insulation is required for ductwork, provide insulation over entire ductwork system, including system components such as filters, mixing air chambers, sound attenuators, air measuring stations, reheat coils, etc. For fire dampers, smoke dampers and combination F/S dampers in ductwork requiring insulation, install insulation and jacket to wall and apply vapor barrier sealant to prevent condensation.
- J. Provide insulation over supply air diffusers, grilles and unlined boots after termination point of flexible ducts or rigid duct insulation to prevent from sweating.
- K. Where vapor barrier jackets are specified, pins and staples if used shall be jacketed over with matching material using 4" tape. Where staples are used for systems requiring vapor barrier, cover lap and staples with finish coat of vapor barrier mastic. Vaporseal insulation seams, punctures, and tears with two 4" wide coats of vapor barrier mastic.
- L. Insulation without factory jacket shall be cut and mitered to suit surface. Buildup voids, seams and joints with insulating cement, cover with glass fabric as specified herein and finish to smooth surface.
- M. For other than factory-applied vapor barrier jackets, apply 2 coats of vapor barrier mastic with glass fiber reinforcing fabric, after application of insulating cement. For surfaces not requiring vapor barrier jackets, apply 2 coats of weatherproof breather mastic with glass fiber reinforcing fabric after application of insulation cement. Apply coating in accordance with manufacturer's recommended procedure.
- N. D-1 jackets:
 - 1. Butt together joints and seams firmly, cover with glass fiber fabric 4" minimum width and finish with 2 coats of vapor barrier mastic.
- O. D-2 jackets:
 - 1. Butt together joints and seams firmly and cover with 3" wide FSK tape. Cover FSK tape with 4" minimum width vapor barrier mastic in 2 coats.
- P. D-3 jackets:
 - 1. Install jacket in strict accordance with manufacturer's installation requirements.
 - 2. For rectangular ducts, overlap bottom half jacket and top half jacket at each side of duct at least 4" (bottom inside top outside at overlap).
 - 3. For round ducts, wrap duct insulation continuously with spiral shaped overlapping. Overlap at least 4".
 - 4. Use welded stickpins for Type D-3 jacketing wider than 24" in width alongside and bottom surfaces of ducts. Retainers of stick pins shall be covered with Type D-3 patch, minimum 4" square, once retainer cup is in place on stick pin.
- Q. Acoustical Barrier Materials:
 - 1. Provide 2" thick Type R insulation with Type D-1 jacket as inner layer. Over insulation install acoustical barrier materials as outer layer in accordance with manufacturer's installation instruction.
 - 2. For ductwork specified with Type F insulation, replace it with insulation specified above.
 - 3. Refer to plans for ductwork requiring acoustical barrier materials.
- R. Ductwork not to be insulated:
 - 1. Internally lined ductwork
 - 2. Ductwork components with factory installed insulation

3. Exposed supply and return ductwork in [shops] [gym] [air conditioned spaces] [XXX]

3.7 PROTECTIVE INSULATION SHIELD (A-1 JACKET) FOR PIPE JACKETS EXTERIOR TO BUILDING

- A. Unless otherwise indicated, install shields (A-1 jacket) around insulated pipe and fittings exterior to building. Seal water and vapor tight at terminations.
- B. Longitudinal overlap shall be at least 2" wide with vapor barrier sealant.
- C. Secure jacketing with 3/4" wide 0.015" stainless steel or 3/4" wide 0.020" aluminum bands and wing seals on maximum 18" centers.

3.8 TYPE FR INSULATION (FIRE RESISTIVE DUCT WRAP)

- A. Install Fire Resistive Duct Wrap system in accordance with manufacturer's instructions and referenced Standards.
- B. Where duct is specified to have Type FR wrap, and other insulation is indicated in Ductwork/Equipment System Schedule in this Section, other insulation does not need to be provided in addition to Type FR wrap.

3.9 TYPE KG INSULATION (KITCHEN GREASE DUCT WRAP)

- A. Install Fire Resistive Duct Wrap system in accordance with manufacturer's instructions and referenced Standards.
- B. Where duct is specified to have Type KG wrap, and other insulation is indicated in Ductwork/Equipment System Schedule in this Section, other insulation does not need to be provided in addition to or Type KG wrap.

3.10 TYPE G INSULATION (CELLULAR GLASS)

- A. Install cellular glass insulation system in strict accordance with manufacturer's installation instructions.
- B. Chilled Water Piping (Interior):
 - 1. Butter joints of insulation with Pittseal 727 or 444N Sealant. Apply insulation to pipe and fittings with joints tightly fitted and sealed full depth with joint sealant. Secure each length of insulation with 1" wide filament tape and stainless steel wire over tape. Apply insulation with joints fitted to eliminate voids. Eliminate voids by refitting or replacing insulation. Do not fill voids with joint sealer.
 - 2. Finish with specified jacket, joints and laps sealed with fire rated adhesive. Finish elbows and fittings with white PC-79 polyester fabric coated with Pittcote 404.
- C. Chilled Water Piping (Underground):
 - 1. Apply insulation to pipe and fittings with joints tightly fitted. Hold each section of insulation in place with minimum 2 stainless steel wires.
 - 2. Apply insulation with joints fitted to eliminate voids. Eliminate voids by refitting or replacing insulation. Do not fill voids with joint sealer.
 - 3. Finish underground insulation with Type E-3 jacket and install in accordance with Pittsburgh Corning Bulletin FI-213, "Foamglass Insulation Systems for Underground Direct Burial Applications" and Product Data Sheets, FI-234, and FI-155, "Pittwrap SS Primer".
- D. Steam and Steam Condensate Piping (with Type A-1 jackets):
 - 1. Apply insulation to piping with all joints dry and tightly fitted without voids. Do not use glue on joints.

2. Secure insulation to piping with 1" wide, high tensile strength, fiber reinforced strapping tape similar to Scotch Brand Filament Tape and stainless steel wire over tape. Apply tape on equal spacing such that there are 2 rounds of tape per insulation section. Overlap tape minimum 50%.
 3. Apply aluminum jackets over insulation.
 - a. Seal water and vapor tight at terminations.
 - b. Longitudinal overlap shall be at least 1/8" wide bead with metal jacketing sealant.
 - c. Secure jacketing with 3/4" wide 0.015" stainless steel or 3/4" wide 0.020" aluminum bands and wing seals on maximum 18" centers. Provide minimum of 2 bands per section.
- E. Steam and Steam Condensate Piping (Underground Direct Buried)
1. Install insulation and jackets in accordance with Pittsburgh Corning Bulletin FI-213, Foamglas Insulation Systems for Underground Direct Burial Applications, and other appropriate Pittsburgh Corning product data sheets.

3.11 TYPE P INSULATION (POLYISOCYANURATE)

- A. Install Type P insulation with specified insulation jacket in accordance with manufacturer's installation recommendations. Insulation shall be tightly butted and free of voids and gaps at joints. Use 3" wide tape at butt joints with minimum 1.25 times circumference wrapping. Apply insulation joint sealant in longitudinal and butt joints.
- B. Install pre-fabricated tight fitting insulation pieces on fittings, elbows, tees and valves.
- C. Insulation at fittings and valves shall be the same thickness as on pipe section.
- D. Replace Type P insulation and jacket with Type R insulation of same thickness with Type P-1 jacket at penetration of fire rated walls and floor slabs where fire stopping system is required.

3.12 TYPE S INSULATION (POLYSTYRENE)

- A. Pipe:
 1. Use sectional insulation (semi-circular form) for pipe sizes 10" and smaller. Use segmental or sectional insulation for pipe sizes above 10".
 2. Plain sectional insulation shall be applied so that end joints are broken by making one-half of first section 18" long and leaving other half 36" in length. Longitudinal joints shall be on top and bottom of pipe. Apply insulation with sealer such as Foster 30-45 Foam-seal or Childers CP-70 Chil Joint on joints of single layer and outer layer insulation with band placed approximately 3" or 4-1/2" (see band schedule) back from end joints. Do not cement insulation to pipe. Omit joint sealer from inner layer of double layer insulation.
 3. Plain insulation lagging (blocks) for segmental insulation may be factory fabricated or beveled lagging assembled on job. Lags shall fit pipe snugly and maximum width of each lag shall be such as to leave not more than 1/8" void between pipe and joints of segments. Joints shall be broken by, starting with alternating 18" and 36" lags. Apply sealer and bands same as specified for plain sectional insulation.
 4. Apply pipe insulation in double layer construction with joints staggered (2 layers at 1" thick each).
- B. Fittings, Valves and Flanges:
 1. Insulation at fittings shall not be of less thickness than insulation on adjacent piping. Fitting insulation (covers) shall be held together and applied with sealer. Insulation on welded fittings shall fit snugly to fitting contour and shall be applied in same manner and with same materials as specified for pipe.
 2. Apply fitting insulation with sealer on joints and band insulation in place using not fewer than 2 bands on threaded fittings and 4 bands on flanged fitting.

3. Insulate threaded fittings before straight pipe is covered. Insulate flanged fittings after straight pipe is covered.
- C. Band Material:
1. Secure single layer or outer layer insulation with stainless steel bands, 6" spacing for insulated outside diameter under 12" and 9" spacing for 12" and over.
 2. Secure inner layer insulation with stainless steel bands 9" spacing.
 3. Tighten bands with mechanical tightening tool and secure with 304 stainless steel wing type seals.
- D. Vapor Barrier and Jacket:
1. Finish plain pipe insulation, fittings, valves and flanges with vapor barrier mastic.
 2. After thoroughly dry, apply service jacket (Type P-1) and insulation shield jacket (Type A-1).

END OF SECTION

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SECTION 21 0000

GENERAL FIRE SUPPRESSION REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Specification requirements defined in Division 20 of this specification apply to, and are in addition to the work associated with equipment, systems, materials, and installation requirements specified in Division 21. Contractor shall provide the requirements specified in Division 20 to obtain complete systems, tested, adjusted, and ready for operation.

1.2 RELATED WORK

- A. Section 20 0000 - General Mechanical Requirements
- B. Section 20 0520 - Excavation and Backfill
- C. Section 20 0700 - Mechanical Systems Insulation

PART 2 - PRODUCTS

2.1 NOT APPLICABLE TO THIS SECTION.

PART 3 - EXECUTION

3.1 NOT APPLICABLE TO THIS SECTION.

END OF SECTION

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SECTION 21 0533

ELECTRICAL HEAT TRACING (FIRE PROTECTION SYSTEMS)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies materials and installation methods necessary for permanent electrical heat tracing system which will protect fire protection pipe that feeds the trash enclosure.
- B. Fire Protection Contractor shall provide complete listed system of heaters and components including third monitor wire which is used for continuity monitoring. System shall be listed by a nationally recognized testing laboratory for fire protection pipe heat tracing.
- C. System shall be monitored by building's fire alarm panel.
- D. Self-regulating heat tracing system shall maintain a temperature of at least 40°F and shall not exceed 120°F.
- E. Heat trace origin shall begin at 0 ft above ground and extend along fire protection feed pipe that provides water to sprinkler head assemblies identified on engineering drawings.
- F. Refer to fire protection drawings for additional information.

1.2 RELATED WORK

- A. Section 20 0000 General Mechanical Requirements
- B. Section 20 0700 Mechanical Systems Insulation
- C. Section 21 0000 General Fire Suppression Requirements
- D. Section 21 1314 Automatic Fire Sprinkler System

1.3 REFERENCE

- A. Work under this Section is subject to requirements of Contract Documents including General Conditions of the Contract, Supplementary Conditions, and sections under Division 01 General Requirements.

1.4 QUALITY ASSURANCE

- A. Applicable Codes, Guidelines and Standards:
 - 1. This installation shall conform to the following:
 - a. NFPA 13, Installation of Sprinkler Systems 2016 Edition
 - b. NFPA 14, Installation of Standpipe and Hose Systems 2016 Edition
 - c. NFPA 70, National Electrical Code 2014 Edition
 - d. NFPA 72, National Fire Alarm and Signaling Code 2016 Edition
 - e. Heat trace system shall conform to ANSI/IEEE Standard 515.1 2012 Edition
- B. Manufacturer's Quality Assurance program shall be certified by ISO 9000 Standard.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Promptly inspect shipments to insure material is undamaged and complies with Specifications.
- B. Protect heat trace system from damage.
- C. Place accessory kits in individual plastic bags to prevent loss of components.
- D. Storage and protection methods must allow inspection to verify products.

1.6 SUBMITTALS

- A. Fire Protection Contractor shall be responsible for all submittals.
- B. Submit manufacturer's technical data and installation instructions for following:
 - 1. Heat trace cable, voltage, phase, and temperature
 - 2. Heat output chart for each pipe size
 - 3. Circuit isometric riser diagram
 - 4. Circuit schedule with circuit length, breaker panel number, breaker number, and amperage.
 - 5. Contractor certification from heat trace manufacturer.
 - 6. Only licensed fire protection contractors or licensed electricians, who are under direction of manufacturer's representative are permitted to install and work on heat trace system.
 - a. Submit document signed by manufacturer's representative indicating that:
 - 1). instruction has been given,
 - 2). proficiency has been demonstrated and,
 - 3). identify those individuals or organizations that are permitted to install heat trace system on fire protection supply pipe.
 - 7. Submit written warranty statement.
- C. Submit shop drawings and product data sheets on items specified herein prior to installation. Submit to:
 - 1. Engineer
 - 2. Authority Having Jurisdiction (AHJ)
- D. At completion of installation and tests, submit one copy of test reports (e.g. megger readings) and "as built" drawings to:
 - 1. Engineer
 - 2. Owner's representative

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Items shall be new and shall be listed by a nationally recognized testing laboratory for use with automatic fire sprinkler systems.

2.2 TEMPERATURE MAINTENANCE HEATERS

- A. Heat Tracing:
 - 1. Heat cable shall consist of two, 16 AWG tinned-copper wires imbedded in parallel self-regulating polymer core, capable of varying its heat output along its entire length. Cable shall be covered by cross-linked polyolefin dielectric outer jacket, rated for 300 volts AC (VAC) at 221 °F with VW-1 flame resistance and protected by tinned-copper braid.
 - 2. Heater cable shall operate at 110-120 VAC, single phase without use of transformers.
 - 3. Heat cable cover shall be permanently marked with manufacturer's batch or serial number. Cable jackets shall be continuously marked with manufacturer's name, catalog number,

nominal supply voltage and nominal power output in watts per foot in an equally permanent fashion. Use of temporary printing or tags is not allowed.

4. Basis of Design: 1" diameter, nominal pipe size (NPS), metallic fire protection pipe utilizing one pass of Thermon 3-FLX heating cable with 1" of fiberglass thermal insulation using 20°F as anticipated low ambient temperature.
 5. Thermon, Model PDMP or equal, power distribution and monitoring panel with thermostat shall be part of heat trace system.
 6. When requested, test certificates shall be available from manufacturer to indicate cable type, cable rating in watts/ft, voltage rating, test date, batch number, reel number, length of cable, test voltage and test amperage reading.
- B. Accessories:
1. Include necessary accessories as needed to ensure that complete and fully operational heat trace system is provided. Accessories shall include: continuity monitoring wire, power connection kits, tee kits, end seal kits, splice kits, polyester fiber attachment tape, caution labels and transformers.
 2. Accessories shall be by same manufacturer as heat cable.
 3. Include fiberglass thermal insulation as part of heat trace system.
 4. Circuit breakers, conduit, power wiring, junction boxes, and other main electrical power accessories shall be provided by Division 26 and Division 28 contractors.
 5. Circuit breakers, supplying power to heat tracing system shall be equipped with 30 mA ground-fault equipment protection. Do not provide a 5mA Ground Fault Interrupter (GFI) since nuisance tripping may result.
- C. Manufacturer:
1. Manufacturer: Thermon or equal
 2. Heat trace cable shall be FLX Self-Regulating type as manufactured by Thermon or equal, rated to provide 40°F when supplied with 110-120 VAC single-phase power.
 3. Identify cable model, manufacturer and operating temperature, and necessary supply voltage.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install system per manufacturer's installation instructions and Listing.
- B. Coordinate installation with Division 26 and Division 28 contractors.
- C. Attach heat trace cable to clean, dry, pipe with manufacturer approved polyester fiber attachment tape. Secure heat trace cable at 12) intervals as stated in manufacturer's installation instructions. Basis of design: Thermon FT-1L attachment tape or equal.
- D. Refer to manufacturer's isometric drawings, which are part of material package for heater locations, heater layout, location of power points, and load chart. Fire Protection Contractor shall obtain these isometrics and submit to Engineer for review and approval prior to installation of heating cable.
- E. Attach heat cable per manufacturer's installation instructions to effectively distribute heat along pipe and develop designated temperature. Consult manufacturer's data for sizing and spacing of heat cable strip.
- F. Attach electric heat tracing labels to insulation vapor barrier at 10 ft intervals. Basis of design: Thermon Model CL caution labels or equal.

- G. Install heat cable and appropriate accessories and controls in conformance with applicable sections of Division 26 Specifications and manufacturer's installation instructions.
- H. Power wiring, connections, breakers, conduit, and other electrical accessories necessary for heat cable power will be provided by Division 26 and Division 28 contractor. Coordinate with Division 26 and Division 28 contractors.
- I. Protect heat trace cable circuits with monitored GFI system installed per manufacturer's installation instructions. Basis of design: Thermon, Model PDMP power distribution and monitoring panel.
- J. Coordinate system's auxiliary contact installation with Division 26 and Division 28 contractors as needed.

3.2 INSPECTION

- A. Inspect heat cable installation with manufacturer's representative and electrical inspector prior to insulating piping.
- B. Manufacturer's representative shall certify that heat cable is installed per manufacturer's installation instructions and successfully tested. Refer to testing section for additional information.
- C. Documentation shall be included in Operation and Maintenance manuals.

3.3 TESTING

- A. Electrician shall measure insulation resistance of heat trace cable with 2500 volt DC (VDC) megohmmeter (megger):
 - 1. Prior to installation while cable is still on reel(s).
 - 2. After installation of heating cable and completion of circuit fabrication kits (including any splice kits) and before thermal insulation has been installed.
 - 3. After installation of thermal insulation but prior to connection of power.
- B. Insulation resistance, measured between braid and either bus wire, should be at least 20 megohms regardless of heat cable length. Record these readings for each circuit.
- C. Contractor shall test continuity of both heater bus wires to verify connection of splices or tees.
- D. If heat cable circuit fails either insulation resistance test or continuity test, electrician shall notify Fire Protection Contractor. Fire Protection Contractor must repair or replace circuits yielding unacceptable readings.

- 3.4 Megger tests may need to be witnessed by owner's representative and manufacturer's representative. Notify owner's representative and manufacturer's representative, at least 24 h in advance for participation.

END OF SECTION

SECTION 21 1314

AUTOMATIC FIRE SPRINKLER SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies materials, methods, and equipment to be used for automatic sprinkler system standpipe system and related fire protection piping to 5 ft outside building.
- B. Research indicates there is possible microbiologically influenced corrosion (MIC) existing in the area of the project.
- C. NFPA 13's seismic requirements are part of this project.
- D. This is not a Factory Mutual Global (FMG) protected property.
- E. Engineer of Record:
 - 1. Contractor shall be Engineer of Record. Contractor shall produce stamped and sealed installation drawings, which are also referred to as shop drawings in this Section, based on design criteria listed in this Section and drawings furnished by Engineer. Contract drawings show zone and main piping layouts of fire protection systems as it relates to architecture, structure, and mechanical/electrical systems.
 - a. Contractor shall provide detailed layout drawings based on submittal requirements by Local Authority. These layout drawings shall be based on system as designed by Engineer of Record. Engineer of Record shall provide hydraulic calculations to be submitted to Local Authority.

1.2 RELATED WORK

- A. Section 20 0000 - General Mechanical Requirements.
- B. Section 20 0520 - Excavation and Backfill.
- C. Section 21 0000 - General Fire Suppression Requirements.

1.3 REFERENCE

- A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.4 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. This installation shall conform to the following:
 - 2. This installation shall conform to the following:
 - a. NFPA 13, Installation of Sprinkler Systems, most recent edition.
 - b. NFPA 14, Installation of Standpipe and Hose Systems, most recent edition.
 - c. NFPA 24, Installation of Private Fire Service Mains and Their Appurtenances, most recent edition.
 - d. NFPA 30, Flammable and Combustible Liquids Code, most recent edition.
 - e. NFPA 45, Fire Protection for Laboratories Using Chemicals, most recent edition.
 - f. NFPA 72, National Fire Alarm and Signaling Code, most recent addition.
 - g. NFPA 101, Life Safety Code, most recent edition.
 - h. International Building Code (IBC), most recent edition.

- i. International Fire Code (IFC), most recent edition.
 - j. Local and State Building, Mechanical, and Fire Codes.
 - k. Underwriters Laboratories (UL) Fire Protection Equipment Directory.
- B. Contractor Installation Program:
- 1. Provide licensed persons employed by sprinkler contractor to perform planning, calculations, layout, installation, and testing of fire protection systems. The following are acceptable:
 - a. Certified sprinkler designer.
 - b. National Institute for Certification of Engineering Technologies, (NICET) Level IV.
 - c. Licensed Professional Engineer.
 - 2. Provide journeyman sprinkler fitter(s) for installation and supervision.
 - 3. Contractor shall be licensed in the State of California for installation of fire protection systems.
 - 4. Contractor shall submit pre-qualification evidence of at least 3 projects of comparable size successfully completed with their Bid.
 - 5. Distortion or misrepresentation of qualification evidence may result in contract cessation.
- C. Electrical Coordination
- 1. All relays, wire, conduit, pushbuttons, pilot lights, and other devices required for power side or the control of electrical equipment shall be furnished by Division 26 and Division 28 contractors, except as specifically noted elsewhere in this specification.
 - 2. Should any change in electrical equipment size, horsepower rating or means of control be made to any motor or other electrical equipment after contracts are awarded, sprinkler contractor is to immediately notify Division 26 and Division 28 contractors of this change and pay any costs due to this change.
 - 3. Division 26 contractors shall provide all power wiring and sprinkler contractor shall be responsible for providing all control wiring and its conduit. Control wiring shall conform to Division 26 and 28 requirements for control wiring.
 - 4. Sprinkler contractor shall provide exterior waterflow alarm and coordinate installation with Division 26 and Division 28 contractors.
 - 5. Furnish wiring diagrams to Division 26 and Division 28 contractors for equipment and devices furnished by sprinkler contractor which have been indicated to be wired by Division 26 and Division 28 contractors.

1.5 SUBMITTALS

- A. Shop Drawings on Items Specified:
- 1. Pipe, Fittings, and Joints.
 - 2. Valves.
 - 3. Tamper Switches.
 - 4. Flow Switches.
 - 5. Exterior Weatherproof Waterflow Alarm.
 - 6. Sprinkler Heads.
 - 7. Hanger Assemblies.
 - 8. Pressure Gauges.
 - 9. Hydraulic Calculations.
 - 10. Drawings.
 - 11. Seismic Restraint Detailing.
- B. Submit Material Safety Data Sheet (MSDS) for corrosion inhibitive paint.
- C. Include items listed in product section and additional items required to provide complete installation.

- D. Indicate by red marking or arrow, items that are to be provided, where more than 1 item appears on manufacturer's catalog sheet.
- E. Submit stamped and sealed drawings, product data sheets, and hydraulic calculations to Engineer and Owner's insurance representative prior to installation or fabrication of system components.
- F. Submit stamped and sealed drawings, product data sheets, and hydraulic calculations to local Fire Department prior to installation or fabrication of system components.
- G. Include copy of Fire Department plan review letter in submission to Engineer.
- H. Review of submittals does not relieve Contractor from coordinating installation of work with other trades, or from compliance with Codes and Standards.
- I. At completion of acceptance tests:
 - 1. Send copy of test log to Engineer.
 - 2. Send copy of Contractor's Material and Test Certificates to:
 - a. Engineer.
 - b. Owner.
 - c. Authority Having Jurisdiction.
 - 3. Provide Owner with following:
 - a. Manufacturer's literature and instructions describing operation and maintenance of equipment and devices installed.
 - b. Typewritten chart with identification and location of all access panels serving equipment and valves. Incorporate into Operation & Maintenance (O&M) manual.
 - c. Typewritten valve schedule indicating valve number, fixture/equipment or areas served by each numbered valve. Incorporate into O&M manual.
 - d. Refer to Section 20 0000 - General Mechanical Requirements for additional O&M manual requirements.
 - e. Current copy of NFPA 25, Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials and Equipment:
 - 1. Materials and equipment in system shall be new and current products of manufacturer regularly engaged in production of such materials and equipment.
 - 2. Where 2 or more pieces of equipment are required to perform interrelated functions, they shall be products of same manufacturer.
 - 3. Clean and cap pipe after fabrication and prior to placing pipe in building.
 - 4. Mark pipe with tags that can be removed during installation so no permanent markings remain on unpainted pipe located in exposed areas.
- B. Approval Guides:
 - 1. Unless otherwise shown, products shall be UL Listed in the latest publication of the UL Fire Protection Equipment Directory or approved in the latest Factory Mutual Research Corporation Approval Guide for service intended.

2.2 PIPE

A. Below Ground:

1. Pipe: Ductile iron, Class 52, American Water Works Association (AWWA) C151, 150 psi working pressure, with standard cement mortar lining, AWWA C104, American National Standards Institute (ANSI) A21.4
2. Fittings: Ductile iron or grey iron, mechanical joint, cement mortar lined, Class 250, AWWA C110.
3. Encasement: Polyethylene encasement, 8 mil thick, AWWA C105.

B. Above Ground:

1. Carbon Steel, 2" and smaller:
 - a. Pipe: Carbon steel pipe, Schedule 40, American Society for Testing of Materials (ASTM) A795, A53, or A135.
 - b. Fittings:
 - 1). Malleable iron, threaded, Class 125, 175 psi Cold Water Pressure (CWP) rating, ANSI B16.3.
 - 2). Cast iron, threaded, Class 125, 175 psi CWP rating, ANSI B16.4.
 - 3). Cast iron, flanged, Class 125, 175 psi CWP rating, ANSI B16.1.
 - 4). Carbon steel butt weld, ASTM A234 Grade WPB/American Society of Mechanical Engineers (ASME) B16.9, standard weight, seamless.
 - c. Joints:
 - 1). Threaded, tapered pipe threads, ANSI B1.20.1.
 - 2). Flanged, cast iron, 175 psi CWP rating, ANSI B16.1, square head machine bolts with semi-finished hexagon nuts, ASTM A183, neoprene gasket.
 - 3). Welded, welding electrodes shall be Lincoln or equal with coating and diameter as recommended by manufacturer for type and thickness of work being done.
2. Carbon Steel, larger than 2":
 - a. Pipe: Carbon steel pipe, Schedule 40, ASTM A795, ASTM A53, or A135.
 - b. Fittings:
 - 1). Carbon steel butt weld, ASTM A234 Grade WPB/ASME B16.9, Schedule 40, seamless.
 - 2). Ductile iron or malleable iron, roll grooved for mechanical coupling, 175 psi CWP rating, malleable iron conforming to ASTM A47. Fitting, gasket, and coupling shall be furnished by same manufacturer.
 - a). Acceptable manufacturers: Anvil Gruvlok, Tyco Grinnell, Victaulic, Viking, or equal.
 - c. Joints:
 - 1). Welded, welding electrodes shall be Lincoln or equal with coating and diameter as recommended by manufacturer for type and thickness of work being done.
 - 2). Cut Groove.
3. Flexible sprinkler hose fittings for fire protection service shall be manufactured by FlexHead Industries, Inc., 56 Lowland St., Holliston, MA 01746; Telephone: (800) 829-6975. No substitutions allowed. Product shall be FMRC approved for its intended use pursuant to FM 1637 Approval Standard for Flexible Sprinkler Hose with Threaded End Fittings. Product shall be UL Listed for its intended use pursuant to UL 2443 Standard for Flexible Sprinkler Hose with Fittings for Fire Protection Service. For seismic projects, product shall be seismically qualified for use pursuant to ICC-ES AC-156 Acceptance Criteria for Seismic Qualification by Shake-Table Testing of Nonstructural Components and Systems. Provide high pressure fittings where pressures exceed 175 psi water working pressure. Model numbers on high pressure fittings must include the "H" suffix.
 - a. FlexHead Flexible Hose Assemblies and End Fittings:
 - 1). Composition: 100% Type 304 Stainless Steel.
 - 2). Shall be fully welded non-mechanical fittings, braided, leak-tested with minimum 1" true-bore internal corrugated hose diameter.

- 3). Straight Hose Assembly Lengths: 2 ft length, Model #2024; 3 ft length, Model #2036; 4 ft length, Model #2048; 5 ft length, Model #2060; 6 ft length, Model #2072.
 - 4). Elbow Hose Assembly lengths: 2 ft length, Model 2024E; 3 ft length, Model #2036E; 4 ft length, Model #2048E; 5 ft length, Model #2060E; 6 ft length, Model #2072E.
- b. FlexHead Ceiling Bracket:
- 1). Composition: Type G90 Galvanized Steel.
 - 2). Type: Direct attachment type, having integrated snap-on clip ends positively attached to the ceiling using tamper-resistant screws.
 - 3). Flexible hose attachment: Removable hub type with set screw]
4. Provide metal pipe's exposed threads with corrosion inhibitive paint, equal to Rust-Oleum.
 5. Provide pipe identification system with flow directional arrows on fire protection pipe. For additional information about pipe identification, refer to Section 20 0553 - Mechanical Systems Identification.
 6. Plain end couplings (Roust-A-Bouts, Plainloks or similar couplings) are not allowed on either new or existing sprinkler systems.

2.3 VALVES

- A. Gate Valve:
1. Acceptable manufacturers: Kennedy, Milwaukee Valve Co., Mueller, Nibco, Stockham, Victaulic, or equal.
 2. Outside screw and yoke (OS&Y), gate valve, bronze body and trim or cast iron body bronze mounted and rated for 175 psi, non-shock cold water working pressure, Nibco, F-607-OTS or equal.
 3. Provide high pressure valves when pressures exceed 175 psi water working pressure.
- B. Check Valve:
1. Acceptable manufacturers: Reliable, Tyco Fire Products, Victaulic, Viking, or equal.
 2. Iron body, bronze seat, stainless steel clapper with a replaceable rubber seal. Tyco Fire Products, CV-1F, Viking Model, G-1 or equal.
 3. Provide high pressure valves and fittings when pressures exceed 175 psi water working pressure.
- C. Check Valve (Anti-Water-Hammer type)
1. Acceptable manufacturers: Reliable, Tyco Fire Products, Victaulic, Viking, or equal.
 2. Ductile iron conforming to ASTM A536, Grade 65-45-12, rust inhibiting coating, sizes 2" to 5" consisting of stainless steel clapper conforming to ASTM A-167 and for sizes 6" to 8" consisting of ductile iron clapper conforming to ASTM A-536. Equal to Gruvlok Series 78FP.
 3. Provide high pressure valves and fittings where pressures exceed 175 psi water working pressure.
- D. Ball Valve:
1. Acceptable manufacturers: Milwaukee Valve Co., Mueller, Nibco, Stockham, Victaulic, or equal
 2. Provide high pressure valves and fittings when pressures exceed 175 psi water working pressure.
- E. Butterfly Valve:
1. Acceptable manufacturers: Kennedy, Milwaukee Valve Co., Mueller, Nibco, Stockham, Tyco Fire Products, Victaulic, or equal.
 2. Milwaukee Valve Co., Series BB for valve sizes 1" to 2-1/2" or equal.

3. Kennedy Valve Co., Fig. G300 for sizes 2-1/2" to 6", Victaulic, Series 705 Firelock for valve sizes 2-1/2" to 8", or equal.
 4. Provide high pressure valves and fittings when pressures exceed 175 psi water working pressure.
- F. Provide identification sign (enamel on metal) for valves per NFPA requirements. For additional information, refer to Section 20 0553 - Mechanical Systems Identification.
- G. Valves in galvanized piping shall be bronze.

2.4 TAMPER SWITCH

- A. Acceptable manufacturers: Potter Electric Signal Co., System Sensor, or equal.
- B. Outside screw and yoke (OS&Y) supervisory switch, NEMA 4 enclosure, provided with 2 sets of SPDT (Form C) contacts rated at 2.5 Amps at 30 VDC and 15 Amps at 125/250 VAC. Provide with optional cover tamper kit. For areas identified as hazardous locations, provide "EX" Model. Potter Electric Signal Co., OSY series or equal.
- C. Control valve supervisory switch, NEMA 4 enclosure, provided with 2 sets of contacts rated at 2.5 Amps at 30 VDC and 15 Amps at 125/250 VAC. Provide with optional cover tamper kit. For areas identified as hazardous locations, provide "EX" Model. Potter Electric Signal Co., PIBV series or equal.
- D. Tamper switch shall be capable of transmitting signal during first 2 revolutions of handwheel or during 1/5 of travel distance of valve control apparatus from its normal position.
- E. Unit shall be compatible with building's fire alarm system.

2.5 FLOW SWITCH

- A. Acceptable manufacturers: Potter Electric Signal Co., System Sensor, or equal.
- B. Vane type waterflow switch for use in wet sprinkler systems, minimum 300 psi service pressure rating, 10 gpm minimal flow rate to activate alarm, and 2 sets of SPDT (Form C) contacts. Provide with optional cover tamper kit. Equal to Potter Electric Signal Co., VS series.
- C. Unit shall be compatible with building's fire alarm system.

2.6 SPRINKLER HEAD

- A. Manufacturers:
1. Unless otherwise noted below, shall be manufactured by Reliable, Tyco Fire Products, Viking, or equal.
- B. Automatic, having temperature and pressure rating suitable for location.
- C. Architect will review deviations from specified styles for approval prior to installation.
- D. Provide the following type of sprinkler head.
- E. Provide the following type of sprinkler head.
1. Type A: Unfinished areas such as mechanical spaces.
 - a. Standard Coverage, Brass Upright or Pendent, ordinary temperature class (155°F), Tyco Fire Products, Model TY-FRB. Viking, Microfast or equal.

2. Type B: In areas with ceilings:
 - a. Concealed Pendent, ordinary temperature class (155°F) solder link, Tyco Fire Products, Model RFII, Viking, Mirage, adjustable sprinkler, with 139°F temperature class cover plate, flush with ceiling or equal. Cover plate color shall match ceiling color and shall be factory-painted (i.e. by manufacturer).
 3. Type C: In areas where ceiling conditions do not permit installation of pendent head or finished area where sidewall head provides better coverage of hazard:
 - a. Standard Coverage, chrome finish, sidewall, ordinary temperature class (155°F), Tyco Fire Products, Model TY-FRB, Viking Microfast, HSW horizontal or VSW vertical sidewall with Viking Microfast Model F-1 adjustable escutcheon or equal.
 4. Type D: In areas requiring window sprinkler protection.
 - a. 155°F horizontal sidewall Tyco Fire Products, Model WS, quick-response or equal.
- F. Submit samples for examination and approval when appearance is different than sprinkler head specified.
 - G. Temperature class of sprinkler heads shall vary if installed close to heat sources, under skylights or in special hazard areas. Refer to NFPA 13 for requirements.
 - H. Provide high pressure sprinklers where pressures exceed 175 psi working water pressure.
 - I. Sprinkler Cabinets:
 1. Shall be complete with required number of spare sprinkler heads of each type and temperature rating per NFPA 13.
 2. Shall be provided with at least one sprinkler wrench for each type of sprinkler installed.
 3. Provide multiple cabinets to meet this requirement.
 4. Coordinate cabinet locations with Owner's representative.

2.7 HANGERS

- A. Acceptable manufacturers: Afcon, Anvil, B-Line, Tolco, or equal.
- B. Concrete expansion hangers, when provided, are to be Hilti, Phillips, Powers, or equal.
- C. Hanger rods shall comply with Manufacturer Standardization Society (MSS) standards and manufacturer's published load rating.
- D. Provide hanger rod, hanger rod attachments, bolts, u-bolts, nuts, studs and washers with electroplated zinc coating or with hot-dipped galvanized finish.
- E. Riser clamps shall be electroplated zinc coated or have a hot-dipped galvanized finish and shall not protrude more than 2" beyond edge of hole. Provide Anvil Fig. 261 or equal.

2.8 EARTHQUAKE BRACING

- A. Sprinkler and standpipe system shall be protected from earthquake influence in accordance with requirements of NFPA 13.
- B. Provide flexible couplings, bracing, and other components required, compatible with piping material and jointing system used.
- C. Seismic detailing shall be included on contractor's fire protection system installation drawings.
- D. Seismic support shall be in accordance with FMG Property Loss Prevention Data Sheet 2-8, Earthquake Protection for Water-Based Fire Protection Systems.

2.9 DIELECTRIC FITTINGS

- A. Acceptable manufacturers: Epco Sales, Lochinvar, Watts Regulator Co., Wilkins, or equal.
- B. Insulating nipple, metal casing, inert thermoplastic lining, Clearflow dielectric fitting by Perfection Corporation.
- C. Dielectric unions 2" and smaller; dielectric flanges 2" and larger; with iron female pipe thread to copper solder joint or brass female pipe thread end connections, non-asbestos gaskets, and pressure rating of not less than 175 psig at 180°F. Provide high pressure type when pressures exceed 175 psi water working pressure.

PART 3 - EXECUTION

3.1 DESIGN CRITERIA

- A. Flow Test:
 - 1. Static Pressure: 55 psig
 - 2. Residual Pressure: 53 psig with 1190 gpm
 - 3. Flow test performed at Administration Building
 - 4. Test Date: December 2013
 - 5. Test Time: Information not provided
 - 6. Elevation of pressure-test hydrant: Information not provided
 - 7. Test information supplied by: Roche Molecular Systems
- B. Sprinkler Contractor, prior to preparation of installation drawings and hydraulic design calculations, shall ensure that a hydrant flow test is conducted within the last 12 months.
- C. Send current hydrant flow test data to Engineer.
- D. Hydraulically calculated system shall be designed to a minimum of 10% below available water flow curve.
- E. Systems that are hydraulically calculated must include 1.2 factor for design area.
- F. Basis of Design:
 - 1. Office areas and general building spaces shall be hydraulically designed to provide minimum density of 0.15 gpm per sq ft over most hydraulically remote 1500 sq ft. Maximum spacing shall not exceed 225 sq ft per head.
 - 2. Mechanical equipment areas shall be hydraulically designed to provide minimum density of 0.20 gpm per sq ft for most remote 1500 sq ft. Maximum spacing shall not exceed 130 sq ft per head.
 - 3. General storage areas shall be hydraulically designed to provide minimum density of 0.15 gpm per sq ft over most hydraulically remote 1500 sq ft. Maximum spacing shall not exceed 130 sq ft per head.
- G. Fire Protection System Layout and Installation Drawings:
 - 1. Contractor shall review Design Drawings and Specifications, and shall provide installation drawings, calculations, and product data sheets.
 - 2. Conceal sprinkler piping above ceilings where possible.
 - 3. Contractor shall consult with Architect during development of piping layout to avoid conflicts with general appearance. Pipe routing is a critical issue due to attributes of this building.
 - 4. Submit stamped and sealed installation drawings, calculations and product data sheets for coordination review to: architect, insurance carrier, City of Pleasanton and other Authorities Having Jurisdiction prior to installation (see submittals).

5. Contractor shall be responsible to have examined "Reflected Ceiling" drawings as well as Mechanical, Electrical, Piping, Information Technology, Structural and Architectural building plans prior to system layout.
6. Contractor shall coordinate routing of piping with other trades and Architect.
7. Contractor shall participate in coordination process and shall not install piping prior to coordination with other trades.

3.2 INSPECTION

- A. Investigate site conditions; verify utility locations and elevations before start of excavation. Forward discrepancies to Architect/Engineer before proceeding with construction.

3.3 INSTALLATION

- A. Install hydraulically designed sprinkler system and associated accessories according to requirements of NFPA 13 and as shown on drawings.
- B. Install hydraulically designed standpipe system and associated accessories according to requirements of NFPA 14 and as shown on drawings.
- C. Install pipe, fittings, couplings, and valves according to requirements of manufacturer.
- D. Keep materials within listed temperature range to assure jointing in accordance with manufacturer's requirements.
- E. Pipe and fittings shall be of corresponding materials when assembled.
- F. Below Ground Pipe:
 1. Anchors and tie rods can be provided in lieu of thrust blocks. Tie rods shall be 3/4" diameter steel rod. Clamps shall be 3/8" thick by 2" wide steel. Each clamp shall be secured with four 5/8" diameter bolts.
 2. Apply asphaltum or approved corrosion inhibitive paint, to tie rods, clamps and bolts of underground pipe.
 3. Provide metallic bond at each joint of ductile iron and cast iron pipe. Bond wire shall be type RHW-USE size 1/0 neoprene-jacketed copper conductor shaped to stand clear of joint.
- G. Above Ground Pipe:
 1. Provide pipe identification system with flow directional arrows on fire protection pipe in accordance with manufacturer's installation instructions.
 2. Coat exposed threads with corrosion inhibitive paint, equal to Rust-Oleum. Apply paint per manufacturer's instructions.
- H. Provide readily removable fittings at end of cross-mains. Minimum size of flushing connection shall be 2".
- I. Provide test connection for each flow switch.
- J. Discharge test connections inside building to receptacles provided as part of plumbing system or to standpipe's drain riser. Outside discharge shall not be allowed.
- K. Provide auxiliary drains at low points of systems per requirements of NFPA 13.
- L. Identify valve with brass tag denoting which flow switch is being tested, when test valves are located remote from flow switch.
- M. Clamp-on or saddle type fittings are not allowed. Outlet fittings inserted into holes drilled into piping or pipe-lets are not allowed.

- N. Provide reducing fittings or provide shop fabricated weld-o-lets to change pipe sizes in sprinkler/standpipe systems. No bushings or grooved reducing couplings, such as Victaulic, Style 750, are allowed.
- O. Feed sprinkler heads, installed in finished ceilings, with swing joint, or return bend arrangement for final positioning in ceiling grid pattern during construction phases.
- P. Sprinklers are required to be installed in the center of ceiling tiles.
- Q. Provide minimum 1" outlets with sprigs or drops for sprinklers located in shelled spaces.
- R. Install tamper switch on each shutoff valve.
- S. Install locking device with each shutoff valve to prevent inadvertent closing of valve. Keys shall be indexed to identify valve location.
- T. Install sprinkler heads as recommended by manufacturer. Sprinklers shall be set level and at locations to avoid interference with spray pattern of sprinkler. When ducts and lights are obstructions to sprinkler distribution, provide additional heads beneath obstruction
- U. Make joints of threaded pipe by cutting pipe square and reaming inside.
- V. Use joint compound sparingly.
- W. Install joints for mechanical coupled pipe according to manufacturer's recommendations. Use manufacturer's gasket lubricant sparingly.
- X. Pipe grooving shall be per coupling manufacturer's instructions.
- Y. Welded joints shall be made in fabrication shop. No welding allowed at project site.
- Z. Hangers, Bracing, and Restraint of System Piping:
 - 1. Provide hangers and associated parts to support piping in perfect alignment without sagging or interference, to permit free expansion and contraction, and meet requirements of NFPA 13 and manufacturer's installation instructions.
 - 2. Select and size building attachments per Manufacturer Standardization Society (MSS) standards and manufacturer's published load rating.
 - 3. Coordinate hanger support installation to group piping of all trades.
 - 4. Hang pipe from building members using either concrete inserts for concrete construction or beam clamps for steel construction. Installation shall comply with manufacturer's installation instructions. Expansion type inserts may be used for branch piping.
 - 5. Restraining clips/clamps are required in locations where vibration may be a concern.
 - 6. Suspend hangers by means of electroplated zinc or hot-dipped galvanized finish hanger rods. Perforated band iron and flat wire straps (strap iron) are not allowed.
 - 7. Mains parallel to joists shall not be supported from a single joist. Mains parallel to joists shall be supported by trapeze hanger and be positioned equally between two joists. Trapeze hangers shall be positioned to load joists at panel points only.
 - 8. Support pipe from top flange of joists and beams.
 - 9. Do not support equipment or piping from metal roof deck.
- AA. Support piping in accordance with NFPA 13 and in accordance with State and Local seismic restraint requirements.
- BB. Include seismic restraint details with sprinkler installation drawings.
- CC. Install flexible fitting at building's expansion joints per manufacturer's instructions.

DD. Install pressure gauges as required in manufacturer's installation instructions, and as required per NFPA standards.

3.4 CLEANING

A. Ensure underground feed pipe has been flushed per NFPA 24 Installation of Private Fire Service Mains and Their Appurtenances, to clear out construction debris, prior to connecting aboveground fire protection system to it.

B. Flush sprinkler system serving server room(s) to purge cutting oil, debris and metal fines.

3.5 TESTING

A. Refer to testing paragraph of Section 20 0000 - General Mechanical Requirements.

B. Coordinate fire pump test with Division 26 and Division 28 contractors.

C. Perform all NFPA required acceptance tests.

D. Test sprinkler system as entire system or partial system. System shall be hydrostatically tested at not less than 200 psi or 50 psi above static pressure in excess of 150 psi for 2 h. No leakage allowed. Replace defective joints with new materials. No caulking of defective joints allowed. Re-test system after defective joints are replaced, until satisfactory results are obtained.

E. Hydrostatically test piping between the exterior fire department connection (FDC) and the check valve in the fire department inlet pipe in the same manner as the balance of the system.

F. Pipe shall not be concealed until satisfactorily pressure tested.

G. In addition to hydrostatic test, dry pipe system shall be air pressure tested at 40 psi for 24 h. Leakage in excess of 1-1/2 psi during 24 h will not be permitted.

H. Conduct drain test. Record static pressure and residual pressure per NFPA 13.

I. Owner's representative or engineer may witness tests. Contractor shall notify Owner and Engineer a minimum of 3 days in advance to allow for participation.

J. Log of tests shall be kept at job site and shall identify:

1. Who performed test.
2. Time of test.
3. Date of test.
4. Section of system tested.
5. Results of test.
6. Completed Contractor's Material and Test Certification form(s) from NFPA 13 and NFPA 14.

K. Operate flow switches to test that signals are transmitted to Fire Alarm Control Panel.

L. Include test for tamper switches.

END OF SECTION

SECTION 22 0000

GENERAL PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Specification requirements defined in Division 20 of this Specification apply to, and are in addition to the work associated with equipment, systems, materials, and installation requirements specified in Division 22. Contractor shall provide the requirements specified in Division 20 to obtain complete systems, tested, adjusted, and ready for operation.

1.2 RELATED WORK

- A. Section 20 0000 - General Mechanical Requirements
- B. Section 20 0520 - Excavation and Backfill
- C. Section 20 0700 - Mechanical Systems Insulation

PART 2 - PRODUCTS

2.1 NOT APPLICABLE TO THIS SECTION.

PART 3 - EXECUTION

3.1 NOT APPLICABLE TO THIS SECTION.

END OF SECTION

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SECTION 22 1114
EXTERIOR SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section lists materials and methods for utility piping systems outside footprint of building(s) under construction. Provide piping extensions to and from 5 ft. of construction indicated and necessary to complete each service connection with utilities. Maintain pitch and depth of cover noted and necessary for utility connections and piping protections. Repair damaged areas to existing conditions.
- B. Provide connections to utility services. Include connections, fees and assessments in Bid.

1.2 RELATED WORK

- A. Section 20 0520 - Excavation and Backfill.

1.3 REFERENCE

- A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.4 QUALITY ASSURANCE

- A. Order piping with each length marked with manufacturer's name or trademark and type of pipe; with each shipping unit marked with purchase order number, metal or alloy designation, temper, size, and supplier's name.
- B. Installed material not meeting specification requirements must be replaced with material that meets these Specifications without additional cost to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Promptly inspect shipments to insure material is undamaged and complies with Specifications.
- B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends from damage. End caps shall remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.
- C. Off-site storage agreements will not relieve Contractor from using proper storage techniques.
- D. Storage and protection methods must allow inspection to verify products.

1.6 SUBMITTALS

- A. Manufacturer's technical data for the following:
 - 1. Sanitary pipe and fittings.
 - 2. Storm pipe and fittings.
 - 3. Water main pipe and fittings.
 - 4. Joints.
- B. Shop drawings on items specified herein.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials specified herein shall be new unless otherwise noted.

2.2 SANITARY SEWER PIPE AND FITTINGS

- A. Underground 15" and Smaller:
 - 1. Cast iron
 - a. Pipe: Cast iron soil pipe, hub and spigot, service weight, ASTM A74.
 - b. Fittings: Cast iron, hub and spigot, service weight, ASTM A74.
 - c. Joints: Neoprene rubber compression gaskets, ASTM C564.

2.3 STORM SEWER PIPE AND FITTINGS

- A. Underground 15" and Smaller:
 - 1. Cast iron
 - a. Pipe: Cast iron soil pipe, hub and spigot, service weight, ASTM A74.
 - b. Fittings: Cast iron, hub and spigot, service weight, ASTM A74.
 - c. Joints: Neoprene rubber compression gaskets, ASTM C564.

2.4 WATER MAIN PIPE, FITTINGS AND VALVES

- A. Underground 3" and Larger:
 - 1. Ductile Iron
 - a. Pipe: Ductile iron, Class 52, AWWA C151; with standard cement mortar lining, AWWA C104.
 - b. Fittings:
 - 1). Ductile iron or gray iron, mechanical joint, cement mortar lined fittings, Class 250, AWWA C110.
 - 2). Ductile iron, mechanical joint compact fittings, Class 350, AWWA C153.
 - c. Joints: Joint shall be restrained type equal to EBAA Iron Megalug 1100 restraint system for mechanical joint for ductile iron pipe, AWWA C111/A21.11 and AWWA C153/A21.53. Joints shall be designed to accommodate deflection after assembly up to 3°.
 - d. Encasement: Provide 8 mil tube or sheet polyethylene encasement of iron pipe and pipe fittings, AWWA C105.
- B. Thrust Restraints:
 - 1. 2500 psi concrete; retainer glands; restrained joint fittings; steel rods, ASTM A575; steel clamps and straps, ASTM A506; steel bolts, ASTM A307; malleable iron rod couplings, ASTM A197; cast iron washers, ASTM A307; bitumastic anti-corrosion coating.
 - 2. Bondstrand Series 3200 filament wound fiberglass reinforced epoxy pipe and fittings with internal epoxy liner and exterior coating. Rated for 200 psi at 150°F, UL listed/FM approved.

2.5 FIRE WATER MAIN PIPE, FITTINGS AND VALVES

- A. Underground 4" and Larger:
 - 1. Pipe and Fitting material shall match material per Civil design, NFPA, and local authority underground pipe requirements.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify local utility datum and baseline information prior to start of construction. Notify Architect or Engineer of discrepancies before proceeding with construction. Verify existing piping inverts and elevations prior to excavation for new installation, and notify Engineer of deviations.
- B. Investigate site conditions verify utility locations and elevations before start of excavation. Discrepancies will be checked with Engineer before proceeding with construction.

3.2 SANITARY SEWER

- A. Install exterior piping below predicted frost level and not less than 5 ft. bury depth to top of pipe wherever possible. Where piping is located above predicted frost level, provide frost protection in accordance with SPS 382.30.
- B. Install sewer lines in straight alignment. Changes of directions shall be made by use of proper fittings or manholes. No joint deflection allowed. Install sewers at uniform grade between manholes unless otherwise noted.

3.3 STORM AND CLEARWATER WASTE SEWER

- A. Verify invert elevations and building elevations prior to installation. Install exterior piping pitched to drain at indicated elevations and slope.
- B. Install exterior piping below predicted frost level and not less than 5 ft. bury depth to top of pipe wherever possible. Where piping is located above predicted frost level, provide frost protection in accordance with SPS 82.30.
- C. Install sewer lines in straight alignment. Make changes of directions by use of proper fittings or manholes. No joint deflection allowed. Install sewers at uniform grade between manholes unless shown or otherwise noted.
- D. Install pipe and fittings according to recommendations of pipe manufacturer. Keep material at proper temperature to assure proper jointing.

3.4 WATER MAIN

- A. Install exterior water piping below predicted frost level in accordance with Comm Table 82.30-6, but in no case less than 6 ft. bury depth to top of pipe.
- B. Maintain minimum of 8 ft. horizontal distance between 2-1/2" and larger water piping and sanitary sewer piping. Maintain minimum of 30" horizontal and 12" vertical distance, water on top, between 2" and smaller water piping and sanitary sewer piping. Where water piping crosses sanitary sewer, provide minimum 18" vertical clearance and waterproof PVC water pipe sleeve (reference sanitary sewer materials) sealed at both ends for distance of 10 ft. from sewer in both directions.
- C. Provide thrust blocks or restrained joints for water mains, sized 3" and larger. Thrust blocks shall be sized as shown on drawings. Provide thrust blocks at each change of direction exceeding 15 degrees and each fitting.
- D. Provide thrust restraints for 3" and larger exterior water piping joints, hydrants, caps, plugs, fittings and bends of 22-1/2 degrees or more. Pour concrete thrust blocks against compacted or undisturbed soil. Where soil bearing capacity is less than 2000 psf or adjacent construction may affect soil bearing capacity, use both concrete thrust blocks and strapped/rodded restraints or

restrained joints. Field apply continuous anti-corrosion coating to strapped and rodded restraint components. Protect mechanical joints, nuts and bolts from concrete cover.

- E. Anchors and tie rods can be provided in lieu of thrust blocks. Tie rods shall be 3/4" diameter steel rod. Clamps shall be 3/8" thick by 2" wide steel. Each clamp shall be secured with four 5/8" diameter bolts. Tie rods, clamps and bolts shall be liberally coated with asphaltum.
- F. Install Bondstrand fiberglass reinforced epoxy pipe per manufacturer's installation recommendations.

3.5 UNDERGROUND PIPE WRAP

- A. Use for steel piping encased in concrete or underground not in conduit. Remove dirt and other foreign material from exterior of pipe. Apply primer as recommended by manufacturer. Use spiral wrap process for applying tape to pipe. Repair breaks in tape coating caused by installation process.

3.6 BONDING

- A. Provide cast iron and ductile iron pipe with metallic bonding strap to produce electrical conductivity without field welding at each joint. Bond wire shall be Type RHW-USE size 1/0 neoprene-jacketed copper conductor shaped to stand clear of joint. Copper inserts in gaskets may be used in lieu of bonding straps.
- B. Provide plastic water main with trace wire. Tape wire to plastic pipe to prevent movement during backfilling.

3.7 CLEANING

- A. Before testing, water mains and sewers shall be flushed to clean construction debris from mains and sewers. Valves and fire hydrants shall be operated to insure proper functioning, including drainage through weep holes.

3.8 TESTING

- A. Hydrostatically test water mains at 1-1/2 times working pressure, but in no case greater than 150 psi, for minimum of 2 h. No leakage shall occur. If leakage is evident, defective joint or fitting shall be replaced with new material; no caulking of leaking joints allowed. After repair is made system shall be retested. Do not backfill piping until successfully tested.
- B. Where water mains are installed as fire mains, test per NFPA Pamphlet 24 at 200 psi or 50 psi above normal system pressure, whichever is greater for minimum of 2 h.
- C. Sewer lines shall be tested for leakage by either infiltration tests or exfiltration tests, as appropriate. Prior to testing for leakage, trench shall be backfilled up to at least lower half of pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving joints uncovered to permit inspection.
- D. Visible leaks encountered shall be corrected regardless of leakage test results. When water table is 2 ft. or more above top of pipe at upper end of pipe line section to be tested, infiltration shall be measured using suitable weir or other device acceptable to Engineer.
- E. When Engineer determines infiltration cannot be properly tested, exfiltration test shall be made by filling line to be tested with water so that head of at least 2 ft. is provided above both water table and top of pipe at upper end of pipe line. Filled line should be allowed to stand until pipe has reached its maximum absorption, but not less than 4 h.

- F. After absorption, head shall be re-established. Amount of water required to maintain this water level during 2 h test period shall be measured.
- G. Leakage as measured by either infiltration test or exfiltration test shall not exceed 0.4 gallons per inch diameter per 100 ft. of pipe line per h. When leakage exceeds maximum amount specified, make corrections and retest.

3.9 DISINFECTION

- A. Disinfect water piping in the following manner:
 - 1. Clean and flush water pipe with water until water at remote tap is clear.
 - 2. Fill water systems with solution containing 50 ppm of chlorine (minimum concentration). Allow solution to stay in water system for 24 h. Alternate use solution of 200 ppm of chlorine (minimum concentration) for 3 h.
 - 3. Flush water system of chlorine solution.
 - 4. Allow clean water to stand in system for 24 h. Take sample from remote tap for bacteriological test.
- B. Do not use water system for potable water supply until safe bacteriological test is obtained. Repeat steps 1 through 4 until safe water system is obtained.

3.10 BACTERIOLOGICAL TESTS

- A. Take representative water samples and test to ensure bacteriologically safe water supply system. Include HPC (Heterotrophic Plate Count) test and test for presence of *Pseudomonas aeruginosa* and regular coliform bacteria test. HPC test maximum containment level of 500 organisms/ml. Perform bacteriological tests shortly before Owner's acceptance of building. If tests fail, make corrections and retest.
- B. Prior to connection to existing inactive water main or building branch main, perform bacteriological tests specified herein after pre-flushing main. If test fails, notify Engineer and Owner prior to proceeding further.

END OF SECTION

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SECTION 22 1118

WATER DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section covers interior domestic cold water, domestic hot water (140°F), domestic hot water return, nonpotable cold water and trap filler lines to a point 5 ft outside building wall.
- B. All components shall comply with NSF-372 to be compliant with requirement for lead content of ≤0.25% maximum weighted average.

1.2 RELATED WORK

- A. Section 20 0520 - Excavation and Backfill.
- B. Section 20 0700 - Mechanical Systems Insulation.
- C. Section 22 1114 - Exterior Services.

1.3 REFERENCE

- A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.4 QUALITY ASSURANCE

- A. Order pipe with each length marked with manufacturer's name or trademark and type of pipe; with each shipping unit marked with purchase order number, metal or alloy designation, temper, size, and supplier's name.
- B. Installed material not meeting specification requirements must be replaced with material that meets these Specifications without additional cost to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Promptly inspect shipments to ensure material is undamaged and complies with specifications.
- B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends from damage. End caps shall remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.
- C. Offsite storage agreements will not relieve Contractor from using proper storage techniques.
- D. Storage and protection methods must allow inspection to verify products.
- E. Before shipping, piping shall be cleaned, free of rust and scale, and chemically treated to protect inside of pipe from rusting, and furnished with end caps.

1.6 SUBMITTALS

- A. Manufacturer's technical data for the following:
 - 1. Pipe.
 - 2. Fittings.

3. Joints.
4. Dielectric fittings.

B. Shop Drawings on items specified herein.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials as specified shall be new unless otherwise noted.

2.2 PIPE, FITTINGS, AND JOINTS

A. Pipe, fittings, and joints for Water Main in Section 22 1114 - Exterior Services to 5 ft from outside building wall.

B. Underground 3" and Larger:

1. Ductile Iron:

- a. Pipe: Ductile iron, Class 52, AWWA C151, with standard cement mortar lining, AWWA C104.
- b. Fittings:
 - 1). Ductile iron or grey iron, mechanical joint, cement mortar lined, Class 250, AWWA C110.
 - 2). Ductile iron, mechanical joint compact fittings, Class 350, AWWA C153.
- c. Joints: Joint shall be restrained type equal to EBAA Iron Megalug 1100 restraint system for mechanical joint for ductile iron pipe, AWWA C111/A21.11 and AWWA C153/A21.53. Joints shall be designed to accommodate deflection after assembly up to 3°.
- d. Encasement: provide 8 mil tube or sheet polyethylene encasement of iron pipe and pipe fittings, AWWA C105.

C. Above Ground:

1. Copper (3" and Larger):

- a. Pipe: Copper tube, Type L, hard drawn, ASTM B88.
- b. Fittings:
 - 1). Cast copper alloy, solder joint, pressure rated, ANSI B16.18.
 - 2). Wrought copper, solder joint, pressure rated, ANSI B16.22.
- c. Joints: Brazed, BCuP-3 or BCuP-5 type, AWS A5.8, 1250°F minimum melting point.

2. Copper (3" and Larger):

- a. Pipe: Copper tube, Type L, hard drawn, ASTM B88.
- b. Fittings:
 - 1). Wrought copper, ASTM B75 or ASTM B152 and ASME B16.22, roll grooved.
 - 2). Copper alloy CDA 836(85-5-5-5), sand cast per ASTM B584 and ASME B16.18, roll grooved.
 - 3). Manufactured to copper tube dimensions with factory grooved ends. Flaring of tube and fitting ends to IPS dimensions is not permitted.
- c. Joints: Roll grooved with ductile iron couplings, ASTM A536. Coupling housing shall be cast with off-setting, angle-pattern bolt pads. Heat-treated carbon steel bolts, ASTM A449 and A183, pressure responsive EPDM gasket UL Classified in accordance with NSF-61, and enamel coated. Victaulic Style 607H.

2.3 UNIONS AND FLANGES

- A. General:
 - 1. Unions, flanges and gasket materials to have pressure rating of not less than 150 psig at 180°F.
- B. Copper (3" and Larger):
 - 1. Ductile iron flange adapters, ASTM A 536, coated with copper-colored enamel for use with grooved end pipe and fittings, flat face, manufactured for engaging directly into roll grooved copper tube and fittings and bolting directly to flanged components with ANSI Class 125 and 150 bolt hole patterns, EPDM gasket. Victaulic Style 641.

2.4 DIELECTRIC FITTINGS

- A. Insulating nipple, metal casing, inert thermoplastic lining, Clearflow dielectric fitting by Perfection Corporation or Victaulic Style 47.
- B. Dielectric unions 2" and smaller; dielectric flanges 2-1/2" and larger; with iron female pipe thread to copper solder joint or brass female pipe thread end connections, non-asbestos gaskets and pressure rating of not less than 175 psig at 180°F. Watts Regulator Company, Lochinvar, Wilkins or Epco Sales, Inc.
- C. Copper-silicon casting, UNS C87850, threaded or grooved end. UL classified in accordance with NSF-61 for potable water service. Victaulic Style 647.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install pipe and fittings in accordance with reference standards, manufacturer's recommendations and recognized industry practices.
- B. Maintain piping system in clean condition during installation. Remove dirt and debris from assembly of piping as work progresses. Cap open pipe ends where left unattended or subject to contamination.
- C. Lay out water system so as to conform to intent of drawings. Coordinate piping with building features and work of other trades. Plans indicate, general routing, provide additional offsets as required. Install piping with necessary swing joints and offsets to allow for expansion. Install shut-off valves on branch lines near mains to avoid long dead-leg branches when valves are closed. Install water piping plumb and square with building. Pitch water pipe to drain with drain valves at low points.
- D. Provide protective sleeve covering of elastomeric pipe insulation where copper or steel piping is embedded in masonry or concrete.
- E. Provide dielectric fittings between dissimilar piping materials.
- F. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including required service space for this equipment, unless piping is serving this equipment.
- G. Install water pipe using proper pipe and fittings. Use reducing fittings for changes in pipe size.
- H. Install trap filler lines to slope to drain tailpiece without trapping.

3.2 COPPER TUBING

- A. Copper tubing shall be installed per Copper Development Association guidelines in addition to methods specified herein.
- B. Soldered Copper Joints:
 - 1. Use non-acidic and lead free flux on cleaned pipe and fittings for soldered joints.
 - 2. Cut tube square, remove burrs from exterior of tube and ream interior of tube before assembly.
 - 3. Fill joints with solder by capillary action. Solder shall cover joint periphery. Wipe joint clean.
 - 4. Apply heat carefully to prevent damage to pipe, fittings and valves.
 - 5. Follow manufacturer's recommendations when heating valves and equipment for soldered connections.
- C. Brazed Copper Joints:
 - 1. Cut tube square, remove burrs from exterior of tube and ream interior of tube before assembly.
 - 2. Joints shall be cleaned and polished before brazing.
 - 3. Flux of any type shall not be used.
 - 4. Apply heat carefully to prevent damage to pipe, fittings and valves. Disassemble valves where possible to prevent damage to seats during brazing.
- D. Grooved Copper Joints:
 - 1. All grooved end piping products shall be supplied by single manufacturer. Grooving tools shall be supplied by same manufacturer as grooved fittings and components.
 - 2. Install rolled groove copper pipe and fittings using equipment specifically for copper tube by mechanical coupling manufacturer.
 - 3. Use only those couplings and gaskets so designated for copper tube.
 - a. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified.
 - b. Gaskets shall be supplied by the grooved coupling manufacturer.
 - 4. Flaring of tube and fitting ends to IPS dimensions is not permitted.
 - 5. Grooved end shall be clean and free from indentations, projections, and roll marks in area from pipe end to groove for proper gasket sealing.
 - 6. Factory-trained field representative shall provide on-site training for contractor's field personnel in proper use of grooving tools, application of groove, and installation of grooved piping products. Factory trained representative shall periodically review product installation. Contractor shall remove and replace any improperly installed products.

3.3 CLEANING

- A. Flush and clean piping prior to testing. Remove corrosion by mechanical or chemical means. Use chemicals that are non-toxic.

3.4 TESTING

- A. Refer to Testing paragraph of Section 20 0000 - General Mechanical Requirements.
- B. Water test system may be applied to system in its entirety or in sections. Test piping with water to pressure of 100 psi for 2 h. No decrease in pressure allowed. Provide pressure gauge with shutoff and bleeder valve at highest point of system tested. Inspect joints in system under test.
- C. Defective work or material shall be replaced or repaired as necessary and inspection and test repeated. Repairs shall be made with new materials. No caulking of threaded joints or holes will be allowed.

- D. Do not conceal pipe until satisfactorily tested.
- E. Testing with air will not be allowed.

3.5 BALANCING

- A. Balance water distribution system. Adjust control valves for proper operation. Set balancing valves to maintain hot water in hot water system.
- B. Balance flush valves, flow control valves and mixing valves for adequate flow and temperature to plumbing fixtures and equipment.

3.6 DISINFECTION

- A. Disinfect water piping in the following manner:
 1. Clean and flush water pipe with water until water at remote tap is clear.
 2. Fill water systems with solution containing 50 ppm of chlorine (minimum concentration). Allow solution to stay in water system for 24 h. Alternately use solution of 200 ppm of chlorine (minimum concentration) for 3 h.
 3. Flush water system of chlorine solution.
 4. Allow clean water to stand in system for 24 h. Take sample from remote tap for bacteriological test.
- B. Do not use water system for potable water supply until safe bacteriological test is obtained. Repeat steps 1 through 4 until safe water system is obtained.

3.7 BACTERIOLOGICAL TESTS

- A. Take representative water samples and test to ensure bacteriologically safe water supply system. Include HPC (Heterotrophic Plate Count) test and test for presence of *Pseudomonas aeruginosa* as well as regular coliform bacteria test. HPC test maximum containment level of 500 organisms/ml. Perform bacteriological tests shortly before Owner's acceptance of building. If tests fail, make corrections and retest.
- B. When connecting to existing water supply of unknown quality, sample for analysis and comparison with finished water system analysis shall be taken prior to making new connection. This will allow isolating source of contamination from within scope of work or pre-existing water supply. Final conditions shall meet criteria specified above for areas within scope of work.

END OF SECTION

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SECTION 22 1314

SANITARY WASTE AND STORM DRAINAGE SYSTEMS

(04/18/16 SI-06)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section includes materials and methods for sanitary waste and vent, and storm drainage piping systems within and including piping to 5 ft outside building wall.

1.2 RELATED WORK

- A. Section 20 0520 - Excavation and Backfill.
- B. Section 22 1114 - Exterior Services.

1.3 REFERENCE

- A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.4 QUALITY ASSURANCE

- A. Order piping with each length marked with manufacturer's name or trademark and type of pipe; with each shipping unit marked with purchase order number, metal or alloy designation, temper, size, and supplier's name.
- B. Installed material not meeting specification requirements must be replaced with material that meets these specifications without additional cost to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Promptly inspect shipments to insure material is undamaged and complies with Specifications.
- B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends from damage. End caps shall remain in place. Protect fittings by storage inside or by durable, waterproof, above ground packaging.
- C. Offsite storage agreements will not relieve Contractor from using proper storage techniques.
- D. Storage and protection methods must allow inspection to verify products.

1.6 SUBMITTALS

- A. Manufacturer's technical data for the following:
 - 1. Pipe and fittings.
 - 2. Joints.
 - 3. Cleanouts.
 - 4. Floor drains.
 - 5. Traps.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials herein specified shall be new, unless otherwise noted.

2.2 PIPE, FITTINGS, AND JOINTS

- A. Interior Underground 15" and Smaller:
 - 1. Cast Iron:
 - a. Pipe: Hub and spigot pipe, service weight, ASTM A74, NSF certified with material test reports.
 - b. Fittings: Hub and spigot fittings, service weight, ASTM A74, NSF certified with material test reports.
 - c. Joints: Neoprene rubber compression gaskets, ASTM C564.
 - B. Adaptor Couplings for Joining Dissimilar Pipe Materials:
 - 1. Acceptable Manufacturers: Fernco, Mission, or approved equal.
 - 2. 1" through 6" diameter: Fernco Proflex 3000 Series shielded coupling with neoprene gasket, stainless steel shield, and stainless steel clamping bands. Adaptor couplings shall be specifically designed for pipe materials being joined.
 - 3. 8" through 27" diameter: Fernco 1000 Series flexible coupling with elastomeric PVC or neoprene gasket and stainless steel clamping bands. Adaptor couplings shall be specifically designed for pipe materials being joined.

2.3 CLEANOUTS

- A. Josam, Mifab, Smith, Wade, Watts or Zurn, equal to number listed in Drains and Cleanout Schedule.
- B. Provide recessed, solid brass, cleanout plugs where fittings are used as cleanouts. Provide taper-thread plug with Teflon tape thread wrap.

2.4 FLOOR DRAINS

- A. Josam, Mifab, Smith, Wade, Watts or Zurn, equal to number listed in Drains and Cleanout Schedule.
- B. Floor drains shall be in accordance with ANSI A112.21.1. Provide with caulked or no-hub connection. Floor drains shall have internal seepage collar for embedding in floor construction and weep holes to provide adequate drainage to drain pipe. Include trap primer connection where indicated on drawings.

2.5 TRAPS

- A. Same material as pipe or fittings unless specified with fixtures. Provide 17 ga brass, chrome plated traps for exposed traps.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

- A. Install pipe and fittings in accordance with reference standards, manufacturer's recommendations and recognized industry practices.

- ~~B.~~ Grade horizontal lines with minimum of 1/8" per ft, except piping 2" diameter or smaller which shall be run at 1/4" per ft slope.
- ~~C.~~**B.** Grade horizontal lines with minimum of 1/4" per ft, except piping 4" diameter or larger which may be run at 1/8" per ft slope with approval of local authority.
- ~~D.~~**C.** Install piping parallel with building lines and at heights, which do not obstruct any portion of window, doorway, stairway, or passageway, except, as may be shown on plans. Install overhead piping as high as possible.
- ~~E.~~**D.** Grade vent pipe for complete drainage by gravity to soil or waste pipes. Vent terminations shall be set true and level. Locate vent piping at least 10 ft away from window, door or intake openings. Coordinate closely with roofing contractor to prevent damage to roofing membrane. Flashing shall be in accordance with requirements of roofing manufacturer.
- ~~F.~~**E.** Where interferences develop, offset or reroute piping as required to clear interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. Consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
- ~~G.~~**F.** Provide protective sleeve covering of elastomeric pipe insulation, where piping and/or fittings are embedded in masonry or concrete.
- ~~H.~~**G.** Maintain piping in clean condition internally during construction.
- ~~I.~~**H.** Mitered ells, notched tees, and orange peel reducers are not allowed. Bushings are not allowed on threaded piping.
- ~~J.~~**I.** Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including required service space for this equipment, unless piping is serving this equipment.
- ~~K.~~**J.** Set cleanouts true and level and protect properly throughout construction.
- ~~L.~~**K.** Set floor drains true and level and protect properly throughout construction. Weep holes shall be filled with removable material and kept free from concrete and other debris during construction. Weep holes shall be cleaned out for final working order. Provide safing for floor drains installed in elevated slabs.
- ~~M.~~**L.** Trap each fixture and piece of equipment requiring sanitary drainage connections. Trap seals shall be standard depth, except when deep seals are required by code. Traps shall be set true and level and located within limits of code requirements. Traps shall not be used as separator, interceptor or other type of device to retain solids. Traps shall be provided with thread type approved cleanout plugs when specified. Protect traps during construction and seal off to prevent stones, debris and other foreign matter from entering before use. Locate running traps for full accessibility with double cleanout.
- ~~N.~~**M.** Provide plugs or caps for pipe openings during construction to prevent debris from entering pipe. Temporary plug shall be plastic cap or equivalent.

3.2 CAST IRON PIPE

- A. Hub and Spigot Piping: Clean pipe end, bell, gasket seat and gasket of dirt or debris. Coat end of pipe and gasket with gasket lubricant. Insure pipe is supported off ground so lubricant does not pick up dirt. Push spigot end into end of gasket bell with levered pipe joining tool recommended by pipe manufacturer. Large diameter exterior mains may be joined by pushing

end of pipe section with backhoe against wood blocking over pipe end. Insert to fully seated position or to reference mark on pipe.

- B. Install cast iron pipe and fittings as recommended by CISPI in their publication "Installation of Cast Iron Soil Pipe and Fittings".
- C. Support piping at every coupling. Locate hanger within 18" of coupling.
- D. Installations with multiple joints within a 4 ft developed length shall be supported at every second joint.
- E. Secure base of risers with thrust restraints to prevent joint separation. Restraint shall be in accordance with CISPI recommendations.
- F. Brace horizontal piping 5" and larger to prevent horizontal movement. Install bracing at every branch connection and every change of direction in accordance with CISPI recommendations.

3.3 TESTING

- A. Refer to Testing paragraph of Section 20 0000 - General Mechanical Requirements.
- B. Water test may be applied to system either in its entirety or in sections. Piping shall be tightly plugged and submitted to 10 ft head of water located at highest point. Provide separate standpipe above highest point being tested or extend system to obtain required 10 ft head of water. Head shall be maintained for at least 30 minutes before inspection starts.
- C. Defective work or material shall be replaced or repaired as necessary and inspection and test repeated. Repairs shall be made with new materials. No caulking of threaded joints or holes will be allowed.
- D. Do not backfill pipe until successfully tested.
- E. Testing with air will not be allowed.

END OF SECTION

SECTION 22 1314

SANITARY WASTE AND STORM DRAINAGE SYSTEMS

(04/18/16 SI-06)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section includes materials and methods for sanitary waste and vent, and storm drainage piping systems within and including piping to 5 ft outside building wall.

1.2 RELATED WORK

- A. Section 20 0520 - Excavation and Backfill.
- B. Section 22 1114 - Exterior Services.

1.3 REFERENCE

- A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.4 QUALITY ASSURANCE

- A. Order piping with each length marked with manufacturer's name or trademark and type of pipe; with each shipping unit marked with purchase order number, metal or alloy designation, temper, size, and supplier's name.
- B. Installed material not meeting specification requirements must be replaced with material that meets these specifications without additional cost to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Promptly inspect shipments to insure material is undamaged and complies with Specifications.
- B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends from damage. End caps shall remain in place. Protect fittings by storage inside or by durable, waterproof, above ground packaging.
- C. Offsite storage agreements will not relieve Contractor from using proper storage techniques.
- D. Storage and protection methods must allow inspection to verify products.

1.6 SUBMITTALS

- A. Manufacturer's technical data for the following:
 - 1. Pipe and fittings.
 - 2. Joints.
 - 3. Cleanouts.
 - 4. Floor drains.
 - 5. Traps.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials herein specified shall be new, unless otherwise noted.

2.2 PIPE, FITTINGS, AND JOINTS

- A. Interior Underground 15" and Smaller:
 - 1. Cast Iron:
 - a. Pipe: Hub and spigot pipe, service weight, ASTM A74, NSF certified with material test reports.
 - b. Fittings: Hub and spigot fittings, service weight, ASTM A74, NSF certified with material test reports.
 - c. Joints: Neoprene rubber compression gaskets, ASTM C564.
 - B. Adaptor Couplings for Joining Dissimilar Pipe Materials:
 - 1. Acceptable Manufacturers: Fernco, Mission, or approved equal.
 - 2. 1" through 6" diameter: Fernco Proflex 3000 Series shielded coupling with neoprene gasket, stainless steel shield, and stainless steel clamping bands. Adaptor couplings shall be specifically designed for pipe materials being joined.
 - 3. 8" through 27" diameter: Fernco 1000 Series flexible coupling with elastomeric PVC or neoprene gasket and stainless steel clamping bands. Adaptor couplings shall be specifically designed for pipe materials being joined.

2.3 CLEANOUTS

- A. Josam, Mifab, Smith, Wade, Watts or Zurn, equal to number listed in Drains and Cleanout Schedule.
- B. Provide recessed, solid brass, cleanout plugs where fittings are used as cleanouts. Provide taper-thread plug with Teflon tape thread wrap.

2.4 FLOOR DRAINS

- A. Josam, Mifab, Smith, Wade, Watts or Zurn, equal to number listed in Drains and Cleanout Schedule.
- B. Floor drains shall be in accordance with ANSI A112.21.1. Provide with caulked or no-hub connection. Floor drains shall have internal seepage collar for embedding in floor construction and weep holes to provide adequate drainage to drain pipe. Include trap primer connection where indicated on drawings.

2.5 TRAPS

- A. Same material as pipe or fittings unless specified with fixtures. Provide 17 ga brass, chrome plated traps for exposed traps.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

- A. Install pipe and fittings in accordance with reference standards, manufacturer's recommendations and recognized industry practices.

- ~~B.~~ Grade horizontal lines with minimum of 1/8" per ft, except piping 2" diameter or smaller which shall be run at 1/4" per ft slope.
- ~~C.~~**B.** Grade horizontal lines with minimum of 1/4" per ft, except piping 4" diameter or larger which may be run at 1/8" per ft slope with approval of local authority.
- ~~D.~~**C.** Install piping parallel with building lines and at heights, which do not obstruct any portion of window, doorway, stairway, or passageway, except, as may be shown on plans. Install overhead piping as high as possible.
- ~~E.~~**D.** Grade vent pipe for complete drainage by gravity to soil or waste pipes. Vent terminations shall be set true and level. Locate vent piping at least 10 ft away from window, door or intake openings. Coordinate closely with roofing contractor to prevent damage to roofing membrane. Flashing shall be in accordance with requirements of roofing manufacturer.
- ~~F.~~**E.** Where interferences develop, offset or reroute piping as required to clear interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. Consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
- ~~G.~~**F.** Provide protective sleeve covering of elastomeric pipe insulation, where piping and/or fittings are embedded in masonry or concrete.
- ~~H.~~**G.** Maintain piping in clean condition internally during construction.
- ~~I.~~**H.** Mitered ells, notched tees, and orange peel reducers are not allowed. Bushings are not allowed on threaded piping.
- ~~J.~~**I.** Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including required service space for this equipment, unless piping is serving this equipment.
- ~~K.~~**J.** Set cleanouts true and level and protect properly throughout construction.
- ~~L.~~**K.** Set floor drains true and level and protect properly throughout construction. Weep holes shall be filled with removable material and kept free from concrete and other debris during construction. Weep holes shall be cleaned out for final working order. Provide safing for floor drains installed in elevated slabs.
- ~~M.~~**L.** Trap each fixture and piece of equipment requiring sanitary drainage connections. Trap seals shall be standard depth, except when deep seals are required by code. Traps shall be set true and level and located within limits of code requirements. Traps shall not be used as separator, interceptor or other type of device to retain solids. Traps shall be provided with thread type approved cleanout plugs when specified. Protect traps during construction and seal off to prevent stones, debris and other foreign matter from entering before use. Locate running traps for full accessibility with double cleanout.
- ~~N.~~**M.** Provide plugs or caps for pipe openings during construction to prevent debris from entering pipe. Temporary plug shall be plastic cap or equivalent.

3.2 CAST IRON PIPE

- A. Hub and Spigot Piping: Clean pipe end, bell, gasket seat and gasket of dirt or debris. Coat end of pipe and gasket with gasket lubricant. Insure pipe is supported off ground so lubricant does not pick up dirt. Push spigot end into end of gasket bell with levered pipe joining tool recommended by pipe manufacturer. Large diameter exterior mains may be joined by pushing

end of pipe section with backhoe against wood blocking over pipe end. Insert to fully seated position or to reference mark on pipe.

- B. Install cast iron pipe and fittings as recommended by CISPI in their publication "Installation of Cast Iron Soil Pipe and Fittings".
- C. Support piping at every coupling. Locate hanger within 18" of coupling.
- D. Installations with multiple joints within a 4 ft developed length shall be supported at every second joint.
- E. Secure base of risers with thrust restraints to prevent joint separation. Restraint shall be in accordance with CISPI recommendations.
- F. Brace horizontal piping 5" and larger to prevent horizontal movement. Install bracing at every branch connection and every change of direction in accordance with CISPI recommendations.

3.3 TESTING

- A. Refer to Testing paragraph of Section 20 0000 - General Mechanical Requirements.
- B. Water test may be applied to system either in its entirety or in sections. Piping shall be tightly plugged and submitted to 10 ft head of water located at highest point. Provide separate standpipe above highest point being tested or extend system to obtain required 10 ft head of water. Head shall be maintained for at least 30 minutes before inspection starts.
- C. Defective work or material shall be replaced or repaired as necessary and inspection and test repeated. Repairs shall be made with new materials. No caulking of threaded joints or holes will be allowed.
- D. Do not backfill pipe until successfully tested.
- E. Testing with air will not be allowed.

END OF SECTION

SECTION 22 2114
PLUMBING SPECIALTIES
(4/18/16 SI-06)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section covers material specialties for piping systems.
- B. All components installed on water systems defined in Section 22 1118 shall comply with NSF-372 to be compliant with requirement for lead content of <0.25% maximum weighted average.

1.2 RELATED WORK

- A. Section 22 1118 - Water Distribution System.
- B. Section 22 1314 - Sanitary Waste and Storm Drainage Systems.

1.3 REFERENCE

- A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.4 SUBMITTALS

- A. Manufacturer's technical data for the following:
 - 1. Backflow preventers.
- B. Shop drawings on items specified herein.
- C. Certificates: Submit performance testing certificates for reduced pressure backflow preventers and double check backflow preventers.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials herein specified shall be new unless otherwise noted.

2.2 BACKFLOW PREVENTER

- A. Reduced Pressure Zone Backflow Preventers:
 - 1. Manufacturers: Cla-Val, Febco, Apollo or Watts, equal to model listed.
 - 2. 3/4" through 2": Bronze body, resilient check valve seats, shut-off valves, Y-pattern strainer with bronze body and stainless steel screen, drain line air-gap fitting, bronze test cocks, certified in accordance with ASSE 1013 and AWWA C511, equal to Watts number 919-S.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backflow preventers as indicated on drawings. Flush debris from strainers. Certified tester shall test reduced pressure zone backflow preventers to verify that functions are operational. Route vent line to adjacent hub drain.
- B. Install strainers for equipment including pumps, meters, backflow preventers, reducers and regulators, and as shown on drawings.

3.2 TESTING

- A. Safings shall be subject to standing water test to detect leaks and proper drainage to weep holes of floor drain.

END OF SECTION

SECTION 22 2114
PLUMBING SPECIALTIES
(4/18/16 SI-06)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section covers material specialties for piping systems.
- B. All components installed on water systems defined in Section 22 1118 shall comply with NSF-372 to be compliant with requirement for lead content of <0.25% maximum weighted average.

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 - 1. Backflow preventers.
- B. Shop drawings on items specified herein.
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 - 1. Manufacturers: Cla-Val, Febco, Apollo or Watts, equal to model listed.
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PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backflow preventers as indicated on drawings. Flush debris from strainers. Certified tester shall test reduced pressure zone backflow preventers to verify that functions are operational. Route vent line to adjacent hub drain.
- B. Install strainers for equipment including pumps, meters, backflow preventers, reducers and regulators, and as shown on drawings.

3.2 TESTING

- A. Safings shall be subject to standing water test to detect leaks and proper drainage to weep holes of floor drain.

END OF SECTION

SECTION 22 3314
WATER HEATING EQUIPMENT
(04/18/16 SI-06)

PART 1 - GENERAL

1.1 REFERENCE

- A. Work under this Section is subject to requirements of Contract Documents including General Conditions of Contract, Supplementary Conditions, and sections under Division 01 General Requirements.

1.2 QUALITY ASSURANCE

- A. Water heating equipment shall conform to State and Local Codes, meet national standards, and be certified by respective organization and bear its stamp.

1.3 SUBMITTALS

- A. Shop drawings on items specified herein.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials specified herein shall be new unless otherwise noted.

2.2 POINT OF USE ELECTRIC WATER HEATER

- A. Manufacturers: Chronomite, Eemax
- B. Water heater shall be point of use, tankless, under counter electric water heater.
- C. Replaceable heating element shall be stainless steel or iron-free nickel-chrome wire. Water heater to operate by electric flow switch and to be tested at 150 psig.
- D. Basis of design water heater is Chronomite model ER-90S/480_3P capable of 5 gpm at 59 °F temperature rise with electrical power input of 43.2 kW at 480 V three phase power.
- E. Refer to Water Heater Schedule for water heater capacity required.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install water heaters as recommended by manufacturer. Provide final connections as required. Coordinate water heater location with other Contractors.
- B. Initial start up and balancing service shall be provided by representative of manufacturer.

END OF SECTION

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SECTION 22 3314
WATER HEATING EQUIPMENT
(04/18/16 SI-06)

PART 1 - GENERAL

1.1 REFERENCE

- A. Work under this Section is subject to requirements of Contract Documents including General Conditions of Contract, Supplementary Conditions, and sections under Division 01 General Requirements.

1.2 QUALITY ASSURANCE

- A. Water heating equipment shall conform to State and Local Codes, meet national standards, and be certified by respective organization and bear its stamp.

1.3 SUBMITTALS

- A. Shop drawings on items specified herein.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials specified herein shall be new unless otherwise noted.

2.2 POINT OF USE ELECTRIC WATER HEATER

- A. Manufacturers: Chronomite, Eemax
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- E. Refer to Water Heater Schedule for water heater capacity required.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install water heaters as recommended by manufacturer. Provide final connections as required. Coordinate water heater location with other Contractors.
- B. Initial start up and balancing service shall be provided by representative of manufacturer.

END OF SECTION

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SECTION 22 4000
PLUMBING FIXTURES
(04/18/16 SI-06)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section lists plumbing fixtures and accessories including method of installation.

1.2 RELATED WORK

- A. Section 22 1118 - Water Distribution System.
- B. Section 22 1314 - Sanitary Waste and Storm Drainage Systems.

1.3 REFERENCE

- A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.4 SUBMITTALS

- A. One package of manufacturer's technical data for all items. Submittal shall be assembled brochure, showing cuts and full detailed descriptions for each item.
- B. Shop drawings on items specified herein.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless steel fixtures shall be 302/304 types of non-corrosive steel, 18 ga self-rim for cabinet sinks, 14 ga for free standing compartment type sinks. Sink material shall have satin finish and coved corners, with faucet holes punched to match specified faucet fitting.

2.2 MANUFACTURERS

- A. Manual Faucets: Chicago Faucet, Delta HDF, Kohler or Moen Commercial, equal to number listed.

2.3 HOSE BIBBS

- A. HB-1 Hose Bibb:
 - 1. Fixture: Woodford Model 22 freezeless hot and cold faucet, 3/4" threaded male hose outlet, 1/2" hot and cold water inlets, vacuum breaker.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install plumbing fixtures as recommended by manufacturer. Caulk around fixtures mounted on irregular surfaces such as tile or stone with silicone sealant, same color as fixture.

- B. Provide individual supplies to fixtures and rough-in fixture piping with adequate support to prevent movement fore, aft and laterally. Provide additional blocking as required.

3.2 PROTECTION

- A. Protect finished surfaces of fixtures from accidental damage or discoloration by use of protective covering.

3.3 CLEANING

- A. Prior to Owner acceptance, clean fixtures with compounds recommended by manufacturer and remove stains and marks from surrounding walls and countertops.

END OF SECTION

SECTION 22 4000
PLUMBING FIXTURES
(04/18/16 SI-06)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section lists plumbing fixtures and accessories including method of installation.

1.2 RELATED WORK

- A. Section 22 1118 - Water Distribution System.
- B. Section 22 1314 - Sanitary Waste and Storm Drainage Systems.

1.3 REFERENCE

- A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.4 SUBMITTALS

- A. One package of manufacturer's technical data for all items. Submittal shall be assembled brochure, showing cuts and full detailed descriptions for each item.
- B. Shop drawings on items specified herein.

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2.1 MATERIALS

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PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install plumbing fixtures as recommended by manufacturer. Caulk around fixtures mounted on irregular surfaces such as tile or stone with silicone sealant, same color as fixture.

- B. Provide individual supplies to fixtures and rough-in fixture piping with adequate support to prevent movement fore, aft and laterally. Provide additional blocking as required.

3.2 PROTECTION

- A. Protect finished surfaces of fixtures from accidental damage or discoloration by use of protective covering.

3.3 CLEANING

- A. Prior to Owner acceptance, clean fixtures with compounds recommended by manufacturer and remove stains and marks from surrounding walls and countertops.

END OF SECTION

SECTION 23 2114

UNDERGROUND (DIRECT BURIED) PIPING

1.1 RELATED WORK

- A. Excavation and Backfill: Refer to Division 31- Earthwork.
- B. Section 20 0520 - Excavation and Backfill.

1.2 REFERENCE

- A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.3 DESCRIPTION

- A. This Section includes pipe and pipe fitting specifications and installation requirements for heating and cooling systems.
- B. Specification of an item in this or any other section shall not relieve Contractor from providing all items, articles, materials, operations, methods, labor, equipment and incidentals necessary for a complete and functional system.
- C. Use only new material, free of defects, rust and scale, and guarantee for services intended.
- D. Use material meeting the latest revision of ASTM Specifications as listed in this Specification.
- E. Follow local codes if they require other types of pipe or joints.
- F. Use only long radius elbows having centerline radius of 1.5 pipe diameters unless otherwise indicated.
- G. Manufacturer, pressure class, size and heat code of each fitting and flange shall be permanently identified on its body in accordance with MSS SP-25.
- H. Where size for a pipe segment is not indicated, the pipe segment size shall be equal to the largest pipe segment to which it is connected. Transition to smaller size shall occur on the side of fitting where smaller size is indicated.
- I. Unless otherwise indicated, fittings and accessories connected to pipe shall be of the same material as the pipe.
- J. Unless otherwise indicated, construct piping for highest pressures and temperatures in respective system in accordance with the latest revision of the applicable Sections of ASME Code for pressure piping, ASME B31 including the following:
 - 1. B31.9 Building Services Piping.
 - 2. B31.1 Power Piping.

1.4 SUBMITTALS

- A. Shop Drawings for each piping system for all pipe sizes including, but not limited to, the following:
 - 1. Name of system.
 - 2. Pipe: ASTM number, grade if known, type, wall thickness, material.
 - 3. Fittings: ASTM/ANSI number, grade if known, class, type, wall thickness, material.
 - 4. Joint type.
 - 5. Flanges: ASTM number, grade, class, type, material.

6. Bolts and nuts: material.
7. Flange gaskets: material, rating.
8. Conduits: material, rating.
9. Insulation: material, rating, thermal performance.
10. Installation drawings including plans, sections, details.
11. Type of welding.
12. Welding Quality Control Program.
13. Test pressure and media.
14. Pipe flushing procedures.
15. Pipe cleaning methods.
16. All other appropriate data.

B. Submit pipe certification as specified under Pipe Certification in this Section.

C. Submit required documents as specified under Pipe Welding in this Section.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Furnish all pipe with plastic end-caps/plugs on each end of pipe. Maintain end-caps/plugs through shipping, storage and handling to prevent pipe-end damage and eliminate dirt and construction debris from accumulating inside of pipe.

B. Wherever possible, store all materials inside and protect from weather. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping.

C. Before shipping, all carbon steel piping shall be free of rust and scale, and furnished with plastic end caps/plugs on each end of pipe.

1.6 PIPE WELDING

A. Procedure and Welding Qualification Records:

1. All Welding Procedure Specifications (WPSs) and their supporting Procedure Qualification Records (PQRs) to be used on the work shall be submitted to Engineer for review and approval prior to performing any welding. These documents shall meet requirements of ASME B31.1 and B31.9, as applicable.
2. Unless otherwise indicated, welding shall be done using only the following processes:
 - a. Shielded Metal Arc Welding (SMAW), also known as "stick" welding.
 - b. Gas Tungsten Arc Welding (GTAW), also known as TIG and Heliarc welding.
 - c. Gas Metal Arc Welding (GMAW), also known as MIG welding.
 - d. Flux-Cored Arc Welding (FCAW), a variation of GMAW.
 - e. Submerged Arc Welding (SAW).
3. Root pass must be applied by only GTAW process with argon gas purge for stainless steel pipe.
4. Unless otherwise stated, fabrication, installation, inspection, examination and testing shall be in accordance with B31.1 or B31.9, as applicable.
5. Back rings (chill rings) or consumable inserts are not allowed, unless specifically requested by Owner or Engineer.

B. Quality Control Program:

1. Submit written quality control program for review and approval prior to implementing any welding on this project. Quality control program shall include the following as minimum:
 - a. Explanation of how Contractor will assure proper fitup for each weld.
 - b. Explanation of how Contractor will document welds performed by individual welding operators for systems under ASME B31.1.
 - c. Explanation of how Contractor will assure that proper welding procedure is being followed.

d. Credentials of personnel responsible for required weld examinations.

C. Weld Inspection and Examination:

1. Provide examination services for all welding for this project. Examination shall be in accordance with requirements of ASME B31, Table 136.4 or B31.9, as applicable. Personnel performing examination shall comply with requirements stipulated in 136.1 (A) through (E) or shall be AWS QC1 certified.
2. Periodically, as welding progress, Contractor shall submit report, signed by weld examiner, indicating status of project welding quality.
3. Arrange with Owner's Inspector for observation of fitup and welding methods prior to implementing any welds, including shop welds, on this Project.
4. In addition, Owner's Inspector will perform any additional observations deemed necessary before, during, or after fabrication to assure, to Owner's satisfaction, that proper welding is provided. Owner reserves the right to perform independent examination of welds. If Owner has any concern as a result of such examination Owner reserves the right to stop in progress welding work, without any cost to Owner, until resolution satisfactory to Owner is reached.
5. Owner will examine selected welds utilizing radiography to confirm quality of welding work.

D. Welder Qualifications:

1. Each welder and welding operator must qualify by passing required procedure test before performing any project welds. Submit copy of Manufacturer's Record of Welder or Welding Operator Qualification Tests as required by Section IX of ASME Boiler and Pressure Vessel Code for all welding procedures to be performed by welding operator.
2. Welder qualifications must be current. If qualification test is more than 6 months old, provide record of welding continuity for each welder.
3. Record of welding continuity is intended to show that welder has performed welding at least every 6 months since the date that welder qualification test was passed for the submitted welding procedure specification.
4. Record of welding continuity shall include, at minimum, the following:
 - a. Welder's employer name and address.
 - b. Date Welder Qualification Test was passed.
 - c. Dates indicating welding continuity.
5. Welders shall be qualified as required by ASME B3.1 or B31.9, as applicable. In addition, there shall be an independent witness of welder tests. That witness shall be representative of independent testing laboratory, Authorized (Code) Inspector, Owner's or Engineer's Inspector or consultant approved by National Certified Pipe Welding Bureau.
6. Welder qualifications must cover all pipe sizes and wall thickness used on this project. Test segments or coupons shall be appropriately selected for qualification. Test position shall be arranged in "6G position".

E. Weld Record:

1. For welding within the scope of ASME B31.1 Power Piping, submit to Engineer for approval an administrative procedure for recording, locating, monitoring and maintaining quality of welds to be performed on the project. This quality control document record shall include but not be limited to:
 - a. Drawings and schedules identifying location of each weld by individual number, identification of welder who performed each weld by individual welder's name, stamp number, date, and WPS used.

1.7 PIPE CERTIFICATION

- A. Certification is required for all pipe within scope of ASME B31.1. Submit certification papers, as outlined below, within 30 days of delivery of pipe to project site.

- B. Type E or S Pipe:
 - 1. Furnish manufacturer's mill certificate (material test report) including dimensions, heat numbers, chemical analysis and tensile test results for pipe shipped to project site.

1.8 PRE-INSULATED PIPING SYSTEMS

- A. General:
 - 1. Pre-insulated piping systems shall be complete as shown on drawings.
- B. End Seals:
 - 1. End seals or gland seals shall be provided at both ends of conduit system. End seals shall consist of steel bulkhead plated welded to pipe and conduit. End seals and gland seals shall be made from 5/16" steel plate with drain and vent openings located diametrically opposite on vertical centerline of mounting plate and shall be shipped with plugs in place. Conduit terminations shall be at least 2" beyond inside face of wall.
- C. Anchors:
 - 1. Provide anchors within 5 ft from walls for piping conduit systems.
 - 2. Anchors shall be prefabricated into piping units and shall include drainage and vent openings. Anchor plates shall be 1/2" steel plate. Sizing of concrete anchor blocks shall be in accordance with manufacturer's recommendations. Concrete anchor blocks shall be keyed into undisturbed soil.
- D. Leakplates:
 - 1. Provide conduits with leakplates in building walls for moisture barrier.
- E. Pipe Supports:
 - 1. Pipes within outer casing shall be supported at not more than 10 ft intervals with galvanized steel supports. These supports shall be designed to allow for continuous airflow and drainage of conduit in place. Straight supports shall be designed to occupy not more than 10% of annular air space.
 - 2. Supports shall be of type where insulation thermally isolates carrier pipe from outer conduit.
 - 3. Surface of insulation shall be protected at support by sleeve not less than 12" long, fitted with traverse and, where required, rotational arresters.
- F. Field Services:
 - 1. Pre-insulated pipe manufacturer shall provide factory trained field service representative to train the installing personnel and verify all phases of installation are conforming to manufacturer's installation requirements.
 - 2. This representative shall submit written reports to Owner/Engineer certifying that Contractor's installation is in accordance with manufacturer's recommendations at completion of installation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Rovanco, Thermacor or Perma Pipe.

2.2 HEATING HOT WATER, CHILLED WATER SUPPLY AND RETURN PIPING.

- A. Carrier Pipe:
 - 1. Pipe: ASTM A53, Grade A or B, Type E or ASTM A106, Grade B, standard weight, black steel.

2. Fittings: ASTM A234, Grade WPB/ASME B16.9, standard weight, seamless, carbon steel weld.
 3. Flanges: Class 150 psi. Refer to Flanges in this Section.
- B. Insulation:
1. Minimum 1.5" polyurethane foam, 0.14 K(Btu·in/(h·ft²·°F)) at 70°F, 2 pcf.
- C. Jacket:
1. HDPE with minimum 175-mil thickness.

2.3 FLANGES

- A. Flanges:
1. ASTM A105, ASME B16.5, hot forged steel, welding neck pattern. Slip-on patterns are not allowed. Bore dimension of welding neck flange shall match inside diameter of connected pipe.
 2. Use raised face flanges for mating with other raised face flanges with self-centering flat ring gaskets. Use flat face flanges for mating with other flat face flanges with full-face gaskets.
 3. Flange pressure class indicated in respective piping service is minimum required. Mating flange pressure class shall match pressure class of device connected to such as valves and piping specialties.
- B. Flange Gaskets:
1. Gasket material to be asbestos free and suitable for pressure temperatures and fluid of piping system. Non-metallic gaskets shall be in accordance with AMSO/ASME B16.21 and ASTM F104. Unless otherwise indicated or recommended by manufacturer, gaskets shall be similar to Garlock IFG 5500 with 1/16" thick gasket.
 2. Service Temperature (250°F thru 800°F) - Flexitallic, Garlock, Lamos equal to Flexitallic Style CG, flexible graphite filler, 304 SS winding, carbon steel centering ring, 0.175" thickness.
- C. Bolting:
1. Bolts, bolt studs, nuts and washers shall have zinc plated finish.
 2. Thread shall be in accordance with ANSI/ASME B1.1, Class 2A tolerance for external threads and Class 2B tolerance for internal threads. Threads shall be coarse-thread series except that alloy steel bolting 1-1/8" and larger in diameter shall be 8 pitch thread series.
 3. Threaded rods are not allowed as fastening elements.
 4. For Class 150 and 300 flanges at 400°F or lower temperature, use carbon steel bolts or stud bolts conforming to ASTM A307, Grade B with nuts conforming to ASTM A307.

PART 3 - EXECUTION

3.1 FLANGED JOINTS

- A. Clean flange surfaces and align flange surfaces parallel. Boltholes of gaskets shall be cut slightly larger than bolt diameter and gasket ID shall be slightly larger than flange ID.
- B. Position gasket concentrically so compression is equally distributed over entire gasket surface.
- C. Lubricate bolts and run nuts down by hand.
- D. By using torque wrench, tighten nuts in the proper sequence so gasket is compressed evenly, and to the appropriate torque specified by bolt manufacturer.
- E. Re-torque bolts 12 to 24 h after start up.

3.2 WELDED PIPE JOINTS

- A. Inspect pipe and pipe fittings for roundness before they are fit-up or set in place.
- B. Properly clean and prepare pipe base material before fit-up. Verify joint land and bevel.
- C. Preheat pipe base material as required by welding procedure specification. Temperature of pipe material must be minimum of 60°F before welding.
- D. Properly align and adjust joint as required by welding procedure and thickness of material. Verify tolerances after tacking sequence.

3.3 WATER SYSTEMS

- A. Pitch horizontal mains up at 1" per 40 ft in direction of flow.

3.4 PIPING SYSTEM PRESSURE TESTS

- A. Coordinate pressure tests with Engineer and Owner at least 3 days in advance of its occurrence and conduct tests in presence of Engineer.
- B. Conduct pressure test prior to flushing and cleaning of piping systems.
- C. Conduct hydrostatic (HYDRO) test with test medium of water unless otherwise indicated.
- D. Conduct Pneumatic (PNEU) test with test medium of dry, oil free air, carbon dioxide, or nitrogen for underground piping conduits.
- E. If leaks are found, repair with new materials and repeat test; caulking will not be acceptable.
- F. Pressure tests may be made of isolated portions of piping systems to facilitate general progress of installation. Any revisions made in piping systems require retesting of affected portions of piping systems.
- G. No systems shall be insulated until it has been successfully tested. If required for additional pressure load under test, provide temporary restraints at expansion joints or isolate them during test. Unless otherwise noted, minimum test time shall be 4 hrs plus such additional time as may be necessary to conduct examination for leakage.
- H. No pressure drop shall occur during test period. Any pressure drop during test period indicates leakage.
- I. Provide pumps, gauges, instruments, test equipment, temporary piping and personnel required for tests and provide removal of test equipment and draining of pipes after tests have been made.
- J. For hydrostatic tests, remove air from piping being tested by means of air vents. Measure and record test pressure at high point in system. Where test pressure at high point in system causes excessive pressure at low point in system, due to static head, portions of piping system may be isolated and tested separately to avoid undue pressure. However, every portion of piping system must be tested at the specified minimum test pressure.
- K. For pneumatic tests, gradually increase pressure to not more than one half of test pressure; then increase pressure in steps of approximately one-tenth of test pressure until required test pressure is reached. Examine all joints and connections with soap bubble solution or equivalent method. Piping system exclusive of possible localized instances at pump or valve packing shall show no evidence of leaking.

- L. Conduct pressure tests with parameters indicated below:

System	Test Pressure	Remarks
Chilled & Heating Hot Water	100 psig	HYDRO
10 ga steel conduits	15 psig	PNEU

3.5 FLUSHING AND CLEANING PIPING SYSTEMS

- A. Flush all water, steam and condensate systems thoroughly for 15 min or longer, as required to ensure removal of all dirt and foreign matter from piping system.
- B. Sectionalize system to obtain minimum velocity of 6 fps. Provide temporary piping to connect dead end supply and return headers as necessary.
- C. After initial flushing of system, use portable pumping apparatus for continuous 24 h minimum circulation of cold-water detergent similar to Nalco 2567 cleaner. Flush detergent clear with continuous draining and raw water fill for additional 12 h or until all cleaner is removed from system. Replace strainers and reconnect permanent pumping apparatus and all apparatus bypassed.

3.6 UNDERGROUND PIPING

- A. General:
1. Install below grade piping as indicated on the drawings and according to the manufacturer's instructions and installation drawings.
 2. Perform hydrostatic pressure test as herein specified for each underground piping system. Repair any leaks and retest until a successful test has been completed. Contractor to drain water used for hydrostatic test, to the sanitary sewer.
 3. Contractor to provide means for conducting drain water from the underground piping to storm sewer, i.e., pumps, hoses, piping, etc.
 4. Contractor to furnish all labor and equipment required to perform hydrostatic test and draining of piping.
 5. After each piping system has been successfully hydrostatic tested, backfill that system as specified in Division 31 or in accordance with the manufacturer's recommendation. Hydrostatic test shall be repeated until a successful hydrostatic test has been completed.
 6. All installation of pre-insulated pipe systems shall be done in strict accordance with requirements specified in this Section and manufacturer's instructions.
- B. Earthwork:
1. Provide excavation, dewatering, backfilling, and shoring as specified in Division 3102 and as recommended by the manufacturer. Comply with all local codes and safety ordinances related to this work. Trenches shall be dug to depths indicated on drawings. Bedding of piping systems shall be in accordance with manufacturer's installation instructions.
- C. Welding:
1. All welding shall meet the requirement specified in this Section. All welding shall be butt-weld.
- D. Testing:
1. Carrier pipes shall be hydrostatically tested in accordance with requirements in this Section before backfilling. Contractor to drain all water used for hydrostatic test to sanitary sewer.

2. System outer conduit shall be air tested at 15 psig for a period of one hour. System may be tested in stages, utilizing test caps provided by conduit system manufacturer, but even conduit field closure shall be tested.
3. Field test for density of soil compaction shall be performed in sufficient number to ensure that the specified density is obtained. The tests shall be in accordance with ASTM D1557-78 or ASTM D2992 and D3017.
4. Engineer shall be notified 48 h prior to any test. Contractor shall submit test reports on every test indicating date of test, sections tested and beginning and ending pressure recorded.

END OF SECTION

SECTION 23 2116
PIPE AND PIPE FITTINGS

PART 1 - GENERAL

1.1 REFERENCE

- A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.2 DESCRIPTION

- A. This Section includes pipe and pipe fitting specifications and installation requirements for heating and cooling systems.
- B. Specification of an item in this or any other sections shall not relieve Contractor from providing all items, articles, materials, operations, methods, labor, equipment and incidentals necessary for a complete and functional system.
- C. Use only new material, free of defects, rust and scale, and guarantee for services intended.
- D. Use material meeting the latest revision of ASTM specifications as listed in this specification.
- E. Follow local codes if they require other types of pipe or joints.
- F. Use only long radius elbows having centerline radius of 1.5 pipe diameters unless otherwise indicated.
- G. Manufacturer, pressure class, size and heat code of each fitting and flange shall be permanently identified on its body in accordance with MSS SP-25.
- H. Where size for a pipe segment is not indicated, the pipe segment size shall be equal to the largest pipe segment to which it is connected. Transition to smaller size shall occur on the side of fitting where smaller size is indicated.
- I. Unless otherwise indicated, fittings and accessories connected to pipe shall be of the same material as the pipe.
- J. Unless otherwise indicated, construct piping for highest pressures and temperatures in respective system in accordance with the latest revision of the applicable Sections of ASME Code for pressure piping, ASME B31 including the following:
 - 1. B31.9 Building Services Piping.
 - 2. B31.9 Building Service Piping for building heating and distribution steam and condensate piping for 15 psig or less, or hot water heating system for 30 psig or less.
 - 3. B31.1 Power Piping.
 - 4. B31.3 Process Piping.
 - 5. B31.5 Refrigeration Piping.
 - 6. B31.8 Gas Transmission and Distribution Piping Systems.
 - 7. B31.4 Liquid Petroleum Transportation Piping Systems.
- K. Boiler external piping shall comply with the latest revision of Section 1 of ASME Boiler and Pressure Vessel Code. This Contractor shall be responsible for materials, installation, testing and certification in accordance with the Code.

- L. Non-metallic piping is acceptable only for services indicated. It is not acceptable in occupied spaces and ventilation plenum spaces.

1.3 SUBMITTALS

- A. Shop Drawings for each piping system for all pipe sizes including, but not limited to, the following:
 - 1. Name of system.
 - 2. Pipe; ASTM number, grade if known, type, wall thickness, material.
 - 3. Fittings; ASME number, grade if known, class, type, wall thickness, material.
 - 4. Joint type.
 - 5. Flanges; ASTM number, grade, class, type, material.
 - 6. Bolts and nuts; material.
 - 7. Thread joint sealants; material.
 - 8. Flange gaskets; material, rating.
 - 9. Unions; ASTM number, type, material, rating.
 - 10. Type of welding.
 - 11. Welding Quality Control Program.
 - 12. Test pressure and media.
 - 13. Pipe flushing/cleaning plan.
 - 14. Pipe cleaning method.
 - 15. All other appropriate data.
- B. Submit pipe certification as specified under Pipe Certification in this Section.
- C. Submit required documents as specified under Pipe Welding in this Section.
- D. Provide Flushing and Cleaning Plan:
 - 1. Submit pipe flushing/cleaning plan for water, fluid, steam and condensate systems for approval. Plan shall detail methods for compliance with requirements of this section, including:
 - a. Flushing and cleaning procedure narratives.
 - b. Size, power source, and connection points of contractor provided pumps that will be used for flushing and cleaning.
 - c. If Contractor proposes to utilize project system pumps, method of protecting pumps from damage and developing required velocity of section of piping to be flushed.
 - d. Method of sectionalizing piping to obtain required velocity.
 - e. Minimum velocities at each section of pipe, clearly indicating any sections where 6 fps cannot be achieved.
 - f. Location and means of temporary bypasses for coils, control valves and other equipment.
 - g. Flushing schedule and drawings or diagrams that will be used for inspection and sign off prior to and after procedure, at Owner's option.
 - 2. Submit documents showing verification of flushing/cleaning following specified requirements and results.
- E. LEED Submittal
 - 1. Product Data for IEQ Credit 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Furnish pipe with plastic end-caps/plugs on each end of pipe. Maintain end-caps/plugs through shipping, storage and handling to prevent pipe-end damage and eliminate dirt and construction debris from accumulating inside of pipe.

- B. Where possible, store materials inside and protect from weather. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping.
- C. Before shipping, all carbon steel piping shall be free of rust and scale, and furnished with plastic end caps/plugs on each end of pipe.

1.5 PIPE WELDING

- A. Procedure and Welding Qualification Records:
 - 1. Submit Welding Procedure Specifications (WPSs) and their supporting Procedure Qualification Records (PQRs) to be used on the work to Engineer for review and approval prior to performing any welding. These documents shall meet requirements of ASME B31.1 and B31.9, as applicable.
 - 2. Unless otherwise indicated, welding shall be done using only the following processes:
 - a. Shielded Metal Arc Welding (SMAW), also known as "stick" welding.
 - b. Gas Tungsten Arc Welding (GTAW), also known as TIG and Heliarc welding.
 - c. Gas Metal Arc Welding (GMAW), also known as MIG welding.
 - d. Flux-Cored Arc Welding (FCAW), a variation of GMAW.
 - e. Submerged Arc Welding (SAW).
 - 3. Root pass must be applied by GTAW process with argon gas purge for high-pressure steam and condensate (400 psig and over) and high temperature hot water (450°F and over) services.
 - 4. Root pass must be applied by only GTAW process with argon gas purge for stainless steel pipe.
 - 5. Unless otherwise stated, fabrication, installation, inspection, examination and testing shall be in accordance with ASME B31.1 or B31.9, as applicable.
 - 6. Backing rings (chill rings) or consumable inserts are not allowed, unless specifically requested by Owner or Engineer.
- B. Quality Control Program:
 - 1. Submit written quality control program for review and approval prior to implementing any welding on this project. Quality control program shall include the following as minimum:
 - a. Explanation of how Contractor will assure proper fitup for each weld.
 - b. Explanation of how Contractor will document welds performed by individual welding operators for systems under ASME B31.1.
 - c. Explanation of how Contractor will assure that proper welding procedure is being followed.
 - d. Credentials of personnel responsible for required weld examinations.
- C. Weld Inspection and Examination:
 - 1. Provide examination services for all welding for this Project. Examination shall be in accordance with requirements of ASME B31.1, Table 136.4 or B31.9, as applicable.
 - 2. Periodically, as welding progresses, submit report, signed by weld examiner, indicating status of project welding quality.
 - 3. Arrange with Owner's Inspector for observation of fitup and welding methods prior to implementing any welds, including shop welds, on this Project.
 - 4. In addition, Owner's Inspector will perform any additional observations deemed necessary before, during, or after fabrication to assure, to Owner's satisfaction, that proper welding is provided. Owner reserves the right to perform independent examination of welds. If Owner has any concern as a result of such examination Owner reserves the right to stop in progress welding work, without any cost to Owner, until resolution satisfactory to Owner is reached.

- D. Welder Qualifications:
1. Each welder and welding operator must qualify by passing required procedure test before performing any project welds. Submit copy of Manufacturer's Record of Welder or Welding Operator Qualification Tests (WPQS) as required by Section IX of ASME Boiler and Pressure Vessel Code for all welding procedures to be performed by welding operator.
 2. Welder qualifications must be current. If qualification test is more than 6 months old, provide record of welding continuity for each welder.
 3. Record of welding continuity is intended to show that welder has performed welding at least every 6 months since the date that welder qualification test was passed for the submitted welding procedure specification.
 4. Record of welding continuity shall include, at minimum, the following:
 - a. Welder's employer name and address.
 - b. Date Welder Qualification Test was passed.
 - c. Dates indicating welding continuity.
 5. Welders shall be qualified as required by ASME B31.1 or B31.9, as applicable. In addition, there shall be an independent witness of welder tests. That witness shall be representative of independent testing laboratory, Authorized (Code) Inspector, Owner's or Engineer's Inspector or consultant approved by National Certified Pipe Welding Bureau.
 6. Welder qualifications must cover all pipe sizes and wall thickness used on this project. Test segments or coupons shall be appropriately selected for qualification. Test position shall be arranged in "6G position."
- E. Weld Record:
1. For welding within the scope of ASME B31.1 Power Piping, submit to Engineer for approval an administrative procedure for recording, locating, monitoring and maintaining quality of welds to be performed on the project. This quality control document record shall include but not be limited to:
 - a. Drawings and schedules identifying location of each weld by individual number, identification of welder who performed each weld by individual welder's name, stamp number, date, and WPS used.

1.6 PIPE CERTIFICATION

- A. Certification is required for all pipe within scope of ASME B31.1. Submit certification papers, as outlined below, within 30 days of delivery of pipe to project site.
- B. Type E or S Pipe:
1. Furnish manufacturer's mill certificates (material test report) including dimensions, heat numbers, chemical analysis and tensile test results for pipe shipped to project site.

1.7 CATHODIC PROTECTION

- A. Cathodic protection shall be designed and provided by system pre-insulated pipe manufacturer for pipe systems as specified in Part 2. Cathodic protection shall conform to recognized practices and shall be designed by qualified personnel. Measurements of corrosivity of soil environment expressed in terms of soil's electrical resistivity (ohm/cm) shall be taken and checked out by pre-insulated pipe manufacturer. Resistivities shall be given along proposed routing of piping systems. Anodes and test stations shall be provided by this Contractor as recommended by pre-insulated pipe manufacturer.
- B. After installation, field survey shall be made by pre-fabricated pipe manufacturer and measurement of current and conduit-to-soil potentials at each test station shall be taken.

PART 2 - PRODUCTS

2.1 HEATING HOT WATER

- A. 2" and Smaller:
1. Pipe: ASTM B88 seamless, Type L, hard temper copper tube.
 2. Fittings: ASME B16.22, wrought copper solder joint.
 3. Joint: ASTM B32, lead free solder, Bridgit, Silvabrite, Silverflow or Canfield.
 4. Unions: ASME B16.18 cast copper alloy or ASME B16.22 wrought copper solder joint, Class 125. No unions to be used for line sizes 3/4" and smaller. Unions shall be used for line sizes over 1".
 5. Flanges: ASME B16.24, Class 150, cast copper alloy.
 6. Use solder joints for valves and piping specialties in copper piping.
 7. Press Joint Option:
 - a. Contractor may use press copper fittings as manufactured by Viega. Other acceptable manufacturers are Nibco and Elkhart.
 - b. Fittings: Copper press fittings with EPDM seal, 0 to 250°F, maximum 200 psi.
 - c. Joints: Press joints by fitting manufacturer approved tool.
 8. T-Drill option:
 - a. Contractor may use mechanically formed tee connections in lieu of wrought copper tee fittings, for branch takeoffs up to one half (1/2) diameter of main. Mechanically formed tees shall be formed by use of T-Drill machine in accordance with ASME B31 and T-Drill manufacturer's installation recommendation. Forming method shall be UL Listed.
 - b. Mechanically formed tee connections shall be made by workers trained and certified by T-Drill manufacturer. Connections shall comply with American Welding Society lap joint weld, and joints shall be brazed in accordance with Copper Development Association Copper Tube Handbook using BCuP series filler metal.
 - c. Owner reserves right to require destructive testing on 3 joints to ensure quality of joints. Contractor shall repair with new materials without any cost to Owner.
 - d. Submit a formed tee sample made by each worker for approval. Sample shall be 1" main with 1/2" branch connection.
- B. 2-1/2" and Larger:
1. Pipe: ASTM A53, Grade B, Type E or ASTM A106, Grade B, standard weight, carbon steel.
 2. Fittings: ASTM A234 Grade WPB/ASME B16.9, standard weight, seamless, carbon steel weld.
 3. Flanges: Class 150. Refer to Unions and Flanges in this Section.
- C. Type F pipe may be used for 2-1/2" through 4" size.
- D. Contractor may use carbon steel as specified below in lieu of copper tube for 2" and smaller.
1. Pipe: ASTM A53, Type F, standard weight, carbon steel.
 2. Fittings: ASME B16.4, Class 125, cast iron, threaded or ASME B16.3, Class 150, malleable iron, threaded.
 3. Unions: ASME B16.39, malleable iron, Class 250. Refer to Unions and Flanges in this Section.

2.2 CHILLED WATER

- A. 2" and Smaller:
1. Pipe: ASTM B88 seamless, Type L, hard temper copper tube.
 2. Fittings: ASME B16.22, wrought copper solder joint.
 3. Joint: ASTM B32, lead free solder, Bridgit, Silvabrite, Silverflow or Canfield.

4. Unions: ASME B16.18 cast copper alloy or ASME B16.22 wrought copper solder joint, Class 125. No unions to be used for lines sizes 3/4" and smaller. Unions shall be used for line sizes over 1".
 5. Flanges: ASME B16.24, Class 150, cast copper alloy.
 6. Use solder joints for valves and piping specialties in copper piping.
 7. Press Joint Option:
 - a. Contractor may use press copper fittings as manufactured by Viega. Other acceptable manufacturers are Nibco and Elkhart.
 - b. Fittings: Copper press fittings with EPDM seal, 0 to 250°F, maximum 200 psi.
 - c. Joints: Press joints by fitting manufacturer approved tool.
- B. 2-1/2" through 24":
1. Pipe: ASTM A53, Grade B, Type E or ASTM A106, Grade B, standard weight, carbon steel.
 2. Fittings: ASTM A234 Grade WPB/ASME B16.9, standard weight, seamless, carbon steel weld.
 3. Flanges: Class 150. Refer to Unions and Flanges in this Section.
- C. Contractor may use carbon steel as specified below in lieu of copper pipe for 2" and smaller.
1. Pipe: ASTM A53, Grade B, Type E or ASTM A106, Grade B, standard weight, carbon steel
 2. Fittings: ASME B16.4, Class 125, cast iron, threaded or ASME B16.3, Class 150, malleable iron, threaded.
 3. Unions: ASME B16.39, malleable iron, Class 250. Refer to Unions and Flanges in this Section.
- D. ASTM A53, Type F, standard weight, carbon steel pipe may be used through 4" size.
- E. 26" through 48":
1. Pipe: API-5L, Grade B, Type DSAW, 0.375" wall thickness, carbon steel.
 2. Fittings: ASTM A234, Grade WPB/ASME B16.9, 0.375" wall thickness, seamless, carbon steel weld.
 3. Flanges: Class 150. Refer to Unions and Flanges in this Section.
- F. 54" through 60":
1. Pipe: API-5L, Grade B, Type DSAW, 0.375" wall thickness, carbon steel.
 2. Fittings: Fabricated carbon steel weld fittings. Fitting wall thickness shall be 0.375".
 3. Flanges: Class 150. Refer to Unions and Flanges in this Section.

2.3 SOLAR HOT WATER

- A. All Sizes:
1. Pipe: ASTM B88 seamless, Type K, hard temper copper tube.
 2. Fittings: ASME B16.22 wrought copper, solder-joint pressure fittings.
 3. Unions: No unions to be used.
- B. 2" and Smaller:
1. Pipe: ASTM A53, Grade A or B, Type E or ASTM A106, Grade B, standard weight, carbon steel.
 2. Fittings: ASTM A126/ASME B16.4, Class 125, cast iron, threaded.
 3. Unions: Malleable iron, Class 250. Refer to Unions and Flanges in this Section.
- C. 2-1/2" and Larger:
1. Pipe: ASTM A53, Grade A or B, Type E or ASTM A106, Grade B, standard weight, carbon steel.
 2. Fittings: ASTM A234 Grade WPB/ASME B16.9, standard weight, seamless, carbon steel weld.
 3. Flanges: Class 150. Refer to Unions and Flanges in this Section.

D. ASTM A53, Type F, standard weight, carbon steel pipe may be used through 4" size.

2.4 REMOTE RADIATOR

A. Use pipe and fittings as specified for heating hot water.

2.5 RAW WATER MAKE-UP

A. Refer to Section 22 1118 - Water Distribution System.

2.6 CHEMICAL TREATMENT

A. Closed Water System (Hot Water, Chilled Water, Glycol, etc.):

1. Use pipe and fittings as indicated for the system to which chemical treatment piping is connected.

B. Condenser Water System:

1. Chlorinated polyvinyl chloride (CPVC), Schedule 80, ASTM D1785 with fittings ASTM F439.

C. Steam Boiler System (Low Pressure):

1. Use plastic tubing compatible with chemicals and system pressure as recommended by chemical treatment manufacturer.

D. Steam Boiler System (High Pressure):

1. Pipe: ASTM A312, TP 316, Schedule 40, seamless stainless steel.

2. Fittings: ASTM 182, Gr. F316, ASME B16.11, 3000 lb socket-weld.

3. Unions: 3000 lb socket-weld, stainless steel ground joint.

2.7 VENTS AND RELIEF VALVES

A. Unless otherwise indicated, use pipe and pipe fittings as indicated for the system to which relief valve or vent is connected.

B. ASTM A53, Type F, carbon steel pipe with standard weight, carbon steel fittings may be used for steam vents smaller than 4".

C. Use ASTM A53, Type E carbon steel pipe with ASTM A234 Grade WPB/ASME B16.9, standard weight, seamless carbon steel weld fittings for refrigerant vent piping.

2.8 PRESSURE GAUGES AND TAPPINGS

A. Use pipe and pipe fittings as indicated for the system to which pressure gauge or tapping is connected. Use "Threadolets", "Sockolets" or tee fittings for tappings. Refer to Part 3 under General for use of "Threadolets" and "Sockolets".

B. Gauge pipe shall be 1/4" unless otherwise indicated.

C. Gauge pipe shall be 1/2" for high pressure steam (101 psig and over) systems.

2.9 COOLING COIL CONDENSATE DRAIN

A. Piping shall be one of the following, unless otherwise indicated on drawings:

1. Pipe: ASTM A53, Type F, standard weight, galvanized steel.

2. Fittings: ASTM A126/ASME B16.4, cast iron, threaded, ASTM A123 galvanize coated.

3. Pipe: ASTM B88, Type M, hard temper copper tubing.

4. Fittings: ASTM B16.22 wrought copper fittings.

5. Joint: ASTM B32, 95-5 tin-antimony solder, Bridgit or Silvabrite.

6. Pipe: ASTM D1785, Schedule 40, polyvinyl chloride (PVC).
7. Fittings: ASTM D2665, solvent weld PVC fittings.

2.10 STAINLESS STEEL PIPING (304)

- A. 2" and Smaller:
 1. Pipe: ASTM A312, 304, Schedule 40, seamless stainless steel.
 2. Fittings: ASTM 182, Gr. F304, ASME B16.11, 3000 lb socket-weld.
 3. Unions: 3000 lb socket-weld, stainless steel ground joint.
- B. 2-1/2" and Larger:
 1. Pipe: ASTM A312, 304, Schedule 40, seamless stainless steel.
 2. Fittings: ASTM A403, Gr. WP, Class S or Class W, ASME 16.9.
 3. Flanges: ASTM A182, Gr. F304, ASME B16.5, 150 lb std. with 1/16" raised face, serrated face finish and welding neck.
 4. Bolts: Stud bolts, ASTM A193, Gr. B7.
 5. Nuts: ASTM A194, Gr. 2H.

2.11 STAINLESS STEEL PIPING (316)

- A. 2" and Smaller:
 1. Pipe: ASTM A312, 316, Schedule 40S, seamless stainless steel.
 2. Fittings: ASTM 182, Gr. F316, ASME B16.11, 3000 lb socket-weld.
 3. Unions: 3000 lb socket-weld, stainless steel ground joint.
- B. 2-1/2" and Larger:
 1. Pipe: ASTM A312, 316, Schedule 40, seamless stainless steel.
 2. Fittings: ASTM A403, Gr. WP, Class S or Class W, ANSI B16.9.
 3. Flanges: ASTM A182, Gr. F316, ASME B16.5, 300 lb std. with 1/16" raised face, serrated face finish and welding neck.
 4. Bolts: Stud bolts, ASTM A193, Gr. B7.
 5. Nuts: ASTM A194, Gr. 2H.

2.12 POLYVINYL CHLORIDE (PVC) PIPING

- A. All Sizes:
 1. Pipe: Schedule 80, ASTM D1785, and D-2467.
 2. Fittings: ASTM D3467 socket type, 125 psi rating fittings.
 3. Joint: ASTM D2564 PVC solvent cement.

2.13 UNDERGROUND PIPE WRAP

- A. Use for all underground steel piping, which is not encased in conduit. Material to be Tapecoat 20, or approved equal, flexible polymer film with coal tar and synthetic elastomeric coating of 58 mil thickness. Primer shall be Tapecoat TC Omni-prime or approved equal.

2.14 DIELECTRIC UNIONS, FLANGES AND FITTINGS (STEEL PIPE TO COPPER PIPE)

- A. 2" and Smaller:
 1. Dielectric fittings similar to Victaulic Style 647 or Clearflow Dielectric Waterway fittings may be used in lieu of dielectric unions for pipe sizes 2" and smaller.
 - a. Clearflow fittings shall be ASTM A53 electro zinc-plated steel pipe with high temperature polyolefin polymer liner, suitable for continuous use at temperatures up to 230 °F and pressures up to 300 psig.
 2. ASTM A197/ASME B16, equal to Stockham Figure 693-1/2, Watts Series 3000 or Wilkins (Zurn) Model DU series dielectric unions with EPDM dielectric gasket, 250 psi at 180 °F.

- B. 2-1/2" through 4":
 - 1. Watts dielectric flange fittings Series LF 3100/LF 3110 with dielectric gasket, 175 psi at 180 °F.
 - 2. Dielectric fittings similar to Victaulic Style 647 or Clearflow Dielectric Waterway fittings may be used in lieu of dielectric unions for pipe sizes 2-1/2" and larger.
 - a. Clearflow fittings shall be ASTM A53 electro zinc-plated steel pipe with high temperature polyolefin polymer liner, suitable for continuous use at temperatures up to 230 °F and pressures up to 300 psig.

2.15 DIELECTRIC UNIONS, FLANGES AND FITTINGS (STEEL TO STEEL PIPE)

- A. 1" and Smaller: Similar to Epco model HA-B with dielectric gasket, 250 psi at 210 °F.
- B. 1-1/2" and Larger: Similar to Epco model W with bolt insulators, dielectric gasket, bolts and nuts, 175 psi at 210 °F). Pikotek model VSC dielectric gasket with viton sealing element, G-10 sleeve and double washers, suitable to 350 °F, may be used with specified flanges.

2.16 UNIONS AND FLANGES

- A. Unions:
 - 1. 2" and Smaller: Malleable iron, ASME B16.39 with ground joint, bronze or brass to iron. Provide black malleable iron for carbon steel piping and galvanized malleable iron for galvanized steel piping. Unless otherwise specified, pressure class and joint type of union shall be equal to that specified for fittings of respective piping service. Minimum pressure class of unions shall be Class 250.
 - 2. 2" and Smaller: Forged steel, ASTM A105 Grade 2, ASME B16.11, 3000 lb WOG with steel to steel seats. Joint type shall match that specified for fittings of respective piping service.
- B. Flanges:
 - 1. 2-1/2" and Larger: ASTM A105, ASME B16.5, hot forged steel, welding neck pattern. Slip-on pattern are not allowed. Bore dimension of welding neck flange shall match inside diameter of connected pipe.
 - 2. Use raised face flanges for mating with other raised face flanges with self-centering flat ring gaskets. Use flat face flanges for mating with other flat face flanges with full face gaskets.
 - 3. Flange pressure class indicated in respective piping service is minimum required. Mating flange pressure class shall match pressure class of connected device, such as valves and piping specialties.
- C. Flange Gaskets:
 - 1. General - Gasket material shall be asbestos free and suitable for pressures, temperatures and fluid of respective piping system. Non-metallic gaskets shall be in accordance with ASME B16.21 and ASTM F104.
 - 2. Service Temperature (through 249 °F) – Garlock, Klingersil or J.M. Clipper, similar to Garlock 5500. Gaskets similar to Garlock Style 3000 may be used for hydronic piping. Unless otherwise indicated or recommended by manufacturer, gaskets shall be compressed inorganic fiber with nitrile binder 1/16" thick for flanges 12" and smaller and 1/8" thick for flanges 14" and larger.
 - 3. Service Temperature (250 °F thru 800 °F) - Flexitallic, Garlock, Lamos equal to Flexitallic Style CG, flexible graphite filler, 304 SS winding, carbon steel centering ring, 0.175" thickness.
 - 4. Service Temperature (801 °F thru 1500 °F) - Flexitallic, Garlock, Lamos equal to Flexitallic Style CG, flexible graphite filler, 316 SS winding, carbon steel centering ring, 0.175" thickness.

5. Service Temperature (1501 °F thru 1700 °F) - Flexitallic, Garlock, Lamos equal to Flexitallic Style CG, flexible graphite filler, Inconel 600 winding, 316 SS centering ring, 0.175" thickness.

D. Bolting:

1. Bolts, bolt studs, nuts and washers shall have zinc plated finish.
2. Thread shall be in accordance with ASME B1.1, Class 2A tolerance for external threads and Class 2B tolerance for internal threads. Threads shall be coarse-thread series except that alloy steel bolting 1/8" and larger in diameter shall be 8 pitch thread series.
3. Threaded rods are not allowed as fastening elements.
4. For Class 150 and Class 300 flanges not exceeding 400 °F temperature, use carbon steel bolts or stud bolts conforming to ASTM A307, Grade B with nuts conforming to ASTM A194.
 - a. Bolts conforming to ASTM A307, Grade A may be used for piping governed by ASME B31.9.
5. For Class 400 and 600 flanges at 750 °F or lower temperature, use alloy steel bolts or stud bolts conforming to ASTM A193, Grade B7 or B16, with nuts conforming to ASTM A194, Grade 2H.

2.17 THREADED JOINT SEALANTS

- A. Paste type for brush application or cord type. Products shall be non-toxic, chemically inert, non-hardening, rated for -50 °F to 400 °F and up to 10,000 psi (liquids) and 3000 psi (gases), certified by UL, CSA, and NSF.
- B. Use sealant similar to Loctite Model 54531 for piping handling oil or petroleum products.

2.18 WELD BRANCH OUTLET FITTINGS (WELDOLETS, THREADOLETS AND SOCKOLETS)

- A. Weld branch outlet fittings shall conform to MSS-SP-97, ASME B16.9 for weldolets, ASME B1.20.1 for threadolets and ASME B16.11 for sockolets.
- B. Materials shall match material of header piping and wall thickness of outlet or branch end shall match wall thickness of branch pipe.

2.19 MECHANICAL GROOVED PIPE CONNECTIONS

- A. Mechanical grooved pipe coupling system including elbow, tee and reducer fittings, as manufactured by Victaulic or Anvil Gruvlok may be used in lieu of flanged or welded steel piping 2-1/2" and larger for systems and spaces indicated below.
- B. The following services may use mechanical grooved pipe connections.
 1. Chilled Water.
 2. Condenser Water.
 3. Cooling Coil Condensate Drain.
 4. Heating Hot Water.
- C. Mechanical grooved pipe connections may be used in spaces indicated below.
 1. Mechanical equipment spaces.
 2. Accessible spaces including ceiling spaces above occupied areas.
- D. Mechanical grooved pipe connection shall not be used in non-accessible spaces such as chases or above critical spaces such as ORs and data centers.
- E. Grooved pipe connection system materials used for the Project shall be produced by the same manufacturer.

- F. Couplings shall be equal to Victaulic 07, 107, or W07 ridged couplings.
- G. Victaulic Style 107 QuickVic rigid couplings with EHP gaskets may be used.
- H. Grooved fittings, valves, and specialties manufactured by coupling manufacturer will be acceptable, provided it meets requirements specified in this Section.
- I. Acceptable materials are listed below, based on Victaulic. When used on galvanized piping, fittings and couplings shall be galvanized in accordance with ASTM A153 Hot Dip Galvanizing. When used on black steel piping, fittings and couplings shall have enamel coating. Fittings and couplings must be suitable for temperature and pressure involved.
- J. Couplings:
 - 1. Ductile iron, ASTM A-536, Grade 65-45-12, Style 07, 107, or W07 Zero-flex rigid couplings, complete with housings cast with offsetting, angle-pattern bolt pads, used to provide system rigidity and support and hanging in accordance with ASME B31.1.
 - 2. Ductile iron, Style 77, 177, or W77 flexible couplings for use in locations where flexible connectors are required.
- K. Flanges:
 - 1. Ductile iron Style 741 or 743.
- L. Fittings:
 - 1. Ductile iron elbows and tees of manufacturer's standard line may be used in all sizes except bullhead tees will not be accepted. Fittings shall be full-flow fittings. Mechanical tee Style 920 or 920N fittings with ductile iron housings may be used for up to 4" outlet size.
 - 2. Ductile iron fittings shall conform to ASTM A-536.
- M. Gaskets:
 - 1. Gaskets shall be elastomer grade suitable for intended service, and shall be molded and produced by coupling manufacturer.
 - 2. Grade "E" EPDM compound, ASTM D-2000, suitable for temperature from -30°F to 230°F.
- N. Hot water heating system shall use "EHP" EPDM, ASTM D-2000, flushseal gaskets, suitable for temperature from -30°F to 250°F.
- O. Bolts and Nuts:
 - 1. Heat treated carbon steel, track head conforming to ASTM A-183 zinc electroplated, minimum tensile 110,000 psi zinc electroplated.
- P. Expansion Joints:
 - 1. Credit for inherent flexibility of mechanical grooved pipe connections when used for expansion joints, may be allowed upon specific application by Contractor. Request shall be made in writing and shall include service, location, line size, proposed application and supporting calculations for intended service.

2.20 REFRIGERANT PIPING

- A. ASTM B88 Type L hard drawn copper tube, cleaned and capped in accordance with ASTM B280, and marked "ACR" with ANSI B16.22 wrought copper or forged brass solder-type fittings.

PART 3 - EXECUTION

3.1 GENERAL

- A. Remove foreign materials before erection. Ream ends of piping to remove burrs.

- B. Install piping parallel to building walls and ceilings and at such heights so as not to obstruct any portion of window, doorway, stairway, or passageway. Install piping to allow adequate service space for equipment. Refer to drawings and/or manufacturer's recommendations. Install vertical piping plumb. Where interferences develop in field, offset or reroute piping as required to clear such interferences. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings or other architectural details before installing piping.
- C. Provide anchors, expansion joints, swing joints and expansion loops so that piping may expand and contract without damage to itself, equipment or building.
- D. Mitered elbows, welded branch connections, notched tees and "orange peel" reducers are not allowed. Unless specifically indicated, reducing flanges and reducing bushings are not allowed. Reducing bushings may be used for air vents and instrumentation connections.
- E. Unless otherwise indicated, use fittings as specified in Part 2 of this Section for elbows, tees, reducers, etc.
- F. "Weldolets" with outlet size 2-1/2" and larger and "Threadolets" or "Sockolets" with outlet size 2" and smaller may be used for branch connections up to one pipe size smaller than main. Use "Threadolets" where threaded fittings are specified and use "Sockolets" where socket weld fittings are specified. Install in accordance with PFI (Pipe Fabrication Institute) Standard ES49.
- G. Install drains throughout systems to permit complete drainage of entire system.
- H. Do not install piping over electrical panelboards, switchgear, switchboards or motor control centers.
- I. Install valves, control valves and piping specialties, including items furnished by others, as specified and/or detailed.
- J. Make connections to all equipment installed by others where that equipment requires piping services indicated in this Section.
- K. For piping within the scope of ASME B31.1 Power Piping, transfer piping material specification and "Heat Number" to each segment of pipe prior to cutting.

3.2 THREADED PIPE JOINTS

- A. Threads of pipe and fittings shall conform to ASME B1.20.1.
- B. Ream pipe ends after cutting and clean before erection. Apply thread sealants to cleaned male threads. Assemble joint to appropriate depth and remove any excess pipe joint compound from tightened joint.

3.3 FLANGED JOINTS

- A. Clean flange surfaces and align them parallel. Bolt holes of gaskets shall be cut slightly larger than bolt diameter. Gasket ID shall be slightly larger than flange ID.
- B. Position gasket concentrically so compression is equally distributed over entire gasket surface.
- C. Lubricate bolts and run nuts down by hand.
- D. By using torque wrench, tighten nuts in the proper sequence so gasket is compressed evenly, and to the appropriate torque specified by bolt manufacturer.
- E. Re-torque bolts 12 to 24 h after start up.

3.4 WELDED PIPE JOINTS

- A. Inspect pipe and pipe fittings for roundness before they are fit-up or set in place.
- B. Properly clean and prepare pipe base material before fit-up. Verify joint land and bevel.
- C. Preheat pipe base material as required by welding procedure specification. Temperature of pipe material must be minimum of 32°F before welding.
- D. Properly align and adjust joint as required by welding procedure and thickness of material. Verify tolerances after tacking sequence.
- E. Use weld material diameter as procedurally required for type and thickness of work being done.
- F. Use sufficient argon pre-purge and argon post-purge for GTAW processes. Post purge should be until weld is no longer glowing plus 5 seconds. Maintain purge for at least 2 layers of weld material.
- G. Properly store welding materials.
- H. Clean tacks before welding out. Remove slag after each pass by grinding to avoid slag inclusion.
- I. Weld reinforcement shall not exceed limits established in Chapter V of ASME B31.1.
- J. Brush each weld free of rust and paint with rust resistant product that matches piping surface color.
- K. For piping within scope of ASME B31.1, each weld shall be permanently marked by welder performing weld. Each welder shall sign and date field welding log record for all welds performed by welder as indicated in Part 1.
- L. Conduct radiographic test for sections or joints that cannot be tested by hydrostatic test methods (such as joints cut into existing piping systems) by qualified radiographic testing firm.

3.5 COPPER PIPE JOINTS

- A. Cutting of tubing shall not make tubing out of round. Ream cut tube ends to full inside diameter.
- B. Remove slivers and burrs remaining from tube cut by reaming and filing both pipe surfaces. Clean fitting and tube with emery or sand cloth. Remove residue from cleaning operation, apply flux and assemble joint. Use solder or brazing to secure joint as specified for specific piping service.
- C. Press Joint Option:
 - 1. Cut pipe square and ream before assembly.
 - 2. Insert pipe fully into fitting and mark on pipe at shoulder of fitting.
 - 3. Check fitting alignment against mark on pipe to ensure pipe is fully engaged.
 - 4. Press joint with press tool approved by fitting manufacturer.

3.6 PLASTIC PIPE JOINTS

- A. Use cleaning procedure and solvent cement as recommended by pipe and fitting manufacturers for particular material being used.

3.7 POLYVINYL CHLORIDE (PVC) PIPING

- A. Install PVC piping in strict accordance with pipe and fitting manufacturer's recommendations, including support spacing, compensation for thermal expansion and contraction and solvent cementing.

3.8 WATER SYSTEMS

- A. Unless otherwise indicated, install horizontal piping level. Install manual air vents at all high points where air may collect. If vent is not in accessible location, extend air vent piping to nearest code acceptable drain location with vent valve located at nearest accessible location to pipe.
- B. Main branches and runouts to terminal equipment may be made at top, side or bottom of main provided that there are drain valves suitably located for complete system drainage and manual air vents are located as described above.
- C. Unless otherwise indicated, for upfeed risers, use top or top 45° connection to main and for downfeed risers use side or bottom 45° connection to main. If side or bottom 45° connection is not practical and bottom connection to main must be used, provide line size Y strainer with shut-off valve at each side at branch connection.
- D. Use minimum of 3 elbows in each pipeline to terminal equipment to provide flexibility for expansion and contraction of piping systems.
- E. Unless otherwise indicated, use concentric fittings for changes in pipe sizes and for valves smaller than pipe sizes.
- F. Notch and dimple branch tubes. Braze joints. Apply heat properly so that pipe and tee do not distort. Remove distorted connections.
- G. Where mechanically formed tee fittings are allowed, form mechanically extracted collars in continuous operation, consisting of drilling pilot hole and drawing out tube surface to form collar having height of not less than 3 times thickness of tube wall. Collaring device to be adjustable.

3.9 RAW WATER MAKE-UP

- A. Refer to Section 22 1118 - Water Distribution System.
- B. Install piping where indicated, including valves, piping specialties and dielectric unions required for functional system.
- C. Raw water make-up piping for this Section is defined as fill line containing pressure reducing valve for water systems.

3.10 CHEMICAL TREATMENT

- A. Install piping as indicated on drawings, as detailed, and as recommended by supplier of chemical treatment equipment.

3.11 VENTS AND RELIEF VALVES

- A. Install vent and relief valve discharge lines as indicated on drawings, as detailed, and as specified for each specific valve or piping specialty item.

3.12 COOLING COIL CONDENSATE DRAIN

- A. Trap each cooling coil drain pan connection with trap seal of sufficient depth to prevent conditioned air from moving through piping. Extend drain piping to nearest code approved drain location. Construct trap with plugged tee for cleanout purposes.
- B. Pitch pipe down at 1/4" per one foot for proper drainage.
- C. Where copper piping is allowed, joints and fittings may be secured with 95-5 tin-antimony solder or brazing alloys.

3.13 UNDERGROUND PIPE WRAP

- A. Remove dirt and other foreign material from exterior of pipe. Apply primer as recommended by manufacturer. Use spiral wrap process for applying tape to pipe. Repair any breaks in tap coating caused by installation process.

3.14 DIELECTRIC UNIONS AND FITTINGS

- A. Install dielectric unions, flanges or fittings in main and branch piping of water systems at each point where copper to steel pipe connection occurs. Dielectric unions or fittings shall not be used at terminal device connections.
- B. Concealed dielectric unions and fittings are not allowed.
- C. Install steel to steel pipe dielectric unions or flanges in hot water] [chilled water] [steam and steam condensate] piping at each point where interior steel piping is connected to exterior underground steel piping.

3.15 UNIONS AND FLANGES

- A. Install union or flange at each automatic control valve and at each piping specialty or piece of equipment that requires tube pull or removal for maintenance, repair or replacement. If required, provide additional unions or flanges in order to facilitate removal of piping sections that interfere with tube pulls or equipment removal. Where valve is located at piece of equipment, provide flange or union connection on equipment side of valve.
- B. Concealed unions or flanges are not allowed.

3.16 MECHANICAL GROOVED PIPE CONNECTIONS

- A. Install grooved joints in accordance with manufacturer's latest published installation instructions.
- B. Use pipe factory grooved in accordance with coupling manufacturer's specifications or field grooved pipe in accordance with the same specifications using specially designed tools available for application.
- C. Grooved couplings, gaskets, fittings, valves, specialties, and grooving tools shall be provided from the same manufacturer.
- D. Grooving shall be performed by qualified grooving operators having demonstrated proper grooving procedure in accordance with manufacturer's recommendations.
- E. Lubricate pipe and coupling gasket, align pipe and secure joint in accordance with coupling manufacturer's specifications.

- F. Support pipe as indicated in Mechanical Supporting Devices section of these specifications except as modified below. Support each horizontal pipe section at least once between couplings and whenever change in flow direction takes place. Support vertical pipe at every other floor or every other pipe length, whichever is most frequent. Set base of riser or base fitting on pedestal or foundation.
- G. Grooved coupling manufacturer's factory trained representative shall conduct on-site training for Contractor's field personnel in installation of grooved products and proper use of grooved tools. Grooved manufacturer's representative shall submit written documentation to verify completion of required training.
- H. Factory-trained representative shall periodically visit jobsite after initial tool and installation training and review field grooving procedures and product installation to insure installation guidelines are being followed.
- I. Contractor shall remove and replace any improperly installed products.
- J. Factory-trained field representative shall provide additional training to Contractor to mitigate any further improperly installed products.

3.17 PIPING SYSTEM PRESSURE TESTS

- A. Owner and/or Owner's representative may elect to witness pressure test. Notify Owner and/or Owner's representative at least 3 days in advance.
- B. Conduct pressure test prior to flushing and cleaning of piping systems.
- C. Conduct hydrostatic (HYDRO) test in accordance with ASME B31.1 137.4. Test pressure shall be in accordance with ASME B31.1, but shall not be lower than the minimum test pressure listed below.
- D. Conduct Pneumatic (PNEU) test with test medium of dry, oil free air, carbon dioxide, or nitrogen for natural gas, compressed air and fuel oil piping and in accordance with ASME B31.1 137.4.
- E. If leaks are found, repair with new materials and repeat test until leaks are eliminated. Caulking will not be acceptable.
- F. Pressure tests may be made of isolated portions of piping systems to facilitate general progress of installation. Any revisions made in piping systems require retesting of affected portions of piping systems.
- G. No systems shall be insulated until it has been successfully tested. If required for additional pressure load under test, provide temporary restraints at expansion joints or isolate them during test. Unless otherwise noted, minimum test time shall be 4 h plus such additional time as may be necessary to conduct examination for leakage.
- H. No pressure drop shall occur during test period. Any pressure drop during test period indicates leakage.
- I. Provide pumps, gauges, instruments, test equipment, temporary piping and personnel required for tests and provide removal of test equipment and draining of pipes after tests have been made.
- J. For hydrostatic tests, remove air from piping being tested by means of air vents. Measure and record test pressure at high point in system. Where test pressure at high point in system causes excessive pressure at low point in system due to static head, portions of piping system may be

isolated and tested separately to avoid undue pressure. However, every portion of piping system must be tested at the specified minimum test pressure.

K. Conduct pressure tests with parameters indicated below:

<u>System</u>	<u>Minimum Test Pressure</u>	<u>Remarks</u>
Heating hot water	100 psig	HYDRO
Chilled & Heating Hot Water	100 psig	HYDRO
Solar hot water	100 psig	HYDRO
Underground chilled and heating hot water	100 psig	HYDRO

L. Underground Water Piping:

1. Underground chilled water piping and underground condenser water piping shall be leakage rate tested. Leakage rate test may be conducted at the same time as hydrostatic pressure test. Leakage rate is defined as quantity of water that must be supplied into the respective underground piping system to maintain specified hydrostatic test pressure after air in piping system has been removed and piping system has been filled with water.
2. Determine maximum allowable amount of leakage by the following formula:
 - a. [XXX]
3. If measured leakage rate exceeds maximum allowable leakage rate, repair with new materials and repeat test; caulking is not allowed. Conduct all testing in presence of Engineer. Coordinate all testing with Engineer and Owner at least 2 days in advance of its occurrence.

M. Contractor shall provide all pumps, gauges, instruments; test equipment, flow meters, temporary piping and personnel required for tests and provide removal of test equipment and draining of pipes after tests have been made.

N. If piping system is drained after testing and left empty or untreated for more than 3 days, add Nalco 2572 at recommended dosages for dry system lay-up.

O. High Pressure Steam and Condensate Piping (181 thru 600 psig/700 °F):

1. Test piping systems using hydrostatic and initial service test in accordance with procedures outlined in Chapter VI, Section 137 of ASME B31.1 Power Piping Code.
2. Successfully complete 800 psig hydrostatic test before proceeding to initial service test.
3. Initial Service Test, gradually increase piping pressure and temperature in steps of approximately one-tenth of final operating conditions until final operating conditions are reached.

P. High Temperature Hot Water (250 thru 450 °F):

1. Test piping systems using hydrostatic and initial service test in accordance with procedures outlined in Chapter VI, Section 137 of ASME B31 Power Piping Code.
2. Successfully complete hydrostatic test at 600 psig at 70 ± 10 °F for 4 h before proceeding to initial service test.
3. Initial Service Test, gradually increase piping pressure and temperature in steps of approximately one-tenth of final operating conditions until final operating conditions are reached.

3.18 FLUSHING AND CLEANING PIPING SYSTEMS

A. Notify Owner and/or Owner's representative at least 7 days in advance.

- B. Flush new water, fluid, steam and condensate systems thoroughly for 15 minutes or longer, as required to ensure removal of dirt and foreign matter from piping system. Bypass pumps and equipment and remove strainers from strainer bodies. Provide circulation by Contractor-supplied portable pumping apparatus.
- C. Provide temporary piping or hose to bypass coils, control valves, heat exchangers, other factory-cleaned equipment, and any component that may be damaged.
- D. Sectionalize system to obtain minimum velocity of 6 fps. Provide temporary piping to connect dead-end supply and return headers as necessary. Flush bottoms of risers.
- E. For pipes 18" and larger, maintain velocity as close as 6 fps possible, but not below 5 fps.
- F. After initial flushing of system, use portable pumping apparatus to circulate cold water detergent for water systems.
- G. After initial flushing of system, use portable pumping apparatus for continuous 24 h minimum circulation of cold water detergent similar to Nalco 2567 cleaner. Flush detergent clear with continuous draining and raw water fill for additional 12 h or until all cleaner is removed from system. Replace strainers and reconnect permanent pumping apparatus and all apparatus bypassed.
- H. Use oil when flushing hydraulic piping.
- I. Flush gas piping with clean, dry compressed air for one (1) h minimum. Open and clean drip legs. Repeat flushing until no debris is found in drip legs.
- J. Flush compressed air piping with clean, dry compressed air for one (1) h minimum. Open and clean drip legs. Repeat flushing until no debris is found in drip legs.
- K. For clean steam system, flush as indicated above followed by passivation in accordance with ASTM A380. Flush with purified water followed by 4 h with clean steam and wasting all condensate. Clean steam generator shall be valved out of system except when clean steam is generated. Submit results of passivation to Engineer.

3.19 FLUSHING AND CLEANING CHILLED WATER PIPING SYSTEM

- A. Contractor shall visually inspect internal portion of each length of pipe during installation. Remove all dirt and foreign matter prior to installing additional lengths. After each major section of piping has been installed, it shall be cleaned and flushed utilizing a high pressure water "hydro-jet" process. The hydro-jet process involves passing a high pressure, high volume spray type cleaning head through the piping. The head is inserted in each section of piping and activated with full water pressure and flow. Through hydraulic force from directional spray nozzles the head propels itself forward up the pipe section. Once the head reaches the end of the pipe section it is retracted while maintaining maximum water pressure and flow. The length of the piping section shall be determined ahead of time so that the proper amount of travel can be tracked with calibrated markings on the spray head feed water hose or a meter on the hose reel. While traveling through the piping the pressurized water spray knocks debris loose and carries it back to the open end of the piping where it is collected and removed from the system. For each section of piping the process shall be performed a minimum of two times and shall be repeated until the water exiting the end of the pipe is clear and free of debris as determined by the Owner/Engineer.
- B. The hydro-jet equipment utilized shall be capable of providing a minimum of 50 gpm at 2000 psi.
- C. All cleaning and flushing shall be performed such that all debris will be pulled or flushed downhill.

- D. All cleaning and flushing shall be initiated from all low points in the system and shall terminate at the nearest adjacent high point in the system.
- E. Coordinate the limitations and requirements of hydro-jet process with the flushing subcontractor such that the piping is installed in a sequence and manner that allows every section of the new pipeline to be cleaned and flushed. Limitations may include maximum length of the pipe section, maximum number and/or degree of bends in the pipe section, maximum slope of the pipe section, equipment and excavation access requirements, and the minimum size of the openings required in the piping to allow for insertion and retraction of the cleaning head.
- F. Contractor shall provide access at all low points through valves, tees, flanges, etc. to facilitate the cleaning and flushing process. If temporary fittings or piping is required it shall be provided by the Contractor and removed by the Contractor after successful cleaning.
- G. After flushing and cleaning is completed, Contractor shall provide necessary pipe and fittings required to complete the piping system. Each cleaned section of piping shall be capped and protected to keep mud, debris, water, etc. from entering the piping. If a piping section is left open or unprotected, or is found to be contaminated, it shall be re-cleaned prior to being filled and activated at no cost to the Owner.
- H. Contractor shall provide all water for flushing and testing. Coordinated rental of fire hydrant meters with local Fire Department(s), or the University as required.
- I. Contractor shall provide all temporary piping from water source to piping system and shall provide means for conducting cleaning water from underground piping system to the appropriate sewer; i.e. pumps, piping, hoses, tanks, etc. Contractor to remove all temporary piping, pumps, hoses, etc. from site immediately after flushing has been completed.

3.20 FLUSHING AND CLEANING PIPING SYSTEMS

- A. Flushing and cleaning piping systems is not required.

3.21 INITIAL SYSTEM FILL AND VENT

- A. Fill and vent systems with proper working fluids.

3.22 PIPE PAINTING

- A. Exposed exterior carbon steel, black iron or other ferrous pipe and fittings shall be prepared and painted by qualified painters using corrosion inhibitive paints. Pipe shall be prepared in accordance with paint manufacturer's instructions and primed (2 coats) and finish painted (2 coats). Paint type shall be approved by Architect/Engineer.
- B. Protect piping from weather and paint promptly to prevent corrosion.

END OF SECTION

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SECTION 26 0543

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL AND TELECOMMUNICATION SYSTEMS

PART 1 - GENERAL

1.1 RELATED WORK

- A. Section 03 3000 - Cast-In-Place Concrete.
- B. Section 26 0543.13 - Excavation and Backfill.
- C. Section 26 0543.19 - Manholes and Hardware.

1.2 REFERENCE

- A. Work under this section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.3 DESCRIPTION

- A. Section includes conduits, ducts, and duct accessories for direct buried and concrete encased for underground distribution for electrical power and communications.
- B. The terms duct and duct bank, as used in this Section, are defined as follows:
 - 1. Duct: A single underground conduit, encased in concrete or direct buried.
 - 2. Duct Bank: Two or more ducts run together.

1.4 REFERENCE STANDARDS

- A. ANSI C2 - National Electrical Safety Code.
- B. ANSI C80.1 - Rigid Steel Conduit-Zinc Coated (GRC).
- C. ASTM F512 - Specification for Smooth-Wall Poly (Vinyl Chloride) (PVC) Conduits and Fittings for Underground Installation.
- D. ETL PVC-001 - PVC Coated Conduit.
- E. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
- F. NEMA TC2 - Electrical Polyvinylchloride (PVC) Conduit.
- G. NEMA TC3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
- H. NEMA TC6&8 - PVC Plastic Utilities Duct for Underground Installation.
- I. NEMA TC9 - Fittings for PVC Plastic Utility Duct for Underground Installation.
- J. NFPA 70 - National Electrical Code.
- K. UL 651 - Schedule 40 and 80 Rigid PVC Conduit.
- L. UL 651A - Type EB and A Rigid PVC Conduit and HDPE Conduit.

M. UL E53373 - Underground Fiber Reinforced Epoxy Conduit (FRE).

N. ULG - Electrical Rigid Metallic Conduit-Steel.

1.5 SUBMITTALS

A. Product data for the following:

1. Duct bank materials, including spacers and miscellaneous components.
2. Ducts and conduits and their accessories, including elbows, end bells, bushings, seals, bends, fittings, plugs, pull tape, and solvent cement.
3. Warning tape.
4. Warning plank.

B. Manufacturer's Installation Instructions:

1. Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

C. Closeout Submittals:

1. Project Record Documents:
 - a. Record actual routing of conduits and duct banks.
2. Operation and Maintenance Data:
 - a. Include manufacturer's recommended operating instructions, maintenance procedures and intervals, and preventive maintenance instructions.
 - b. Include spare parts data listing, source, and current prices of replacement parts and supplies.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with NFPA 70.
2. Comply with ANSI C2.
3. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and indicated.

B. Certification:

1. Installer of PVC coated conduits and fitting shall be certified by a PVC conduit manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect from dirt, water, construction debris, and traffic.
- B. Deliver ducts to project site with end capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

1.8 WARRANTY

- A. Manufacturer shall provide standard 1 yr written warranty against defects in materials and workmanship for products specified in this Section. Warranty period shall begin on date of substantial completion.

PART 2 - PRODUCTS

2.1 CONDUITS

- A. Rigid Steel Conduit (RSC): NEMA RN 1, ANSI C80.1, UL 6, heavy wall, hot dipped, galvanized steel with ETL PVC-001 certified PVC coating.
- B. Rigid Nonmetallic Conduit (RNC): NEMA TC 2 Type EPC-40-PVC and Type EPC-80-PVC, UL 651, with matching fittings by same manufacturer, complying with NEMA TC 3 and UL 651, listed for underground use, concrete encased.
- C. Size:
 - 1. 4" nominal for voltages below 600 V and communications.
 - 2. 5" nominal for voltages above 600 V.

2.2 NONMETALLIC DUCTS

- A. Underground Plastic Utilities Duct: NEMA TC 6 & 8, Type EB-20-PVC, ASTM F 512, UL 651A, with matching fittings by the same manufacturer, complying with NEMA TC 9.
- B. Underground Fiber Reinforced Epoxy Conduit (FRE): UL E53373.

2.3 DUCT ACCESSORIES

- A. Duct Spacers:
 - 1. Rigid PVC interlocking spacers.
 - 2. Factory-fabricated, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling. Horizontal and vertical locking separation between ducts as shown on drawings.
 - 3. High density polyethylene (HDPE) template. QwikDuct by SP Products or equal. UL listed with factory fabricated template openings for ducts, rebar and additional openings to allow concrete flow through template.
- B. Elbows: Material to match conduit; minimum bend radius of 48".
- C. Bell Ends: Manufactured bell ends of appropriate sizes at each end of conduit; pre-manufactured system for PVC with conduit seals, provisions for roughing into the concrete pour and waste stops, when entering a new building or a new manhole.
- D. Bushings: Groundable steel bushings of appropriate sizes on all metal conduits where bell ends are not used; pre-manufactured system for PVC with conduit seals, provisions for roughing into concrete pour and water stops, when entering a new or existing building or a new or existing manhole.
- E. Seals: Mechanical interlocking assembly seal of modular synthetic rubber links properly sized to fit the pipe and tightened in place, in accordance with manufacturer's instructions, when entering an existing building or manhole below grade and concrete shall be core drilled for the appropriate size conduit and seal.
- F. Plugs: Closure plugs or caps of same material as conduit at ends of unused sections.
- G. Pull Tape: Nylon pull tape with measurement markings in uniform lengths in each empty duct.
- H. Grounding:
 - 1. Steel grounding bushings, where bell ends are not used.
 - 2. Bonding fitting with bonding strap on steel conduit with end bells.

- I. Concrete Warning Plank: Nominal 12" x 24"x 3" in size, manufactured from 6000 psi concrete.
 - 1. Color: Red dye for electrical duct bank and yellow dye for communications duct bank added to concrete during batching.
 - 2. Label: 2" high, 3/8" deep letters with word "ELECTRIC" marked on plank.
- J. Solvent Cement: Recommended by conduit manufacturer.

PART 3 - EXECUTION

3.1 COORDINATION

- A. Coordinate layout and installation of ducts with final arrangement of other utilities, site grading, and surface features as determined in the field.
- B. Coordinate elevations of ducts and duct bank entrances into manholes, pad-mounted transformer with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect. For manholes and handholes construction, refer to Section 26 0543.19 - Manholes and Hardware.
- C. Adjust the depth of electrical utilities to avoid existing utilities with no change to contract price.
- D. Utility Coordination: When duct lines are being constructed for use by a utility serving the project, consult with them for duct size and quantity, minimum bending radii, maximum distance between pulling points, grounding details, termination arrangement, and other criteria.
- E. Duct Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.
 - 1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
 - 2. Drawings shall be signed and sealed by a qualified professional engineer.

3.2 EXISTING UTILITIES

- A. The existing utilities shown on contract drawings have been plotted from available records. No guarantee is made as to accuracy of locations indicated, and is shown for the benefit of Contractor.
- B. Contact all serving utility companies and have them locate their lines prior to commencing work. Telephone "Call Before You Dig" , 48 hours prior to commencing work. Coordinate with Owner all existing utility lines prior to commencing work.
- C. Protect shown, visible and located utilities from damage. Promptly repair all active shown, visible and located utilities damaged by construction. This repair shall be made solely at the expense of the Contractor.
- D. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

3.3 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Owner no fewer than 1 week in advance of proposed interruption of electrical service.

2. Do not proceed with interruption of electrical service without Owner's written permission.

3.4 DUCT INSTALLATION

- A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.
- B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends, both horizontally and vertically, at other locations, unless otherwise indicated. All 90-degree sweeps with radius 10 ft or less shall be rigid steel conduit.
- C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane. Do not use conduit that requires the use of couplings for straight runs. Use acceptable PVC terminal adapters when joining PVC conduit to metallic fittings or rigid metal conduit.
- D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10" o.c. for 5" ducts, and vary proportionately for other duct sizes.
 1. Begin change from regular spacing to end-bell spacing 10 ft from the end bell without reducing duct line slope and without forming a trap in the line.
 2. Direct Buried Duct Banks: Install an expansion and deflection fitting in each conduit in area of disturbed earth adjacent to manhole or handhole.
 3. Concrete Enclosed Duct Banks: Install watertight expansion fitting in each conduit, with internal bonding jumper to allow for 3/4" movement in any direction.
 4. Grout end bells into structure walls from both sides to provide watertight entrances.
- E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 5 ft outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition.
- F. Expansion Fittings: Provide suitable expansion fittings or other suitable means to compensate for expansion and contraction for raceways crossing expansion joints in structures or concrete slabs between two adjacent structures and between a duct bank and structure. Provide for the high rate of thermal expansion and contraction of PVC conduit by providing PVC expansion joints as recommended by manufacturer and as required. Refer to structural drawings for location of expansion joints in structures.
- G. Sealing: Provide temporary closure at termination of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand minimum of 15 psig hydrostatic pressure. Provide watertight entrance sealing device where an underground conduit enters a structure through a concrete roof or membrane waterproofed wall or floor.
- H. Fire Stops: Provide fire stop openings around electrical penetrations to maintain fire-resistance rating, where underground raceways penetrate fire-rated walls or floors.
- I. Pulling Cord: Install 100 lbf test nylon cord in ducts, including spares. Identify with tags at each end and at any intermediate pull point the origin and destination of each spare duct. Provide a removable permanent cap over each end of each spare duct.
- J. Concrete Encased Ducts: Support ducts on duct spacers.
 1. Spacer Installation:
 - a. Provide spacers close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 ft of duct. Secure spacers to earth and to ducts to prevent floating during concreting. Stagger spacers approximately 6" between tiers. Tie

entire assembly together using tie wires and reinforcing steel. Install base and intermediate spacers at every coupling point of each duct line for a separation horizontally and vertically per NEC.

- b. Preassemble ducts and duct spacers. Preassemble ducts and spacers by using HDPE spacer templates. Space spacers close enough to prevent sagging and deforming of ducts with not less than 5 spacers per (20 ft) of duct. Tie assembly together using tie wires and reinforcing steel. Where soil conditions allow, trench width shall be equal to width of duct bank. Avoid worker entrance into trench by lowering preassembled units into trench from above. Workers shall only enter trench at either end of preassembled units for joining of adjacent units. Use wide nylon straps for lifting units into trench. Wrap lifting straps around conduits and reinforcing steel. Lifting straps shall not be wrapped around duct spacers.
2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
 - a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
 - b. Terminate each pour in a vertical plane if more than one pour is necessary, and install 3/4" reinforcing rod dowels extending 18" into concrete on both sides of joint near corners of envelope. Obtain Architect's approval for the number and location of dowels.
 3. Pouring Concrete: Space concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct bank application.
 4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing bars and ties without forming conductive or magnetic loops around ducts or duct groups. Size reinforcing bars and wire ties as indicated on drawings. Provide rebars with minimum of 2" of concrete on sides, top and bottom. Reinforcing bars shown in sections are required throughout.
 5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms of materials and in a manner acceptable to Architect.
 6. Minimum Space between Ducts: 3" between ducts and exterior envelope wall, 2" between ducts for like services, and 4" between power and signal ducts.
 7. Depth: Install top of duct bank at least 24" below finished grade in areas not subject to deliberate traffic, and at least 30" below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated.
 8. Maintain a grade of at least 4" per 100 ft, either from one manhole or pull box to the next, or from a high point between them, depending on surface contour.
 9. Warning Tape: Bury warning tape approximately 12" above all concrete-encased ducts and duct banks. Align tape parallel to and within 3" of the centerline of duct bank. Provide an additional warning tape for each 12" increment of duct bank width over a nominal 18". Space additional tapes 12" apart, horizontally.
 10. Place duct banks on an undisturbed soil base if possible. Where concrete encased duct bank is installed over an extensive area of disturbed earth such that within the periphery of a building, provide a separate concrete base under the duct bank to ensure stability of raceways during installation. Allow this base to set before duct bank is installed.
- K. Direct Buried Duct Banks:
1. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.

2. Space spacers close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 ft of duct. Secure spacers to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6" between tiers.
3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Section 26 0543.13 - Excavation and Backfill.
4. Install backfill as specified in Section 26 0543.13 - Excavation and Backfill.
5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4" over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction as specified in Section 26 0543.13 - Excavation and Backfill.
6. Install ducts with a minimum of 3" between ducts for like services and 6" between power and signal ducts.
7. Depth: Install top of duct bank at least 36" below finished grade, unless otherwise indicated.
8. Set elevation of bottom of duct bank below the frost line.
9. Warning Plank: Bury warning plank approximately 12" above direct buried ducts and duct banks, placing them 24" o.c. Align plank along the width and along the centerline of duct bank. Provide an additional plank for each 12" increment of duct bank width over a nominal 18". Space additional planks 12" apart, horizontally.

L. Stub-Ups:

1. Use manufactured PVC duct elbows for stub-ups at poles and equipment and at building entrances through floor, unless otherwise indicated. Extend concrete encasement throughout length of the elbow. Concrete encasement applies to concreted encased ducts.
2. Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase couplings with 3" of concrete. Concrete encasement applies to concrete encased ducts.
 - b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete pads, extend steel conduit horizontally a minimum of 5 ft from edge of equipment pad or foundation. Encase in concrete for concrete encased ducts. Install insulated grounding bushings on terminations at equipment.

M. Arrangement and Routing:

1. Arrange multiple duct runs substantially in accordance with details shown on drawings. Locate underground ducts where indicated on drawings and grade to the elevations shown on civil drawings.
2. Make minor changes in location or cross-section as necessary to avoid obstructions or conflicts. Where duct runs cannot be installed substantially as shown because of conditions not discoverable prior to digging of trenches, refer the condition to the Architect for written instructions before further work is done.
3. Maintain a 12" minimum vertical separation between ducts and other systems at crossings where other utility piping systems are encountered or being installed along a raceway route. Maintain a 12" minimum separation between ducts and other systems in parallel runs. Do not place ducts over valves or couplings in other piping systems. Refer conflicts with these requirements to the Architect for written instructions before further work is done.
4. Provide markers at grade to indicate direction of underground conduits provided under this contract. Provide markers consisting of double-ended arrows, straight for straight runs and bent at locations where runs change direction. Provide markers at all bends and at intervals not exceeding 100 ft in straight runs. Use markers made of sheet bronze not less than 1/4"

thick embedded in and secured to the top of concrete posts. Use markers not less than 10" long and 3/4" wide and marked ELECTRIC CABLES in letters 1/4" high incised into the bronze to a depth of 3/32".

5. Enter manholes and structures with ducts at right angles.

N. PVC Coated Conduits: Use tools approved for use with PVC coated conduits and fittings.

3.5 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Cables Over 600V: RNC, NEMA Type EPC-40-PVC, in concrete encased duct bank, unless otherwise indicated.

B. Ducts for Electrical Feeders 600V and Less: RNC, NEMA Type EPC-40-PVC, in concrete encased duct bank, unless otherwise indicated.

C. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40-PVC, in direct buried duct bank, unless otherwise indicated.

D. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC, in concrete encased duct bank, unless otherwise indicated.

E. Underground Ducts for Telephone, Communications, or Data Circuits: RNC, NEMA Type EPC-40-PVC, in direct buried duct bank, unless otherwise indicated.

F. Underground Ducts Crossing Paved Paths, Walks, Driveways, and Roadways: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

3.6 EARTHWORK

A. Excavation and Backfill: Comply with Section 26 0543.13 - Excavation and Backfill, do not use heavy-duty, hydraulic-operated compaction equipment.

3.7 CONCRETE

A. Concrete: 3000 psi, 28-day strength, complying with Division 03 - Concrete, where concrete encased.

3.8 GROUNDING

A. Ground underground ducts.

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts.

2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80% fill of duct. If obstructions are indicated, remove obstructions and retest.

B. Preparation for pulling in conductors:

1. Do not install crushed or deformed raceways. Avoid traps in raceways where possible. Take care to prevent the lodging of plaster, concrete, dirt, or trash in raceways, boxes, fittings, and equipment during the course of construction. Make raceways entirely free of obstructions or replace them. Ream all raceways, remove burrs, and clean raceway interior before introducing conductors or pull wires.

2. Immediately after installation, plug or cap all raceway ends with watertight and dust-tight seals until the time for pulling in conductors.
- C. Do not backfill underground direct buried and concrete encased ducts until the Architect has inspected them. Notify Architect 24 h in advance of duct concrete pour, or backfill of direct buried ducts.

3.10 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

END OF SECTION

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SECTION 26 0543.13
EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.1 RELATED WORK

- A. Section 31 2000 - Site Earthwork.
- B. Section 26 0543 - Underground Ducts and Raceways for Electrical Systems.

1.2 REFERENCE

- A. Work under this section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.3 DESCRIPTION

- A. Section lists methods and materials for trench excavation and backfill for electrical and communications conduits in duct banks. Refer to Section 26 0543 - Underground Ducts and Raceways for Electrical Systems.

1.4 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
- B. Excavation: Removal of material encountered above sub-grade elevations and to lines and dimensions indicated.
- C. Duct: A single underground conduit encased in concrete or direct buried.
- D. Duct Bank: Two or more ducts run together.
- E. Fill: Soil materials used to raise existing grades.
- F. Sub-grade: Surface or elevation remaining after completing excavation, or top surface of fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- G. Utilities: On-site underground ducts and duct banks as well as underground services within buildings.

1.5 SUBMITTALS

- A. Submit list of materials to be used for backfill.

1.6 QUALITY ASSURANCE

- A. Pre-excavation Conference: Conduct conference at project site to comply with requirements in Division 01 Section "General Requirements."

PART 2 - PRODUCTS

2.1 FILL MATERIAL

- A. Type 1 Fill:
 - 1. Material from excavation separated from materials, which do not compact by tamping and rolling. No stones larger than 3" and no building, organic, or corrosive or frozen materials and no lumps larger than 6".
- B. Type 2 Fill:
 - 1. Sand or gravel materials with none larger than 2" and of that portion passing the #4 sieve less the 5% to pass #200 sieve.
- C. Type 3 Fill:
 - 1. Gravel of rounded to sub-angular shape, screened, which will pass 3/4" sieve and retained on #4 sieve.
- D. Type 4 Fill:
 - 1. Pit run rock or gravel with maximum stone size of 1".
- E. Type 5 Fill:
 - 1. Pea gravel, screened, which will pass 3/8" sieve and retained on #4 sieve.

2.2 CRUSHED ROCK

- A. Crushed Rock: 1-1/4" minus, unless smaller is required for bedding material.

2.3 SAND

- A. Sand: Clean and washed building sand.

2.4 TOPSOIL

- A. Topsoil: Equal in quality to that removed.

2.5 SOD

- A. New Sod: Mature, densely rooted grass free of weeds and objectionable grasses.

2.6 PLANTS

- A. Plants: Obtained from a commercial nursery and be similar to those replaced.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Establish grade lines and locations of roadways and sidewalks, grade beams, and pill caps. Provide necessary stakes and batter boards.
- B. Verify elevations of existing utilities prior to excavation for new ducts.
- C. Verify locations of manholes with civil drawings
- D. Coordinate excavation and backfill with Section 31 2000 - Site Earthwork.

3.2 EXCAVATION

- A. Provide excavation for underground work, including ducts, manholes, handholes, and pull boxes, unless otherwise shown or specified. Lay duct in open trench, except when Architect gives written permission for tunneling.
- B. Excavate trench as indicated on drawings to 24" wider than duct or duct bank dimensions and minimum of 3" below bottom of duct.
- C. Include clearing, tree removal, grubbing, pavement removal, substructure removal such as walls, footings, and piers, and all incidental work such as tunneling, sheet piling, shoring, underpinning, pumping, bailing, and transportation. Coordinate excavation extending beyond construction limits with Construction Manager and Owner.
- D. Do not provide blasting on this project without written permission of Architect and Owner.
- E. Remove all excess excavation material from site, unless directed otherwise.
- F. Over excavate 3" and fill with 3" of sand, where trench bottom is rock, or rocky, or contains debris larger than 1", or material with sharp edges.
- G. Perform all crossings of concrete or asphalt after surface material has been saw cut to required width and removed.
- H. Conform to utility company requirements for excavation and vault installation in addition to contract document requirements where excavations are for installing utility company's ducts and vaults.

3.3 ROCK EXCAVATION

- A. Use mechanical methods to remove rock in trenches for underground ducts.
- B. Refer to Geotechnical Report available from Architect/Engineer for data on rock.
- C. Include rock excavation in the Bid, unless otherwise indicated.

3.4 INSTALLATION

- A. Keep underground ducts to proper line and grade and sealed to prevent entrance of animals or foreign matter.
- B. Provide bracing and sheet piling as necessary to support trenches. Comply with Local Regulations, applicable provisions of OSHA Regulations on trenching, or with provisions of "Manual of Accident Prevention in Construction" published by Associated General Contractors of America.
- C. Do not lay duct in water.
- D. Keep trench free from water until duct joint material has hardened and concrete encasement is in place.
- E. Do not increase the contract cost due to presence of ground water in soil or necessity of sheet piling or bracing trenches. Adjust contract cost when sheet piling is left in place, on written order of Owner.
- F. Do not remove sheet piling until trench is substantially backfilled. Cut off sheet piling left in place not less than 2 ft below new, finished grade.

- G. Place underground ducts on 3" compacted bedding of sand. Shape bedding for clearance for joints and fittings, tamped in place and graded evenly to ensure uniform bearing for the full length of duct. Do not support duct by blocking, planking or mounding of bedding material.
- H. Install lines passing under foundations with minimum of 3" clearance to concrete and ensure there is no disturbance of bearing soil.

3.5 BACKFILL

- A. Backfill around ducts by hand to depth of 12" above top of duct with specified fill in 6" layers. Compact backfill thoroughly with compactor of suitable weight or with approved mechanical tamper. Do not use flooding or jetting with water.
- B. Place backfill from 12" above duct to elevation of subgrade in layers not exceeding 8" in depth with specified fill.
- C. Backfill from 12" above duct to sub-grade with specified fill, when excavating through areas which are to become walks, roads, driveways or parking areas of concrete, bituminous or exposed gravel surfacing or such areas are existing to remain. Backfill in 12" layers and compact with mechanical means to density 95% modified proctor.
- D. Conform excavation, duct laying, backfilling, grading and surfacing, as herein specified, when excavation occurs on public property or areas beyond the property line. Comply with additional requirements for public utility or other authorities. Check with each utility and incorporate cost of any additional requirements in base bid.
- E. Backfill around vaults and handholes to be free of debris larger than 1 3/4" in all directions to 1 ft from vault.
- F. Provide 6" of pea gravel or sand bedding for vaults and handholes larger than 3'-0" x 3'-0". For handholes smaller than 3'-0" x 3'-0", provide 3" pea gravel or sand.
- G. Other backfill shall be free of debris larger than 6" in diameter.
- H. Place backfill material so as to obtain a minimum degree of compaction of 95% of maximum density at optimum moisture content. Moisten backfill material as required to obtain proper compaction.
- I. Broken pavement, concrete, sod, roots, and debris shall not be used for backfill.

3.6 DEWATERING

- A. Provide, operate, and maintain all pumps or other dewatering equipment required for control of water in trenches and excavations for electrical and communications site work during the entire construction period.

3.7 SHORING

- A. Provide as required by trenching and excavating to secure site work. Comply with applicable safety regulations.

3.8 FINISHING

- A. On completion of trenching and backfilling operations, restore grades to original elevation or to new sub-grade elevation.

- B. Replace surfaces to existing conditions when trenching is through existing areas or beyond construction limits.
- C. Use 6" of topsoil and sod to match existing elevations in landscaped areas or as otherwise approved by Landscape Architect.

3.9 SURFACE FINISHING

- A. Refinish every disturbed surface to its original condition.
- B. Replace planted materials not surviving 90 days after contract acceptance at Contractor's own expense.
- C. Return after 1 year and re-fill, compact and refinish settled areas to grade.

3.10 CARE OF PLANTS AND TREES

- A. Remove and safely store plants and trees with trunks smaller than 6" diameter prior to commencing site work. Avoid trees larger than 6" diameter when so indicated on drawings. Replace plants and trees upon completion of site work.

END OF SECTION

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SECTION 26 0543.19
MANHOLES AND HARDWARE

PART 1 - GENERAL

1.1 RELATED WORK

- A. Section 03 3000 - Cast-in-Place Concrete.
- B. Section 26 0543 - Underground Ducts and Raceways for Electrical Systems.
- C. Section 26 0543.13 - Excavation and Backfill.

1.2 REFERENCE

- A. Work under this section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.3 DESCRIPTION

- A. Section includes underground utility structures: manholes, handholes, pull boxes and accessories for power and communication cable systems.

1.4 REFERENCED STANDARDS

- A. AASHTO HB 17 - Standard Specifications for Highway Bridges.
- B. ANSI C2 - National Electrical Safety Code.
- C. ASTM A 48/A 48M - Specification for Gray Iron Castings.
- D. ASTM C 270 - Specification for Mortar for Unit Masonry.
- E. ASTM C 387 - Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
- F. ASTM C 858 - Specification for Underground Precast Concrete Utility Structures.
- G. ASTM C 891 - Standard Practice for Installation of Underground Precast Concrete Utility Structures.
- H. ASTM C 1.037 - Practice for Inspection of Underground Precast Concrete Utility Structures.
- I. ASTM E 329 - Standard Specification for Agencies Engaged in Construction Inspection and/or Testing.
- J. ISO 9000 - Quality Management.
- K. ISO 10012 - Measurement Management Systems.
- L. NFPA 70 - National Electrical Code.
- M. SCTE 77 - Specification for Underground Enclosure Integrity.

1.5 SUBMITTALS

- A. Product Data:

1. Accessories for underground utility structures.
- B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:
 1. Duct entry provisions, including locations and duct sizes.
 2. Reinforcement details.
 3. Frame and cover design and manhole frame support rings.
 4. Grounding details.
 5. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
 6. Joint details.
- C. Shop Drawings for Factory-Fabricated Handholes and Pull Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:
 1. Duct entry provisions, including locations and duct sizes.
 2. Cover design.
 3. Grounding details.
 4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
- D. Product Certificates: For concrete and steel used in precast concrete manholes and handholes, as required by ASTM C 858.
- E. Qualification Data: For professional engineer and testing agency.
- F. Source quality-control test reports.
- G. Field quality-control test reports.
 1. Indicate field test and inspection procedures and interpret test results and corrective action taken for compliance with specification requirements.
- H. Manufacturer's Installation Instructions:
 1. Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- I. Closeout Submittals:
 1. Project Record Documents:
 - a. Record actual location of underground utility structures.
 2. Operation and Maintenance Data:
 - a. Include manufacturer's recommended operating instructions, maintenance procedures and intervals, and preventive maintenance instructions.
 - b. Include spare parts data listing, source, and current prices of replacement parts and supplies.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Comply with ANSI C2.
- C. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store precast concrete and other factory-fabricated underground utility structures at project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.
- B. Lift and support precast concrete units only at designated lifting or supporting points.

1.8 WARRANTY

- A. Manufacturer shall provide standard 1 yr written warranty against defects in materials and workmanship for products specified in this Section. Warranty period shall begin on date of substantial completion.

1.9 MAINTENANCE

- A. Extra Materials:
 - 1. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 PRECAST CONCRETE MANHOLES

- A. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom. Frame and cover shall form top of enclosure and shall have load rating consistent with that of manhole.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Oldcastle Precast Group.
 - 2. Utility Concrete Products, LLC.
 - 3. Jensen Precast.
- C. Comply with ASTM C 858 and with interlocking mating sections, complete with accessories, hardware, and features.
 - 1. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12" vertically and horizontally to accommodate alignment variations.
 - a. Windows: Located not less than 6" from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
 - b. Window opening: Cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
 - 2. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
 - a. Type and size: Fittings matched to duct or conduit to be terminated.
 - b. Fittings: Aligned with elevations of approaching ducts and located near interior corners of manholes to facilitate racking of cable.
- D. Concrete Knockout Panels: 1-1/2" to 2" thick, for future conduit entrance and sleeve for ground rod.
- E. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the groundwater level at grade.

2.2 PRECAST CONCRETE HANDHOLES AND PULL BOXES

1. Christy Concrete Products.
 2. Oldcastle Precast Group.
 3. Utility Concrete Products, LLC.
 4. Jensen Precast.
- B. Comply with ASTM C 858 for design and manufacturing processes.
- C. Structural Load Ratings: As specified in Part 3 “Underground Enclosure Application.”
- D. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or pull box.
1. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
 2. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 3. Cover Legend: Molded lettering, as indicated for each service.
 4. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
 5. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
 - a. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.
 6. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12” vertically and horizontally to accommodate alignment variations.
 - a. Windows: Located no less than 6” from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
 - b. Window opening: Cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie-in to concrete envelopes of ductbanks.
 7. Duct Entrances in Handhole Walls:
 - a. Type and size: Fittings matched to duct or conduit to be terminated.
 - b. Fittings: Aligned with elevations of approaching ducts and located near interior corners of handholes to facilitate racking of cable.
 8. Handholes 12” wide by 24” long and larger: Inserts for cable racks and pulling-in irons installed before concrete is poured.

2.3 UTILITY STRUCTURE ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Christy Concrete Products.
 2. Oldcastle Precast Group.
 3. Utility Concrete Products, LLC.
- B. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.
1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A 48/A 48M, Class 30B with milled cover-to-frame bearing surface; diameter as indicated on drawings.
 - a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.
 2. Cover Legend: Cast in. Selected to suit system.
 - a. Legend: “ELECTRIC-LV” for duct system with power wires and cables for systems operating at 600 V and less.

- b. Legend: "ELECTRIC-HV" for duct systems with medium-voltage cables.
 - c. Legend: "SIGNAL" for communications, data, and telephone duct systems.
- C. Manhole Sump Frame and Grate: ASTM A 48/A 48M, Class 30B, gray cast iron.
- D. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2" diameter eye, and 1" x 4" bolt.
 - 1. Working Load Embedded in 6", 4000 psi Concrete: 13,000 lbf minimum tension.
- E. Pulling Eyes in Nonconcrete Walls: Eyebolt with reinforced fastening, 1-1/4" diameter eye, rated 2500 lbf minimum tension.
- F. Pulling-in and Lifting Irons in Concrete Floors: 7/8" diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.
 - 1. Ultimate Yield Strength: 40,000 lbf shear and 60,000 lbf tension.
- G. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts for noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2" ID by 2-3/4" deep, flared to 1-1/4" minimum at base.
 - 1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.
- H. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2" bolt, 5300 lbf rated pullout strength, and minimum 6800 lbf rated shear strength.
- I. Cable Rack Assembly: Steel, hot-rolled galvanized, except insulators.
 - 1. Stanchions: T-section or channel; 2-1/4" nominal size; punched with 14 holes on 1-1/2" centers for cable-arm attachment.
 - 2. Arms: 1-1/2" wide, lengths ranging from 3" with 450 lb minimum capacity to 18" with 250 lb minimum capacity. Arms shall have slots along full length for cable ties and be arranged for secure mounting in horizontal position at any vertical location on stanchions.
 - 3. Insulators: High-glaze, wet-process porcelain arranged for mounting on cable arms.
- J. Cable Rack Assembly: Nonmetallic. Components fabricated from nonconductive, fiberglass-reinforced polymer.
 - 1. Stanchions: Nominal 36" high by 4" wide, with minimum of 9 holes for arm attachment.
 - 2. Arms: Arranged for secure, drop-in attachment in horizontal position at any location on cable stanchions, and capable of being locked in position. Arms shall be available in lengths ranging from 3" with 450 lb minimum capacity to 20" with 250 lb minimum capacity. Top of arm shall be nominally 4" wide, and arm shall have slots along full length for cable ties.
- K. Duct-Sealing Compound: Non-hardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35°F. Capable of withstanding temperature of 300°F without slump and adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.
- L. Cover Hooks: Heavy duty, designed for lifts 60 lbf and greater. Two required.

2.4 SOURCE QUALITY CONTROL

- A. Test and inspect precast concrete utility structures according to ASTM C 1037.

- B. Nonconcrete Handhole and Pull Box Prototype Test: Test prototypes of manholes and pull boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 - 1. Tests of materials shall be performed by an independent testing agency.
 - 2. Strength of tests of complete pull boxes and covers shall be by either an independent testing agency or the manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 - 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 UNDERGROUND ENCLOSURE APPLICATION

- A. Manholes: Precast concrete:
 - 1. Manholes Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.
 - 2. Manholes Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.
- B. Handholes and Pull Boxes for 600 V and Less, Including Telephone, Communications, and Data Wiring:
 - 1. Handholes and Pull Boxes in Roadways and Other Deliberate Traffic Paths: Precast concrete AASHTO HB 17, H-20 structural load rating.
 - 2. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17 structural load rating.
 - 3. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10.
 - 4. Handholes and Pull Boxes Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin structurally tested according to SCTE 77 with 3000 lbf vertical loading.

3.2 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND PULL BOXES

- A. Precast Concrete Manhole and Handhole Installation
 - 1. Comply with ASTM C 891, unless otherwise indicated.
 - 2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
 - 3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1" sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
 - 4. Concrete: 5000 psi 28-day strength, complying with Division 03 - Concrete.
- B. Elevations:
 - 1. Manhole Roof: Install with rooftop at least 15" below finished grade.
 - 2. Manhole Frame: In paved areas and traffic-ways, set frames flush with finished grade. Set other manhole frames 1" above finished grade.
 - 3. Handhole Covers: In paved areas and traffic-ways set surface flush with finished grade. Set covers of other handholes 1" above finished grade.
 - 4. Where indicated, cast handhole cover frame integrally with handhole structure.
- C. Drainage: Install drains in bottom of manholes via drain lines where indicated. Coordinate with drainage provisions indicated.
- D. Manhole Access: Circular opening in manhole roof; sized to match cover size.

- E. Dampproofing: Apply dampproofing to exterior surfaces of **manholes** after concrete has cured at least 3 days. Dampproofing materials and installation are specified in Division 07 Section "Bituminous Dampproofing." After ducts have been connected and grouted, and before backfilling, dampproof joints and connections and touch up abrasions and scars.
- F. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.
- G. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8" for manholes and 2" for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.
- H. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.
- I. Pack and smooth non-shrink grout at all rough edges around duct entrances at each manhole.

3.3 GROUNDING

- A. Provide 1 ground rod in each power system manhole and 2 ground rods in each communication system manhole. Provide ground ring conductor, minimum #3/0 AWG bare copper, secured around perimeter of the manhole interior at 12" above floor, and exothermically connected to the ground rod.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 - 1. Demonstrate capability and compliance with requirements on completion of installation of underground utility structures.
 - 2. Test manhole grounding to ensure electrical continuity of grounding and bonding connections.
- B. Correct deficiencies and retest as specified above to demonstrate compliance.
- C. Interpret test results in writing and submit to Engineer.

3.5 CLEANING

- A. Clean internal surfaces of manholes, including sump and remove foreign material, after completing the installation of all devices, equipment, cables and terminations.
- B. Remove water from manholes. If manholes continue to fill up with water, Contractor shall pump them regularly until the source of water has been detected and corrected.

END OF SECTION

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SECTION 31 1000

CLEARING AT WORK SITE

PART 1 - GENERAL

1.1 SCOPE

- A. Provide all material, labor, equipment and services necessary to clear the work site for site improvements and other related items necessary to complete the Project as indicated by the Contract Documents unless specifically excluded. Confine cleared areas to minimum area required to accomplish proposed work.

1.2 SECTION INCLUDES

- A. Remove organic matter and vegetation, topsoil and debris.
- B. Remove pavement where said pavement is indicated to be removed on the construction plans.
- C. Clear site of plant life and grass where authorized for removal.
- D. Remove trees and shrubs where authorized.
- E. Remove root system of trees and shrubs where authorized.
- F. Remove existing utilities where said utilities are indicated to be removed on construction plans.
- G. Buried objects encountered.
- H. Coordinate clearing work with utility agencies.
- I. Remove indicated paving, curbs and flatwork.

1.3 RELATED SECTIONS

- A. Section 01 7300 – Execution Requirements.
- B. Section 31 2000 – Site Earthwork.
- C. Section 31 2316 – Trench Excavation and Backfill for Site Utilities.

1.4 REGULATORY REQUIREMENTS

- A. Conform to applicable codes for disposal of debris.
- B. Coordinate clearing work with the Construction Inspector.

PART 2 - PRODUCTS

2.1 MATERIALS

Not Used

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify that existing plant life to be removed has been authorized for removal.
- B. Examine site and compare individual work sites with the Drawings and Specifications.
- C. Thoroughly investigate and verify conditions under which the work is to be performed.
- D. No allowance will be made for extra work resulting from negligence or failure to meet requirements of Paragraphs 3.1 A, B and C.
- E. Protect Monitoring wells if present, and associated piping.

3.2 PROTECTION

- A. Locate, identify, and protect utilities that remain, from damage. Refer to Section 31 2316/1.7.
- B. Protect trees, plant growth, and features not specifically designated for removal. Protect existing trees indicated to remain in place against unnecessary cutting; breaking or skinning of the roots, skinning and bruising of the bark, smothering of trees by stock piling building or excavated materials, or parking of vehicles, or allowing vehicular traffic within the drip line. Contractor shall install a temporary 6 foot high chain link fence at the "drip line" of all trees within or adjacent to the Construction site. And will provide water at a regular basis for existing trees within the project limits.
- C. Protect existing structures and other existing improvements from damage or displacement.
- D. Protect salvageable signs and other improvements for reinstallation.

3.3 CLEARING

- A. Clear only limited areas required for execution of work at proposed improvement location.
- B. Remove paving only where authorized and necessary to execute the Work.
- C. Remove only trees and shrubs authorized for removal.

3.4 REMOVAL

- A. Remove pavement where designated, debris, organic matters, vegetation, trees and shrubs from the site and lawfully dispose of offsite.
- B. Remove all utility lines shown on the plans to be removed, and/or those that fall within the footprint and 5 feet beyond of any proposed building or structure. Fill lines completely with grout or lean cement mix and plug ends of any portion of lines to remain. Perform excavation and backfill per Section 31 2316. Legally dispose of removed materials offsite.

3.5 TOPSOIL EXCAVATION

- A. Remove all topsoil, which contains sod, grass or other vegetation to the satisfaction of the geotechnical engineer. Remove all subsoil, clay, stones, or other objects over 4" in diameter

and dispose of off-site. Store topsoil on-site at a place designated by owner or his/her representative, and install erosion control measures to protect.

- B. Where existing vegetation is to be placed back on the excavated area following backfill and compaction, temporarily store at site. Cover storage piles to prevent wind blown dust and erosion per details shown on plans.
- C. Where existing vegetation is to be replaced by new materials, remove contaminated or excess soil from site and dispose of those materials offsite. Remove all rubbish, concrete, asphalt and other undesirable materials resulting from site clearing operations and dispose of off premises. Burning of materials will not be permitted.

3.6 BURIED OBJECTS ENCOUNTERED

- A. Remove and dispose of all undesirable buried objects not to remain (including rock, debris, footings and foundations, abandoned utilities, etc.), which are encountered in the excavation, at no additional cost to owner.
- B. Where excavating through tree roots, perform work by hand and cut roots, where authorized by the owner's arborist, with a saw.
- C. Any wells encountered within the project limits shall be capped per the local County Health Department's regulations.

3.7 PROPERTY AND BUILDING LAYOUT

- A. Establish building locations with appropriate offsets to allow for grading work.
- B. Retain the services of a Civil engineer or surveyor, licensed in the State of California, for site improvements, building layout, utility layout and as-built surveys.
- C. Reset property stakes, if required, or disturbed during construction operations.
- D. Reset benchmark if required.
- E. Define locations of paving walks and other site features including underground utility locations.
- F. Verify inverts or flow-lines of existing utility structures adjacent to the site or to be connected to, including but limited to stubs, laterals, catch basins, junction boxes and manholes.

3.8 CLEAN UP

- A. Thoroughly clean the entire site to a neat and acceptable condition to the owner. Remove all construction waste and unused materials, loose rock and stones; roots, weeds and all debris resulting from this work.

END OF SECTION

SECTION 31 2000

SITE EARTHWORK: EXCAVATION, FILLING AND GRADING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Over excavation of building area.
- B. Excavating soil and other material for surface improvements.
- C. Placing fill.
- D. Compaction of existing ground and fill.
- E. Preparation of sub-grade for other improvements.
- F. Grading of soil.
- G. Consolidation and compaction.
- H. Fill under parking and drive aisle-paved surfaces, and hardscape and flatwork.
- I. Fill for over-excavation.

1.2 RELATED SECTIONS

- A. Contract General Conditions.
- B. Section 01 4000 – Quality Requirements.
- C. Section 01 5000 – Temporary Facilities and Controls.
- D. Section 02 3200 – Geotechnical Investigation

1.3 WORK NOT INCLUDED IN THIS SECTION

- A. Trench Excavation and Backfilling: See 31 2316.
- B. Landscape Grading and Soil Preparation: See 32 9119.
- C. Import Topsoil for Vegetated Swales: See 32 0513.

1.4 REFERENCES

- A. California Test Method No. 216 (Dry Method).
- B. Geotechnical Engineering Investigation prepared by TRC, Inc., for Roche Molecular Diagnostics, 4300 Hacienda Dr., Pleasanton, CA, 94566, Bldg 730, Report # 234269, July 13, 2015, and any subsequent addenda.

- C. Comply with provisions of Section 3301 and 3302 of the current California Building Codes with latest edition of the California Amendments for requirements for Excavations and Fills.
 - D. UBC – Uniform Building Code, Chapter 18 and Chapter 33 and Chapter 16, Table 1.
 - E. CCR – California Code of Regulations, Title 24, Part 2, Chapter 18A and Chapter 33. And Chapter 16, Table 1.
 - F. Local County Code.
 - G. Local agency's California Dust Control Ordinance.
 - H. Storm Water Quality Task Force – Construction Activity Handbook.
 - I. State Water Resources Control Board Order No. 92-08-DWQ.
 - J. ASTM C136 – Method for Sieve Analysis of Fine and Coarse Aggregates.
 - K. ASTM D448 – Sized of Aggregate for Roadway and bridge Construction.
 - L. ASTM D1556 – Test Method for Density of Soil in Place by the Sand-Cone Method.
 - M. ASTM D1557 – Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures using 10 Lb. Rammer and 18 inch Drop.
- 1.5 SUBMITTALS
- A. Submit samples under provisions of Section 01 3000.
 - B. Submit 10-lb. sample of each type of fill to testing laboratory in airtight containers.
 - C. Submit name of imported materials source. Provide materials from same source throughout the work. Change of source requires Architect's approval.
 - D. Submit test reports under provisions of Section 01 4000.
 - 1. Submit an excavation support plan in accordance with the geotechnical report prior to beginning construction to the geotechnical engineer for his/her review, to ensure that excavation does not harm adjacent buildings.
- 1.6 DEFINITIONS
- A. Utility: Any buried or above ground pipe, conduit, cable, associate device or appurtenances, or substructure pertaining thereto.
 - B. Geotechnical Engineer: Refers to the Geotechnical Engineer of Record, being the one and same party. Geotechnical Engineer of Record for this project is TRC, Inc.
- 1.7 COORDINATION
- A. Coordinate work with affected trades.
 - B. Verify that the location of existing utilities has been indicated at work site by utility authorities.

1.8 EXISTING UTILITIES

- A. The Engineer has made a diligent attempt to indicate on the plans the location of all underground main and trunk line utility facilities, which may be associated with and otherwise affect the Work. The location of said facilities, therefore, shall only be considered approximate, until exposed by the Contractor.
- B. Service laterals and appurtenances have also been shown where information was available as to their location. The location of said facilities, therefore, shall be considered approximate only, until exposed by the Contractor.
- C. At new work location, expose by hand methods all existing utilities along the route of the new work prior to using any mechanical equipment. If mechanical equipment is allowed at a particular location, it may only be used after the completion by the Contractor of a successful exhaustive search by hand methods to locate all existing facilities as indicated on the plans and as indicated at the work site by utility companies.
- D. Maintain all existing utility mains and service lines in constant service during construction of the Work.

1.9 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01 3000.
- B. Accurately record actual locations of utilities encountered.

1.10 QUALITY ASSURANCE

- A. Comply with local governing agency(s) County Code.
- B. Comply with local agency's California Dust Control Ordinance.
- C. All bidders are required to contact the local governmental agency responsible for issuing erosion control permits and requirements.
- D. Perform Best Management Practice dust control techniques for given site conditions as defined in the notes on the plans and/or the SWPPP.

1.11 FIELD CONDITIONS

- A. Verify that the survey benchmark and intended elevations for the work areas are as indicated.
- B. Notify Architect of unexpected subsurface conditions and discontinue work in area affected until notified to resume work.
- C. Perform site assessment to identify any contaminated soils, which may occur on site.

1.12 PROTECTION

- A. Protect trees, shrubs, lawns and other features remaining as portion of final landscaping.
- B. Protect benchmarks, sidewalks and paving and curbs as indicated.

- C. Underpin adjacent structures, including utilities and pipe chases, which may be damaged by excavation work.
- D. Protect above or below grade utilities, which are to remain.
- E. Barricade open excavations and post warning lights. Operate lights from dusk to dawn.
- F. Protect facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.
- G. Repair or replace all damaged landscaping, hardscapes and other items that were damaged, to original condition.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Fill in Turf, landscaped, or Other Planting Areas: As required by the Landscape Architect's specifications, Sections 32 0513 Import Topsoil.
- B. Bioretention areas shall have a minimum infiltration rate of 5 inches per hour, and a maximum infiltration rate of 10 inches per hour. Bioretention areas to have a minimum depth of 18" of biotreatment soil mix. Contractor to provide a certification letter from the supplier of the biotreatment soil to the Civil engineer stating that the biotreatment soil mix meets the specifications as outlined in the Appendix L, of the most current version of Alameda County Clean Water Program C.3 Stormwater Technical Guidance Manual, which can be found at their website: www.cleanwaterprogram.org. No other submittals will be accepted requiring the engineer to determine if the submittal meets these requirements.
- C. Fill in Non-planting Areas: Onsite materials below the stripped layer if approved by the geotechnical engineer, and shall not contain rocks or lumps larger than 6 inches in the greatest dimension, with 15 percent or less larger than 2-1/2" in the greatest dimension.
- D. Imported fill material shall be inorganic, have a PI of 15 or less, and shall have sufficient binder to reduce the potential for sidewall caving of foundation and utility trenches. Non-expansive fill (NEF) should have a PI of 15 or less. Samples of all proposed import fill shall be submitted to the geotechnical consultant of record at least 10 working days prior to delivery to the site to allow for visual review and laboratory testing.
 - 1. For laboratory testing and evaluation, import soils may not be more corrosive than the on-site native materials. Suitable documentation must be provided for the import material demonstrating that its pH, soluble sulfates, chlorides and resistivity is not greater than the native soils.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify site conditions.

3.2 PREPARATION

- A. Identify required lines, levels, contours and datum.
- B. Locate, identify, and protect existing above and below grade utilities from damage.
- C. Protect plant life, lawns, trees, shrubs, and other features not authorized for removal.
- D. Protect existing structures, fences, sidewalks, paving, curbs and other improvements to remain from damage from excavation equipment and vehicular traffic.
- E. Employ equipment and methods appropriate to the work site.
- F. Protect excavated areas from drainage inflow, and provide drainage to all excavated areas.
- G. All topsoil, vegetation, organics, and debris should be removed from the proposed building, pavement and flatwork areas. The general depth of stripping should be sufficiently deep to remove the root systems and organic topsoils. For estimate purposes, a minimum stripping depth of 8 inches shall be used. The Geotechnical Engineer shall review the actual depth of stripping at the time of construction. Deeper stripping may be required in localized areas. Stripping shall extend laterally a minimum of 5 feet outside the building and pavement perimeters. These materials will not be suitable for use as engineered fill; however, stripped topsoil may be stockpiled and reused in landscape areas at the discretion of the owner and landscape architect.
- H. Following stripping operations, the building pad areas, pavement areas, and proposed flatwork areas shall be over excavated of existing fills to native soil, as determined by the Geotechnical Engineer. The exposed sub-grade at the bottom of the excavations shall be scarified to a minimum depth of 6 inches and compacted as engineered fill. The excavation shall be backfilled as engineered fill.
- I. The Contractor shall locate any foundations, floor slabs, debris pits, abandoned pipes and/or trenches, uncontrolled fills, and subsurface structures. These soils or structures shall be entirely removed. The resulting excavations shall be cleaned of all loose or organic material; the exposed native soils shall be scarified to a depth of 6-inches then compacted as engineered fill and the excavation back filled with engineered fill.
- J. The Contractor shall locate any onsite water wells. All wells scheduled for demolition shall be abandoned per state and local requirements. The Contractor shall obtain an abandonment permit from the local environmental health department, and issue certificates of destruction to the Owner and Geotechnical Engineer upon completion.
- K. To ensure that loose soils associated with tree removal and residual roots are removed, existing and former tree wells shall be over excavated to a depth of at least 24 inches below sub-grade (BSG). The roots larger than 1/4-inch in diameter shall be removed, the exposed ground surface scarified to a depth of 6-inches and compacted as engineered fill, and the over excavated soils compacted as engineered fill to final grade.
- L. The exposed ground surface in areas to receive engineered fill material shall be scarified to a depth of 6-inches, moisture conditioned to within two percent of optimum moisture content and compacted as engineered fill. The zone of scarification and compaction shall extend laterally a minimum of 5 feet outside the perimeters of the buildings. The scarification and compaction

shall be conducted following stripping operations, removal of subsurface structures, over excavation, and removal of all soft or plant areas.

- M. All fill required to bring the site to final grade shall be placed as engineered fill. In addition, all native soils over-excavated shall be compacted as engineered fill.

3.3 OVER EXCAVATION ON BUILDING PAD AND PAVEMENT AREA

- A. No over-excavation is anticipated for this project, unless soft or saturated soil is encountered during excavation, at which point the geotechnical consultant shall be contacted. If loose soil or undesirable material is encountered in the excavations, it shall be removed and the over-excavation backfilled with lean or structural concrete to the originally planned bottom of the footing elevation.

3.4 EXCAVATION

- A. Excavation for site utilities or buildings or structures shall be so constructed or protected that they do not endanger life or property.
- B. Excavate soil to below finish subgrade of improvements (or layer thereof) to be placed thereon, or to finish surface grade where no improvements are to be placed thereon. Soils below pavement areas or areas to receive fill, shall be scarified a minimum of 6 inches below the subgrade, moisture conditioned and compacted in accordance with the requirements in Section 3.6, Compaction.
- C. Conform excavation to the lines, grades and cross-sections showed on the plans.
- D. When excavating through tree roots, perform work by hand and cut roots, where authorized by the owner's arborist, with a saw.
- E. Remove and stockpile excess soil not to be used as fill in the work from the site at no additional cost to the Owner.

3.5 FILLING

- A. Filling for site utilities or buildings or structures shall be so constructed or protected that they do not endanger life or property. All fills used to support the foundations of any building or structure shall be placed under the direction of a Geotechnical engineer, and the Geotechnical engineer or his or her representative shall inspect the placement of the fill.
- B. Clear all debris, vegetable matter and other deleterious material from areas to receive fill, per Section 31 1000.
- C. Soils below pavement areas or areas to receive fill, shall be scarified a minimum of 6 inches below the subgrade, moisture conditioned and compacted in accordance with the requirements in Section 3.6, Compaction.
- D. On existing slope areas steeper than 8 horizontal to 1 vertical, plow or scarify existing surface prior to filling to produce a bond with the material to be placed.
- E. Place and compact soil fill to finish subgrade of improvements (or layer thereof) to be placed thereon, or to finish surface grade where no improvements are to be placed thereon.
- F. Conform fill to the lines, grades and cross-sections shown on the plans.

- G. Place fill materials in layers not exceeding 8 inches in uncompacted thickness, and compact in accordance with Paragraph 3.6.
- H. Maintain optimum moisture content of fill materials to attain required compaction density of 90 to 95 percent as measured by the ASTM Test Designation D1557. In areas where pavement will be installed, the upper 6 inches of fill material shall be moisture conditioned within 2 percent of the optimum moisture content and compacted to at least 95% relative compaction.
- I. Fill materials to conform to Section 2.1, Materials. All fill material shall be submitted a minimum of 10 (ten) days to the geotechnical engineer of record, and tested and approved by same to determine its suitability for use as fill materials prior to placing.

3.6 COMPACTING

- A. Utilize equipment, which will not disturb or damage existing utilities and other improvements.
- B. Maintain optimum moisture content of materials to attain required compaction density.
- C. Compact fill in layers not exceeding 8 inches in uncompacted thickness.
- D. In pavement areas, the upper 6 inches of subgrade and full depth of aggregate base shall be compacted to at least 95 percent relative compaction (ASTM D1557, latest edition), except for the native clays. The native expansive clays shall be compacted to between 87 and 92 percent relative compaction at moisture content at least 3 percent over optimum.
- E. Obtain minimum 80% relative compaction of soil in areas to receive replacement sod, other replacement vegetation, or bare ground.

3.7 PREPARATION OF SUBGRADE FOR SURFACE IMPROVEMENTS

- A. Do not begin surface improvements until a Verified Report has been prepared by the Geotechnical Engineer indicating that all the tests required by the plans and specifications were completed in compliance with the recommendations of the Geotechnical Report, and until the Verified Report has been submitted and reviewed by the IOR, appropriate governmental agency(s), i.e. DSA, and the Architect/ Engineer.
- B. Where concrete, asphalt-concrete, aggregate base, or other non-vegetative surface improvements, or a layer of said surface improvements, are to be constructed on the soil surface, prepare the subgrade for said improvements in accordance with this section. Note: For sub base below open grade (permeable) asphalt, do not compact, scarify or moisten. Slope as indicated on plans. Notify geotechnical consultant of record a minimum of 48 hours prior to installing crushed rock.
- C. Blade or disk the soil to a depth of 6 inches, and remove and dispose of (off the project site) all rocks, hardpan chunks or otherwise unsuitable material over 4 inches in size.
- D. Thoroughly mix, water, roll and compact to a relative compaction of no less than 90 to 95 percent relative compaction as determined by ASTM Test Designation D1557, latest edition.
- E. Repair completely, any soft, spongy or otherwise unstable areas encountered in the subgrade, by removing the material and replacing it with acceptable materials in conformance with this section, and to the satisfaction of the Geotechnical Consultant of Record.

- F. Prior to commencing construction of surface improvements, pass a test roller of size and weight as approved by the Owner over the subgrade to ascertain that there are no soft or spongy areas requiring repair.
- G. Conform finished subgrade surface to the lines, grades and cross-sections shown on the plans.

3.8 FINE GRADING

- A. Fine grade all finished surfaces to the lines, grades and cross-sections shown on the plans.
- B. Make gradual grade changes. Blend slopes into level areas.
- C. Rake and smooth all finished surfaces not to receive surface improvements.

3.9 TOLERANCES

- A. Top surface of Subgrade for Non-Vegetative Surface Improvements or Layers Thereof: Plus or minus 0.05 foot from planned elevation.
- B. Top surface of Subgrade for Vegetative Surface Improvements or for Bare Ground - Plus or minus 0.10 foot of planned elevation, or as required for finish surface to match adjacent improvements or ground.

3.10 FIELD QUALITY CONTROL

- A. Field Inspection and testing will be performed under provisions of 01 4000.
- B. Compaction testing will be performed in accordance with ASTM Test Designation D1557.
- C. If tests indicate work does not meet specified requirements, recompact, or remove and replace, and retest, at no cost to the owner.
- D. All earthwork, excavation, filling and grading shall be performed under the observation of the geotechnical consultant of record, TRC Inc. Minimum 48-hour notification to them prior to beginning any earthwork operations is required.

END OF SECTION

SECTION 31 2316

TRENCH EXCAVATION AND BACKFILLING

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Excavating trenches holes and pits for constructing of the Work.
- B. Compacted fill from top of utility bedding to subgrade or finish grade elevations.
- C. Backfilling and Compaction.

1.2 RELATED SECTIONS

- A. Contract General Conditions.
- B. Section 01 4000: Quality Requirements.
- C. Section 01 5000: Temporary Facilities and Controls.
- D. Section 31 1000: Clearing at Work Site for Site Improvements
- E. Section 31 2000: Site Earthwork.
- F. Section 33 4100: Site Storm Drain System.
- G. Section 33 1110: Domestic Site Water.
- H. Section 33 5100: Natural Gas Distribution.
- I. Section 33 3100: Site Sanitary Sewer System
- J. Section 33 1100: Underground Fire Protection Systems

1.3 WORK NOT INCLUDED IN THIS SECTION

- A. Earthwork: Excavation, Filling and Compacting. See, Section 31 2000.

1.4 REFERENCES

- A. California Test Method No. 216 (Dry Method)
- B. Geotechnical Engineering Investigation prepared by TRC, Inc., for Roche Molecular Diagnostics, 4300 Hacienda Dr., Pleasanton, CA, 94566, Bldg 730, Report # 234269, July 13, 2015, and any subsequent addenda.

1.5 DEFINITIONS

- A. Utility: Any buried or above ground pipe, conduit, cable, associate devices or appurtenances, or substructure pertaining hereto.

1.6 COORDINATION

- A. Coordinate work with affected trades.
- B. Verify that the location of existing utilities have been marked/identified at the work site by utility authorities.

1.7 EXISTING UTILITIES

- A. The Engineer has made a diligent attempt to indicate on the plans the location of all main and trunk line utility facilities, which may affect the Work. The locations of said facilities, therefore, shall be considered approximate only, until exposed by the Contractor.
- B. Service laterals and appurtenances have also been shown where information was available as to their location. The locations of said facilities, therefore, shall be considered approximate only, until exposed by the Contractor.
- C. At new work location, expose by hand methods all existing utilities along the route of the new work prior to using any mechanical equipment. If mechanical equipment is allowed at a particular location, it may only be used after the completion by the Contractor of a successful exhaustive search by hand methods to locate all existing facilities as indicated on the plans, and as indicated on the ground by utility companies.
- D. Maintain all existing utility mains and service lines in continual service during construction of the Work.

PART 2 – PRODUCTS

2.1 FILL MATERIALS

- A. Refer to geotechnical report for soil description and type. Trench excavations having a depth of 5 feet or more must be excavated and shored in accordance with OSHA regulations. Bedding materials for utility pipes should be well graded sand or gravel conforming to the manufacturer's recommendations. Provide the minimum bedding beneath the pipe in accordance with the manufacturer's recommendation, typically 4 to 6 inches. Compact all bedding per manufacturer's recommendations.
- B. Trench backfill may consist of on-site soils if approved by the geotechnical consultant, moisture conditioned and placed in maximum lifts of 8 inches, and compacted at least 90 percent. The upper 6 inches of backfill of subgrade for trenches within areas of paving must consist of properly moisture conditioned, and compacted to at least 95 percent relative compaction. Unless native soil is used for the trench backfill, it should be compacted to between 87 to 92 percent at a moisture content at least 3 percent over optimum. Use equipment and methods that are suitable for work in confined areas without damaging utility conduits.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Protect plant life, lawns, trees, shrubs, and other features not authorized for removal.
- B. Protect existing structures fences sidewalks, paving, curbs, and other improvements from excavation equipment and vehicular traffic.
- C. Maintain and protect above and below grade utilities which are to remain.

- D. Comply with all provisions of the Construction Safety Orders and General Safety Orders of the California Division of Industrial Safety, as well as all other applicable regulations as they pertain to the protection of workers from the hazard of caving ground in excavations.

3.2 EXCAVATION

- A. Excavate soil required to locate existing utilities and install the work.
- B. Use hand methods of excavation to locate existing utilities, and to excavate trenches, pits and holes in congested areas.
- C. Employ equipment and methods appropriate to the work site. Small mechanical excavators may be used only in areas where there is sufficient space so as not to damage adjacent improvements and where the locations of all existing utilities have been determined by hand methods of excavating.
- D. Cut trenches just wide enough to enable installation and proper backfill, and to allow inspection.
- E. Do not extend utility trenches located adjacent to footings below an imaginary 1:1 (horizontal :vertical) plane projected downward from the footing bearing surface to the bottom edge of the trench. Where utility trenches will cross below the footing bearing planes, the footing concrete must be deepened to encase the pipe, or the utility trench must be back-filled with sand/cement slurry or lean concrete within the foundation bearing plane.
- F. Hand trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.
- G. Excavate trenches, pits or holes bottoming in hardpan to a minimum of 6 inches below the grade for the bottom of the pipe and any couplings, and then backfill to the pipe grade with fill materials as specified in Section 2.1, Fill Materials, and thoroughly compact. No additional payment will be made for such over-excavation and refill.
- H. In all trenches or excavation sites where a firm foundation is not encountered, such as soft, spongy, or otherwise unsuitable material, remove the material to a minimum of 12 inches, or to a depth determined by the Geotechnical engineer, below the bottom of the proposed pipe or structure, and backfill the space with materials as specified in Section 2.1, Fill Materials, containing sufficient moisture to produce maximum compaction. No additional payment will be made for such additional excavation or backfill.
- I. Excavate trenches to provide the minimum cover required.
- J. Stockpile excavated material to be returned to trench adjacent thereto in location, which will not be detrimental to existing improvements, or pedestrian or vehicular traffic. Remove unsuitable or excess material not being used, from site, at no additional cost to the owner.
- K. When excavating through tree roots, perform work by hand and cut roots, where authorized by the owner's arborist, with a saw.

3.3 BACKFILLING

- A. After installation of pipes and appurtenances and placement of pipe bedding material at any location, backfill trenches and excavations to finish grade, or to the subgrade upon which replacement or new surface improvements are to be placed.

- B. Backfill trenches above pipe bedding material and to within 6 inches of finish sub-grade with fill materials as specified in section 2.1, containing sufficient moisture to produce maximum compaction.
- C. Employ a placement method that does not disturb or damage existing or proposed pipes or other utilities or improvements.
- D. Place and compact all soil backfill in continuous layers not exceeding 8 inches in uncompacted thickness.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Backfill final 6-inch thickness to finish sub-grade in areas to receive concrete, asphalt-concrete, aggregate base, or other non-vegetative surface improvement, with fill materials as specified in Section 2.1, Fill Materials, containing sufficient moisture to produce maximum compaction.
- G. Backfill final 6-inch thickness to finish sub-grade in areas to receive sod, other vegetation, or bare soil, with fill material as specified in Sections 32 9119, Landscape Grading and Soil Preparation, and Section 32 0513, Import Topsoil for Vegetated Swale.
- H. Obtain minimum of 90% relative compaction of backfill from bottom of backfill to finish sub-grade, and obtain minimum of 95 percent relative compaction of backfill in top 6 inches below finish sub-grade, in areas to receive concrete, asphalt-concrete, aggregate base, or other non-vegetative surface improvement.
- I. Obtain minimum of 80 percent relative compaction of backfill in areas to receive sod, other vegetation, or bare soil.

3.4 TOLERANCES

- A. Top Surface of Backfilling Under Paved or Concrete Areas: Plus or minus 0.05 feet from required elevations.
- B. Top Surface of General Backfilling: As required for finish surface to match adjacent improvements or ground.

3.5 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01 4000.
- B. Compaction testing will be performed in accordance with ASTM D-1557.
- C. If tests indicate work does not meet specified requirements, recompact, and retest at no additional cost to owner.
- D. All trench backfilling and compaction will be performed under the observation of the geotechnical consultant. Sufficient notification to them prior to beginning earthwork operations is essential.

3.6 PROGRESS AND PROSECUTION

- A. Backfill any excavation opened in any day on that same day.

END OF SECTION

SECTION 31 3119

HERBICIDE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Furnishing and installing herbicide under all new asphaltic-concrete pavement.

1.2 RELATED SECTIONS

- A. Contract General Conditions.
- B. Section 01 5000 – Temporary Facilities and Controls.
- C. Section 31 2000 – Site Earthwork: Excavation, Filling and Grading.
- D. Section 31 2316 – Trench Excavation and Backfill.
- E. Section 32 1123 – Aggregate Base Course.
- F. Section 32 1216 – Site Asphalt-Concrete Paving.

1.3 STANDARDS

- A. In accordance with 01 4100 and the following:
 - 1. CCR-T21 California Code of Regulations, Title 21 Public Works.
 - 2. CBC California Building Code, California Code of Regulations, Title 24, Part 2, CCR-T24.
 - 3. USDA - United States Department of Agriculture.
 - 4. EPA - Environmental Protection Agency.
 - 5. All applicable Environmental Regulations and Standards.

1.4 QUALITY ASSURANCE

- A. Provide licensed operator to apply herbicide.
- B. All products shall comply with the current EPA laws at time of application. Should the products listed become unavailable because of changes in the law, submit substitute products per 01630 for review by the Owner.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01 3000 Administrative Requirements.
- B. Certificates of application.
- C. Certificates of compliance for material.

1.6 COORDINATION

- A. Coordinate with other work, including subgrade preparation and asphalt-concrete paving.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Herbicide: Environmentally friendly material such as "Treflan, Oust, and Casoram"; or approved equal. Herbicide shall be currently registered by the California State Department of Agriculture and the EPA

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that site is ready for application.

3.2 PREPARATION

- A. Identify installation locations.
- B. Employ equipment and methods appropriate to the work site.
- C. Provide vehicular and traffic controls per 01 5000.

3.3 APPLICATION

- A. Thoroughly water soak surface to be treated. Avoid excessive water runoff.
- B. Apply the specified herbicide over the entire area to be paved, in strict accordance with the manufacturer's recommendations after placement of aggregate base course.
- C. Apply in spray form, at rate as allowable by State of California and recommended by the manufacturer.
- D. Take all precautions to limit herbicide solution to areas immediately under proposed pavement. Use shields as necessary, and do not apply under windy conditions.

3.4 FIELD QUALITY CONTROL

- A. Field inspection will be performed under provisions of 01 4000.

3.5 CERTIFICATION OF WEED CONTROL

- A. Upon completion of this work, the professional applicator shall furnish to the Architect the following information:
 - 1. Project Name

2. Chemicals Used with Total lbs./gal. Used
3. Square Footage Treated
4. Agricultural Pest Control Operator and Adviser License Number
5. Dates of Application
6. Sketch of Areas Treated

END OF SECTION

SECTION 32 1123

AGGREGATE BASE COURSE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Furnishing, spreading and compacting aggregate base course for parking surfaces, aisles, driveways, loading/unloading areas and exterior flatwork.

1.2 RELATED SECTIONS

- A. Section 01 7300: Execution Requirements.
- B. Section 02 3200: Geotechnical Investigation.
- C. Section 31 2000: Site Earthwork.
- D. Section 31 2316: Trench Excavation.
- E. Section 32 1216: Site Asphaltic-Concrete Paving.

1.3 REFERENCES

- A. SSCDOT - Standard Specifications, Department of Transportation, State of California (Caltrans), latest edition, except for references to method of payment, and references to any state furnished materials.

1.4 QUALITY ASSURANCE

- A. Furnish aggregate materials conforming to SSCDOT.
- B. Perform work in accordance with SSCDOT.

1.5 COORDINATION

- A. Coordinate with other work, including subgrade preparation and soil sterilization.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aggregate Base (for dense-graded asphalt): Class 2, 3/4-inch Maximum Per Section 26 of SSCDOT.
- B. Aggregate Base (for open-graded asphalt): 3/4-inch crushed and washed rock with no more than 5 percent passing the ASTM No. 200 sieve. Do not allow it to be contaminated with dirt soil or other material, in transit or at site. (NOT USED FOR THIS PROJECT)

- C. Recycled crushed concrete and/or asphalt providing it is acceptable and approved by the geotechnical engineer, and certification provided from the supplier to the engineer as part of the submittal that it meets or exceeds all requirements and specifications of Section 26 of the SSCDOT.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify quantities required.
- B. Verify that the sub-grade has been prepared and compacted in accordance with the Geotechnical Report recommendations, and section 31 2000, Site Earthwork.
- C. Verify gradients and elevations of subgrade are correct.

3.2 SUBBASE

- A. Per Section 31 2000 and 31 2316 - Unless shown otherwise on the plans, compacted soil subgrade forms the base construction for work of this Section. Note: Sub-base below open grade (permeable) asphalt not to be compacted, scarified, or moistened. Slope as shown on plans and install geo-grid filter fabric and under drain system per plans prior to placing crushed rock. Do not allow rock to become contaminated with foreign material.

3.3 INSTALLATION OF AGGREGATE BASE COURSE

- A. Install in conformance with SSCDOT Section 26, Aggregate Bases.
- B. Thickness - As shown on Construction Drawings.
- C. Spreading and Compacting - In accordance with Section 26, SSCDOT. The relative compaction of each layer of compacted base material shall be not less than 95 percent, in vehicular pavement areas, and 90% in pedestrian pavement areas, per ASTM Test Designation D1557. Note: For crushed rock under open grade (permeable asphalt), consolidate rock with vibratory equipment such as vibratory roller or plate. Notify geotechnical consultant minimum of 48 hours before so he or she can be present to observe.
- D. The completed surface shall be thoroughly compacted, free from ruts, depressions, and irregularities and to be true to grade and cross-section, and shall conform to Section 26, SSCDOT.

3.4 TOLERANCES

- A. Finished Surface: The surface of the finish aggregate base at any point shall not vary more than 0.05 feet above or below the specified grade at that point. No more than 50% of the finish surface shall be above or below the specific grade for aggregate base.

3.5 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01 4000 Quality Requirements.

3.6 PROTECTION

- A. Immediately after placement and compaction protect surface from erosion or mechanical abrasion.
- B. Protect completed base surface until final pavement surfacing is in place.
- C. Remove any excess material from the site.

END OF SECTION

SECTION 32 1216

SITE ASPHALTIC-CONCRETE PAVING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Dense graded asphaltic-concrete paving and open-graded (permeable) asphaltic-concrete paving.
- B. Header boards and stakes.
- C. Prime and Fog seal coats.
- D. Related painting/stripping/pavement markers.
- E. Crack sealing/repair.
- F. Geo grids, filter fabrics.

1.2 REFERENCES

- A. SSCDOT - Standard Specifications, Department of Transportation, State of California (Caltrans), latest edition, except for references to method of payment, and references to any State furnished materials.
- B. California Department of Transportation (C.D.T.):
 - 1. Standard Specifications:
 - a. Section 26 Aggregate Bases
 - b. Section 37 Bituminous Seals
 - c. Section 39 Asphalt Concrete
 - d. Section 51 Concrete Structures
 - e. Section 52 Reinforcement
 - f. Section 73 Concrete Curbs and Sidewalks
 - g. Section 85 Pavement Markers
 - h. Section 90 Portland Cement Concrete
 - i. Section 91 Paint
 - j. Section 92 Asphalts
 - k. Section 93 Liquid Asphalts
 - l. Section 94 Asphaltic Emulsions
 - m. Section 95 Epoxy
 - 2. California Department of Transportation Traffic Manual
 - 3. California Department of Transportation Highway Design Manual.
 - C. Geotechnical Engineering Investigation prepared by TRC, Inc., for Roche Molecular Diagnostics, 4300 Hacienda Dr., Pleasanton, CA, 94566, Bldg 730, Report # 234269, July 13, 2015, and any subsequent addenda.

1.3 QUALITY ASSURANCE

- A. American Society for Testing and Materials (ASTM):
 - 1. D1557 Moisture unit weight relations of soils and aggregate mixtures using a 10lb. (4.5) kg rammer and I inch (457mm) drop.

- B. Design Criteria: Asphaltic concrete shall show no evidence of cracking, uneven settlement, improper drainage, or untoward junctions with adjoining or existing surfaces. Correct work displaying such conditions under the Contractor's guarantee of all work.
- C. Allowable Tolerances: Finish surface shall be true to established elevations within 1/4" in ten feet and slope to drain.
- D. Provide licensed operator to apply herbicide.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 3000.
- B. Certificates of compliance for material.
- C. Load tags for delivered material.

1.5 COORDINATION

- A. Coordinate with other work, including subgrade preparation and soil sterilization.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not place asphalt-concrete, prime coat, seal coat and paint binder when atmosphere temperature is less than 50 degrees F, or where weather conditions are unsuitable for material placement and finishing.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Cover loads of asphaltic concrete with tarpaulin during transport to site if required to hold temperature drop of not more than 20 degrees F.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Asphalt Concrete Paving (Dense Graded):
 1. Paving asphalt to be mixed with aggregate shall be steam-refined asphalt, with asphalt binder viscosity grade AR-4000 when the ambient temperature is below 75 degrees, and AR-8000 when the ambient temperature is above 75 degrees, conforming to Sections 39 and 92 of the CDT Standard Specifications.
 2. Mineral aggregate shall be Type B mineral aggregate as specified in Section 39 of the CDT Standard Specifications.
 3. Maximum aggregate size shall be as follows:

AC Thickness	No. of Lifts	Max. Ag. First Lift	Max Ag. Second Lift
a. 3/4" or 1" overlay	1	3/8" fine	--
b. 1 1/2" surface course	1	1/2" fine	--
c. 2" to 2 1/2" surface course	1	1/2" fine	--
d. 3"	2	2" thick, 3/4" fine	1" thick, 3/8" fine
e. 4"	2	2 1/2" thick, 3/4" fine	1 1/2" thick, 1/2" fine
f. >4"	varies	2 1/2" thick, 3/4" fine	1 1/2" thick, 1/2" fine

4. Liquid asphalt for prime coat shall be Grade SC-70 in conformance with Section 93 of the CDT Standard Specifications.
 5. Asphaltic emulsion for paint binder and fog seal coat shall be emulsified asphalt, Type SS-1h, conforming to Section 94 of the CDT Standard Specifications.
- B. Asphalt Concrete Paving (Open-Graded) (NOT USED)
1. Paving asphalt to be mixed with aggregate shall be steam-refined asphalt with asphalt binder viscosity grade AR-4000 when the ambient temperature is below 75 degrees, and AR-8000 when the ambient temperature is above 75 degrees, conforming to Sections 39 and 92 of the CDT Standard Specifications.
 2. Mineral aggregate shall be open-graded, mineral aggregate, 3/8 inch maximum as specified in Section 39 of the CDT Standard Specifications.
 3. No fog seal coat shall be applied to open graded asphalt.
- C. Crack Sealers
1. Crack sealers shall be commercial rubberized asphalt or liquid asphalt as manufactured by Overkote Industries, or approved equal.
 2. Reinforcing Fabric
 - a. Paving asphalt for fabric tack coat shall be that recommended by the manufacturer of the fabric to be used.
 - b. The reinforcing fabric shall be non-woven, needle-punched, made of polyester or polypropylene filers, dimensionally stable, able to withstand the applications of a hot asphalt overlay without degrading and capable of forming a watertight interlayer over the existing pavement.
 3. The fabric shall conform to the following properties when tested by the appropriate ASTM Test Methods:
 - a. Tensile Strength (ASTM D-1682): 80-lbs. min.
 - b. Elongation of Crack (ASTM D-1682): 25% min.
 4. Acceptable fabrics shall be petromat, Bidim C-28 or C-34, or Trutex MG-100, or approved equal. These brand names are stated to establish a standard quality for comparison, and are not to be taken as promotion of a brand or brands over others.
- D. Geo Grid, Filter Fabrics
1. Geogrid and filter fabric material shall be as specified on the plans, or an equal approved by the Geotechnical Engineer.
- E. Fog Seal Coats: Asphalt based fog seal coats shall be in accordance with sections 37 and 94 of the S.S.C.D.O.T. The material specifications for the undiluted asphaltic emulsion SS-1h to be supplied to the project shall conform with Section 94, State of California, Standard Specifications, 1999 (ASTM D977-9B). (Note: No fog seal coats to be placed on open graded asphalt.)

<u>Test</u>	<u>Minimum</u>	<u>Maximum</u>
Viscosity SSF at 25°C, Sec.	20	100
Settlement, 5 days, %	-	5
Storage Stability, 1Day, %	-	1.0
Sieve Test, %	-	0.10
Cement Mixing, %	-	2.0
Residue by Distillation, %	57	-

<u>Test on Residue</u>	<u>Minimum</u>	<u>Maximum</u>
Penetration, 25°C	40	90
Ductility, 25°C, 5cm/min., cm	40	-
Solubility in Trichloroethylene, %	97.5	-

1. The SS-1h may be diluted with clean fresh water, but the resulting mixture may not contain more than one part added water to the asphaltic emulsion.

F. Headers and Stakes: Rough Redwood, foundations grade RIS grade marked; size as detailed on drawings.

G. Pavement Marking Paint:

1. Pavement marking paint shall be good quality traffic paint conforming to or exceeding the standards set forth by the State of California Materials and Research Department. Acceptable brands are Kelly Moore No. 2130, Crown Products, Desoto, Bauer, or approved equal, per section 84 of the S.S.C.D.O.T.
2. Thermoplastic material shall meet the standards of CDT Standard Specifications 84-2.02.

2.2 MIX

- A. Mix surface course aggregate and asphalt binder in central mixing plant in accordance with SSCDOT Section 39 to produce uniform distribution of binder.
- B. Plant shall be equipped with accurately calibrated devices for control of temperature and weight of both ingredients.
- C. Ensure temperature of Asphaltic concrete does not exceed 320 degrees at time of delivery.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection:

1. Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence. The finished subgrades shall be tested and approved by the Geotechnical Engineer prior to the placement of additional pavement courses.
2. Verify that Asphaltic concrete pavement may be installed in strict accordance with the original design, all pertinent codes, regulations, and referenced standards.
3. When conditions require patching and matching of existing asphaltic surfaces, Contractor shall verify all existing conditions and match sections of new work with existing or provision of the most restrictive conditions that apply.
4. In the event of discrepancy, immediately notify the Architect. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 EQUIPMENT

- A. Compacting Equipment: All equipment for compacting shall be steel-tired power rollers having a minimum weight of eight tons, except that hand-held vibrator-compactors may be used in areas not accessible to rollers when specifically approved in advance by the Architect.
- B. Coating Equipment: All equipment for seal coating shall be specifically designed for that purpose and shall be subject to the inspection and approval of the Architect.
- C. Paving Equipment: All equipment for paving shall be spreading, self-propelled asphalt paving machines capable of maintaining line, grade, and minimum surface course thickness specified or, subject to the advance approval of the Architect, may be spreader boxes.

3.3 EXAMINATION

- A. Verify quantities required. New asphalt-concrete paving is required at all locations shown on the plans, and where existing asphalt-concrete paving to remain is removed or damaged by the Project excavation or related work.
- B. Verify that subgrade has been compacted to required relative compaction and is dry.
- C. Verify gradients and elevations of base are correct.
- D. Verify that the aggregate base has had a herbicide applied per 31 3119.

3.4 BASE

- A. Where shown on the construction plans, place and compact aggregate base course, per Section 32 1123.
- B. Where shown on the construction plans, place asphalt - concrete on compacted earth subgrade per Section 31 2000 and 31 2316.
- C. A herbicide shall be applied over the entire area to be paved.

3.5 INSTALLATION OF ASPHALTIC-CONCRETE

- A. General:
 - 1. Asphalt concrete shall be proportioned, mixed, placed, spread, and compacted in conformance with Section 39 of the CDT Standard Specifications.
 - 2. Before placing asphalt concrete on untreated base, a liquid asphalt prime coat shall be applied to the base course in conformance with Section 39 of the CDT Standard Specifications. Prime coat shall be applied at the rate of 0.25 gallons per square yard. Note: Prime coat shall not be applied to baserock that is below open graded asphalt.
 - 3. Before placing asphalt concrete, as asphalt emulsion tack coat (pain binder) shall be applied to all vertical surfaces of existing pavement, curbs, gutters, construction joints, and all existing pavement to be surfaced, in conformance with Section 39 of the CDT Standard Specifications.
 - 4. Spreading and Compacting asphalt concrete shall be performed in accordance with Section 39 of the CDT Standard Specifications.

5. Surface course shall not be placed when atmospheric temperature is below 50 degrees.
6. Thickness - As shown on construction plans. Where thickness exceeds 3 inches, place in multiple lifts with the top lift being no less than 1-1/2" thick. Asphalt-concrete shall be laid to the rolled and compacted thickness designated on the Plans. The plan thickness is to be considered as a minimum thickness. The Contractor shall lay the asphaltic concrete to a depth required to ensure that, after compaction, the in place compacted thickness is equal to or greater than the specified plan thickness.
7. The Contractor shall provide to the Engineer the truck delivery weight tags for the asphaltic concrete material. The quantity delivered shall be equal to or greater than the calculated in place quantity based on the specified thickness and area to be paved as designated on the construction plans and based on a unit density of the asphaltic concrete of 141 pounds per cubic feet.
8. The asphalt-concrete shall be compacted to an average relative compaction of 97% with no single test value below a relative compaction of 95%, based on a 50 blow Marshall maximum density.
9. Provide smooth skid and water resistant surfaces, true within tolerances specified and free of birdbaths.
10. Bring asphaltic concrete to edges of concrete curbs, gutters, and adjacent paving; do not overlap these items.
11. Roll surfaces longitudinally. Do not over-roll open graded asphalt. Cross rolling will be required where space permits in accordance with Section 39, SSCDOT.
12. Compaction Equipment - In accordance with Section 39, SSCDOT. At small difficult areas, equipment may be altered as approved by Engineer.
13. The completed surface shall be thoroughly compacted, free from ruts, depressions, and irregularities and to be true to grade and cross-section.

B. Preparation

1. Before applying prime coat, the existing paved surfaces shall be cleaned by sweeping, flushing, or other means necessary to remove all loose particles of paving, dirt, and other extraneous material.
2. All pavement cracks and gaps between edge of sawn or cut pavement and new concrete gutter shall be cleared of dirt, dust, and all other deleterious materials to a depth of 1/4" to 1/2", and then filled with hot liquid asphalt crack filler. Cracks 1/8" in width and greater shall be sealed.
3. Repairs to sub-base, base, and old asphalt shall be made as specified or directed by the Geotechnical Engineer.
4. Application of crack sealer shall be in accordance with the manufacturer's recommendations: in accordance with Chapter 9.3 of the Asphalt Institute Manual Series No. 4 (MS-4), the Asphalt Handbook, or as directed by the engineer.

C. Reinforcing Fabric Installation

1. Cleaning: Existing and recently patched pavement to be fabric-overlaid shall be clean, to the satisfaction of the Engineer, of all materials such as, but not limited to, gravel, sand, dirt, water, leaves, vegetation, and trash.
2. Tack Coat Application: A tack coat of paving asphalt shall be applied to all surfaced to receive fabric. Unless otherwise recommended by the manufacturer or his representative, the tack coat shall be applied:
 - a. At a rate of 0.22-0.28 gallons per square yard.
 - b. In accordance with Section 92.104 of the Standard Specifications by suitably metered truck.
 - c. At an asphalt temperature between 290 degrees F and 365 degrees F.

- d. For the full width of the fabric plus 4 inches.
- e. No farther a distance in advance of the fabric application and overlay than the Contractor can maintain free of traffic.
- 3. Fabric Installation: Reinforcing fabric shall be installed as per manufacturer's recommendations, unless otherwise directed by the Engineer.
 - a. No traffic shall be allowed on the fabric before it is overlaid.
 - b. No more fabric will be installed than can be overlaid in the same working day. In case some installed fabric is not overlaid; traffic will be prevented from traveling on the exposed fabric.
 - c. Fabric joints shall be as recommended by the manufacturer, but in no case shall more than two layers of fabric result. No additional asphalt at the joints shall be applied unless called for by the manufacturer's representative.
 - d. Fabric shall be laid free of wrinkles and bubbles that lap. Wrinkles that raise 1/2" or more above the mat (when gathered together) shall be slit and laid flat so as not to be picked up by the paving machine.
 - e. Fabric shall be neatly cut around the manhole covers, valve boxes, etc. to allow for the raising of it to finish grade.
 - f. If the Engineer so determines, the Contractor may be required to pneumatically roll and fabric after it is placed, to remove wrinkles and folds in the fabric and to increase the bond of the fabric with the existing pavement.
 - g. Should the fabric be picked up by the paving machine's treads/wheels, additional tack coat or asphalt cement may be required to be placed under the fabric before it is replaced, if the Engineer so determines.

D. Geo Grid and Filter Fabrics

- 1. Install per manufacturer's requirements and as shown on plans.

3.6 ASPHALTIC HANDICAP RAMP AND SPEED BUMPS

- A. None to be installed

3.7 INSTALLATION OF FOG SEAL COAT

- A. Allow new asphalt-concrete sufficient time to cure prior to sealing.
- B. Immediately prior to applying the sealer, the surface shall be cleaned of all loose material, which might adversely affect bonding of the sealer. Any standard cleaning method such as power sweepers and blowers may be employed.
- C. Apply fog seal to the finished surface of all newly placed asphalt-concrete, and/or where designated on plans. Note: Do not apply fog seal to open graded asphalt.
- D. Apply fog seal at a rate of 0.05 to 0.10 gallon per square yard in conformance with section 37-1.05 of the CDT Standard Specifications.
- E. Do not allow sealer to remain on concrete edgings.
- F. Protect sealed surface until it is cured.

3.8 REMEDIAL MEASURES

- A. Upon direction of the Architect cut out and/or rework all surfaces and subgrade areas which do not meet the requirements of this Section. Perform all remedial measures at no additional cost to the Owner.
- B. Repair damage caused by construction operations and restore to new condition.

3.9 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01 4000.
- C. The finished asphalt pavement, where not controlled adjacent structures or features, shall not vary more than 0.05 feet above or below the planned grade, and should be uniform and free of sharp breaks.
- D. The cross-section of the finished pavement shall be free of ridges and valleys and shall not vary more than 0.03 feet above or below the theoretical section at any point on the cross-section.
- E. The specified thickness of the finished pavement shall be the minimum acceptable.
- F. Conforms shall form a smooth, pond-free transition between existing and new pavement.

3.10 PROTECTION

- A. Permit no surface traffic until surface has cooled sufficiently to resist damage to asphaltic concrete surfaces and sealed surfaces.

3.11 PAVEMENT STRIPING AND MARKING

- A. Preparation: Thoroughly clean the areas upon which striping will be placed and locate all striping where indicated on the Drawings.
- B. Painting: Paint shall not be applied until a minimum of three to four days after placement of the asphaltic fog seal coat, depending upon weather conditions. Paint shall be applied such as to result in a thick uniform appearance that is not translucent. Two applications may be required to achieve the desired results. Painting includes:
 - 1. Parking stall lines and markings (white).
 - 2. Directional arrows (white).
 - 3. Fire lane lines and markings (red) indicated on the plans and also as further directed by the Fire Marshall.
- C. The international symbol of accessibility shall be painted in whole on the surface of each parking space indicated and shall be a minimum dimension of 3-foot square with a white symbol painted on blue background. The stall lines for the handicapped stall shall also be blue.
- D. Replace all pavement striping and marking removed or obliterated by the Work, unless indicated otherwise on the plans.

- E. All new surfaces shall have traffic paint applied in two applications. First or priming coats shall be in light application to seal the pavement.
 - 1. Second heavier coat of paints is the wearing surface and the rates of application are shown on Table 1. Restriping may be in one application.
- F. All surfaces to be painted shall be clean and dry prior to painting. Ample time shall be allowed between the asphalt pavement seal coat and the initial painting application. Usually, the drying time of the seal coat is approximately three to four days, depending upon weather conditions. There shall be a minimum drying time between paint applications of approximately 20 minutes.

TABLE 1 - PAVEMENT MARKINGS

New surface (1 st coat)	Approximately 1 gallon 200 S.F. of area
Second coat or restriping	1 gallon per 100-sq. ft. of area

- 1. The Contractor shall provide sufficient evidence to the Construction Manager that the quantity of paint specified has been applied to the job. Such evidence can be invoice tickets made out to the specific job, counting empty paint cans, or a method acceptable to the Construction Manager.
- 2. Striping shall not be applied at temperatures below 50 degrees F or if pavement surface is hot.
- G. Thermoplastic
 - 1. Thermoplastic material shall be applied only to dry clean pavement surfaces. A primer shall be applied to all asphaltic surfaces over six months' old and all P.C.C. surfaces.
 - 2. The thermoplastic material shall be applied to the pavement at a temperature between 400 degrees and 425 degrees. The thermoplastic material shall be applied by either spray or extrusion methods in a uniform layer.

3.12 CLEANUP

- A. General:
 - 1. Surplus material remaining upon completion of paving operations shall become the property of the Contractor, to be removed from the work site and disposed of in a lawful manner to the satisfaction of the Owner.
 - 2. All surfaces shall be left in a clean, neat, and workmanlike condition, and all construction waste, rubbish, and debris shall be removed from the work site and disposed of to the satisfaction of the Owner.
 - 3. The open-graded (permeable) asphalt shall have its surface vacuumed at the completion of pavement installation.

END OF SECTION

SECTION 32 1313
SITE CONCRETE (Civil)

PART 1 - GENERAL

1.1. SECTION INCLUDES

- A. Concrete sidewalks, ramps, flatwork, curbs, gutters, v-ditches, valley gutters and miscellaneous concrete site work.
- B. Thrust blocks for water systems.
- C. Cast-in-place slabs for utility structures.

1.2. RELATED SECTIONS

- A. Section 03 2000 - Reinforcing.

1.3 REFERENCES

- A. ASTM C33 - Concrete Aggregates.
- B. ASTM C150 - Portland Cement.
- C. ACI 318 - Building Code Requirements for Reinforced Concrete.
- D. ASTM C94 - Ready-Mixed Concrete.
- E. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
- F. ACI 305 - Recommended Practice for Hot Weather Concreting.
- G. ACI 306 - Recommended Practice for Cold Weather Concreting.
- H. Uniform Building Code, International Conference of Building Officials (ICBO), current edition.
- I. ASTM C31 - Standard Method of Making and Curing Test Specimens in the Field.
- J. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- K. ASTM C138 - Standard Test Method for Unit Weight, Yield and Air Content (Gravimetric) of Concrete.
- L. ASTM C143 - Standard Test Method for Slump of Portland Cement Concrete.
- M. ASTM C172 - Standard Method of Sampling Fresh Concrete.
- N. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

- O. ANSI/ASTM A185 - Welded Steel Wire Fabric or Concrete Reinforcement.
- P. ANSI/ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.
- Q. ASTM A615 - Deformed and Plain Billet-Steel for Concrete Reinforcement.
- R. ASTM C260 - Air-Entraining Admixtures for Concrete.
- S. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.
- T. ASTM C494 - Chemical Admixtures for Concrete.
- U. FS TT-C- 800 - Curing Compound, Concrete, for New and Existing Surfaces.
- V. The Geotechnical investigation Report prepared by:

Geotechnical Engineering Investigation prepared by TRC, Inc., for Roche Molecular Diagnostics, 4300 Hacienda Dr., Pleasanton, CA, 94566, Bldg 730, Report # 234269, July 13, 2015, and any subsequent addenda.

1.4 JOB CONDITIONS

- A. Weather Limitations: Construct concrete surface course only when atmospheric temperature is above 40 degrees F., when the underlying base is dry, and when forecast does not call for rain.
- B. Grade Control: Establish and maintain the required lines and grades, including cross-slope during construction operations. Provide positive slope on all surfaces to convey storm water such that ponding does not occur.

1.5 QUALITY CONTROL

- A. Standard Specifications: The American Concrete Institute (ACI) "Specification for Structural Concrete for Buildings" ACI 301-82 shall be used as standard specification. All cast-in-place concrete shall conform to this standard specification except as modified by the requirements specified herein and/or details on the drawings.
- B. Obtain cementitious materials from same source throughout.
- C. Provide special testing to validate compaction requirements specified.
- D. Provide a 4'x4' mock-up for each of the concrete finishes specified on plans. Include integral color in samples as specified on plans.
- E. Repeat Mock-up if the finished product does not match existing textures.

1.6 SUBMITTALS

- A. Submit under provisions of Section 01 3000.
- B. Product Data: Provide data on color (integral), joint filler, admixtures and curing compounds.

1.7. ENVIRONMENTAL REQUIREMENTS

- A. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is saturated or frozen.

1.8 DEFINITIONS

- A. Substantial Completion: When the paving installation work has been completed according to the drawings and supporting specifications, including, finish work, removal of forms, restoration of adjacent areas damaged during construction and general housekeeping.
- B. Base rock: Base rock shall conform to Section 32 1123 Aggregate Base Course.
- C. Structural Soil: Patented mix to be used in basic rock conjunction with base rock in parking lot tree planting areas. See Landscape Architect for specific mix design, source, and plans for location.

PART 2 - PRODUCTS

2.1. MATERIALS

- A. Concrete material shall comply with ASTM C94, Ready-mixed Concrete.
Poured-in-Place Concrete: All slabs and steps shall be Class A conforming to Section 90 of State Specifications" with a 28 day compressive strength in excess of 2500 psi.
Cement : Type II modified conforming to ASTM-C-150, Portland cement.
- B. Aggregate – ASTM C33, Maximum size 3/4-inch diameter, clean, crushed stone aggregate free of materials causing stains; use natural sand for fine aggregate.
- C. Water: Clean, free from injurious amounts of oil, alkali, organic matter or other deleterious matter detrimental to concrete.
- D. Expansion Joints: Homex 300 wood fiber strip (non-asphaltic) or approved equal. Full thickness of slab, 3/8" wide.
- E. Color: As specified on plans.

2.2 FORM MATERIALS

- A. Wood form material, profiled to suit conditions.
- B. Expansion Joint Filler: ANSI/ASTM D1751, Non-asphaltic fibrous type; 3/8 inch thick.

2.3 REINFORCEMENT

- A. Reinforcing steel and wire fabric: Type specified in Section 03 2000.
- B. Welded Steel Wire Fabric: 6x6x10 gauge flat sheets; unfinished.
- C. Dowels: ASTM A615, smooth plain steel, unfinished.
- D. Steel Reinforcement for concrete should be protected by providing at least 3-inch minimum cover with good quality concrete to avoid corrosion of rebar from chloride contamination.

2.4 CONCRETE MIX – BY PERFORMANCE CRITERIA

- A. Mix concrete in accordance with ACI 304. Deliver concrete in accordance with ASTM C94.
- B. Select proportions for normal weight concrete in accordance with ACI 301.
- C. Provide concrete to the following criteria:
 - 1. Compressive Strength: 2,500 psi at 28 days
 - 2. Slump: 4 inches
 - 3. Minimum Cement Ratio: 5 sack
 - 4. For vehicular accessible areas use Class concrete with a minimum cement ratio of 6 sack, 4" slump, and 3500 psi at 28 days.
- D. Use accelerating admixtures in cold weather only when approved by Architect/Engineer. Use of admixtures will not relax cold weather placement requirements.
- E. Use calcium chloride only when approved by Architect/Engineer.
- F. Use set retarding admixtures during hot weather only when approved by Architect/Engineer.

2.5 SUB-GRADE

- A. Prepared per Section 31 2000, Site Earthwork: Excavation, Filling and Grading.
- B. Provide 3' (three feet) of structural soil base rock under all vehicular loaded AC paving in areas to receive tree planting. See civil plans for location of the base material.

2.6. INTEGRAL COLOR

- A. Integral color (if specified) shall be as specified on Landscape plans.
- B. Application of integral color shall be in conformance with manufacturer's recommendations. Use rates as prescribed by manufacturer to achieve color accuracy depicted in manufacturer color chips.
- C. Provide sealant and curing compounds as recommended by manufacturer.

PART 3 - EXECUTION

3.1. EXAMINATION

- A. Verify gradients and elevations of substrate are correct.
- B. Verify that substrate is level, smooth, and capable of supporting flatwork, pavement, curbs, and curb and gutter sections. Minimum slope of concrete curbs and gutters to be 0.5 percent.
- C. Verify that curbs, thresholds, piping, sleeves, inlet elevations and related underground engineering are formed, installed and complete, presenting conditions suitable for this work.

3.2. INSTALLATION - REINFORCING

- A. Refer to Section 03 2000 and drawings.
- B. Reinforcing is to be held firmly in place during concrete placement.
- C. Place reinforcement at mid-height of slabs-on-grade.
- D. Provide doweled joints 12" on center at interruptions of concrete with one end of dowel set in capped sleeve to allow longitudinal movement. See landscape details.
- E. Interrupt reinforcement at expansion joints per plans. Provide and install dowels.
- F. Install dowels to assure pavement and curb alignment remains true.

3.3 PREPARATION - CONCRETE

- A. Moisten base to minimize absorption of water from fresh concrete.
- B. Coat surfaces of manhole catch basin, and other metal frames with oil to prevent bonding with concrete.
- C. Notify Architect/Engineer minimum of 24 hours prior to commencement of concrete operations.

3.4 CONCRETE CONSTRUCTION

- A. General:
 - 1. All concrete shall be mixed in accordance with applicable provisions of Section 90 of the CDT Standards Specifications.
 - 2. Construction of concrete substructures shall conform to applicable provisions of Section 51 of the CDT Standard Specifications. Unless noted otherwise in the Specifications, all exposed surfaces of structure shall have Class 1 surface finish.
 - 3. Construction of concrete curbs and sidewalks shall conform to applicable provisions of Section 73 of the CDT Standard Specifications.
 - 4. Curing shall conform to applicable portions of Section 90 of the CDT Standard Specifications. No pigment shall be used in curing compounds.
 - 5. All work shall be subject to the inspection of the I.O.R. / Architect / Owner. No concrete shall be placed until the I.O.R. / Architect / Owner
 - 6. Expansion joints on curbs, gutters, and walks shall be placed 20 feet on centers, adjacent to structures, and at all returns, and shall be filled with joint filler. Dummy joints shall be formed 10 feet on centers. The score shall be 1" deep.
 - 7. Concrete shall not be dropped freely where reinforcing bars will cause segregation, nor shall it be dropped freely more than 6 feet. Spouts, elephant trunks, or other approved means shall be used to prevent segregation.
 - 8. Place concrete continuously between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.
 - 9. Ensure reinforcement, inserts, embedded parts, formed joints and subgrade are not disturbed during concrete placement.

3.5 JOINTS

- A. Place expansion joints at maximum of 20-foot intervals where not specified on plans. Align curb, gutter, and sidewalk joints.

- B. Place approved joint filler between components and building or other appurtenances. Recess top of filler 1/4 inch for sealant placement.
- C. Provide scored joints in sidewalks at 5 feet intervals, and curb, and between sidewalks and curbs, as well as between curbs and pavements as indicated on the drawings.
- D. Caulk all expansion joints with an approved elastomeric, non-sagging sealant, color approved by architect.

3.6. FINISHING

- A. City Sidewalks: Per local Public Works Standards.
- B. Sidewalk Paving: Exterior Concrete (in landscape flatwork): Shall be as indicated on landscape plans. Radius edges to 1/4 inch
- C. Cure concrete in accordance with state standard specifications. Place curing compound on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.
- D. Medium Broom Finish: After trowel finishing, draw a fine hair push broom over the surface at the time when such broom marks shall produce a medium uniform texture on the surface. Unless indicated otherwise, direction of brooming shall be perpendicular to direction of walk. Provide three 3-foot square sample panels with color and finishes for review by Architect. After concrete has set, wash samples for approval prior to construction of pavement. Walks with inadequate amounts of texture will be rejected. Flatwork shall be poured during the same operation. Areas of poor workmanship, as determined by the Architect shall be removed and redone at Contractor's expense.

3.7 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01 4000.
- B. Testing firm will take cylinders and perform slump and air entrainment tests in accordance with State Standard Specifications. A set of test cylinders shall be taken for each individual pour or placement of concrete and in no case shall a set of cylinders represent more than 200 cubic yards of concrete placed.

3.8 PROTECTION

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury. Provide curing per Cal-Trans State Standard.

3.9 CLEANUP

- A. General:
 - 1. Surplus material remaining upon completion of paving operations shall become the property of the Contractor, to be removed from the work site and disposed of in a lawful manner to the satisfaction of the Owner.
 - 2. All surfaces shall be left in a clean, neat, and workmanlike condition, and all construction waste, rubbish, and debris shall be removed from the work site and disposed of to the satisfaction of the Owner.

END OF SECTION

SECTION 32 1316
CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. On-site walks, ramps and stairs.
- B. Related Sections:
 - 1. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.
 - 2. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.
 - 3. Division 32 Section "Aggregate Base Courses".

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 3000.
- B. Mix design for each class of concrete to the Architect/Engineer and Owner's Inspection and Testing laboratory.
- C. Laboratory test reports for concrete mixes.
 - 1. Compression test data (field experience method) or results of testing (trial batch method) used to establish mix proportions
 - 2. Shrinkage test data or results of testing used to establish mix proportions for shrinkage-controlled concrete.
- D. Material certificates for concrete materials, including cements, aggregates and admixtures. Material certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with specified requirements. Where more than one admixture is used, certify that admixtures are compatible.
- E. Product Data: Provide data on fiber reinforcement, curing materials, waterproofing admixtures, joint devices, vapor barrier and attachment accessories
- F. Submit ticket to Owners Testing Laboratory for each batch of concrete delivered to the job site, bearing the following information. Refer to FIELD QUALITY CONTROL Article of this Section.
 - 1. Mix Identification

2. Weight of cement, aggregate, water added at the batch plant, water added at site (only when allowed by Architect/Engineer) and admixtures.

1.5 QUALITY ASSURANCE

- A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").
- B. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- C. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.
- D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship. Not less than 4'x4'.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

PART 2 - PRODUCTS

2.1 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
 1. Use flexible or uniformly curved forms for curves with a radius of 100 feet (30.5 m) or less. Do not use notched and/or bent forms.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615, Grade 60; deformed billet steel bars, uncoated finish.
- B. Reinforcing Steel: ASTM A706, Grade 60; deformed billet steel bars, uncoated finish, as noted on drawings.
- C. Welded reinforcing steel: ASTM A706

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:

1. Portland Cement: To be Type V or Type II (modified) conforming to the requirements of ASTM Designation C-150.
 - a. Fly Ash: ASTM C 618, Class F.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: Shall conform to the requirements of Section 90-2.02A and B of the State of California Department of Transportation Standard Specifications.
- C. Water: Potable and complying with the requirements of Section 90-2.03 of the State of California Department of Transportation Standard Specifications.
- D. Air-Entraining Admixture: ASTM C 260, MB/AE 90.
- E. Water-Reducing Admixture: ASTM C 494, Pozzolith 200N.
- F. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
- G. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.
 1. Color: as shown on drawings.

2.4 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, [Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

2.5 RELATED MATERIALS

- A. Joint Fillers:
 1. Non-asphaltic cellulosis fiber, of the thickness indicated on the plans.
- B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Epoxy Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements.

2.6 DETECTABLE WARNING MATERIALS

- A. Detectable Warning Paver: As shown on drawings.
 - a. Provide sample

2.7 CONCRETE MIXTURES

- A. Landscape Site Concrete Prepare design mixtures, proportioned according to ACI 301, with the following properties:
 - 1. Compressive Strength (28 Days):
 - a. 3500 psi for curbs, gutters, valley gutters and all vehicle-accessible areas.
 - b. 2500 for pedestrian-accessible areas.
 - 2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45-0.50.
 - 3. Slump Limit: 4 inches, plus or minus 1 inch.
 - 4. Air Content: 2-1/2 percent plus or minus 1.5 percent.
 - 5. Sack Mix:
 - a. Vehicular load: Six sack
 - b. Pedestrian load: Five sack
- B. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
- C. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions.

2.8 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M. Furnish batch certificates for each batch discharged and used in the Work.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.
 - 1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
 - 2. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Division 31 Section "Earth Moving."
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.
- E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
 - 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
 - 1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
 - 2. Provide tie bars at sides of paving strips where indicated.
 - 3. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
 - 5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
 - 1. Locate expansion joints at intervals of 20 feet unless otherwise indicated.
 - 2. Extend joint fillers full width and depth of joint.
 - 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
 - 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 - 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.

6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
 - a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
 - a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.
 3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
- B. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- C. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- D. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- E. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- F. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
- G. Screed paving surface with a straightedge and strike off.

- H. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- I. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
 - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.
- J. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
 - 1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
- K. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
 - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

3.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
 - 1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
 - 2. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

3.8 SPECIAL FINISHES

- A. Sandblast Finish: Blast all surfaces at the same age for uniform result. Grading of abrasive to meet ADA Title II Regulation.

3.9 DETECTABLE WARNINGS

- A. Blockouts: Form blockouts in concrete for installation of detectable paving units specified in Division 32 Section "Unit Paving"
 - 1. Tolerance for Opening Size: Plus 1/8 inch, no minus.

3.10 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound or a combination of these as follows:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period using cover material and waterproof tape.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.11 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
 - 1. Elevation: 1/2 inch.
 - 2. Thickness: Plus 3/8 inch , minus 1/4 inch.
 - 3. Surface: Gap below 10-foot-long, unlevelled straightedge not to exceed 1/2 inch.
 - 4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
 - 5. Lateral Alignment and Spacing of Dowels: 1 inch.
 - 6. Vertical Alignment of Dowels: 1/4 inch.
 - 7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
 - 8. Joint Spacing: 3 inches.
 - 9. Contraction Joint Depth: Plus 1/4 inch, no minus.
 - 10. Joint Width: Plus 1/8 inch, no minus.

3.12 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
 5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
 6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mixture will be satisfactory if average of any 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.
- D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain 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.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- G. Concrete paving will be considered defective if it does not pass tests and inspections.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- I. Prepare test and inspection reports.

3.13 REPAIRS AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION

SECTION 32 1373

CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cold-applied joint sealants.
 - 2. Hot-applied joint sealants.

1.2 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples: For each kind and color of joint sealant required.

1.3 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Product test reports.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range noted on Drawings.

2.2 COLD-APPLIED JOINT SEALANTS

- A. Single-Component, Nonsag, Silicone Joint Sealant for Concrete: ASTM D 5893, Type NS.

2.3 JOINT-SEALANT BACKER MATERIALS

- A. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

- B. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D 5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.4 PRIMERS

- A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
- B. Cleaning of Joints: Clean out joints immediately before installing joint sealants.
- C. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- D. Install joint-sealant backings of kind indicated to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of joint-sealant backings.
 - 2. Do not stretch, twist, puncture, or tear joint-sealant backings.
 - 3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.
- E. Install joint sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place joint sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:
 - 1. Remove excess joint sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- G. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.
- H. Clean off excess joint sealant or sealant smears adjacent to joints as the Work progresses, by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

END OF SECTION

SECTION 32 1400

UNIT PAVING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Concrete pavers set in aggregate and mortar setting beds.
 - 2. Aluminum edge restraints.

1.2 ACTION SUBMITTALS

- A. Product Data: For materials other than water and aggregates.
- B. Samples for unit pavers and edge restraints.

1.3 PROJECT CONDITIONS

- A. Cold-Weather Protection: Do not use frozen materials or build on frozen subgrade or setting beds.
- B. Weather Limitations for Bituminous Setting Bed: Install bituminous setting bed only when ambient temperature is above 40 deg F (4 deg C) and when base is dry.
- C. Weather Limitations for Mortar and Grout:
 - 1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
 - 2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. Do not apply mortar to substrates with temperatures of 100 deg F (38 deg C) and higher.

PART 2 - PRODUCTS

2.1 CONCRETE PAVERS

- A. Concrete Pavers: Solid interlocking paving units complying with ASTM C 936 made from normal-weight aggregates.
 - 1. Manufacturers: As noted on drawings, provide sample.
 - 2. Thickness: As noted on drawings.
 - 3. Face Size and Shape As noted on drawings.
 - 4. Face Size and Shape: As noted on drawings.
 - 5. Color: As noted on drawings.

2.2 EDGE RESTRAINTS

- A. Aluminum Edge Restraints: Manufacturer's standard L-shaped, 3/16-inch thick by 2-1/4-inch high extruded-aluminum edging with loops pressed from face to receive stakes at 12 inches o.c., and aluminum stakes 12 inches long for each loop.
 - 1. Manufacturers: As noted on drawings.

2.3 AGGREGATE SETTING-BED MATERIALS

- A. Graded Aggregate for Base: Per specification section 32 11 23 Aggregate Base Course.
- B. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C 33 for fine aggregate.
- C. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 sieve and no more than 10 percent passing No. 200 sieve.
- D. Drainage Geotextile: Nonwoven needle-punched geotextile fabric, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Apparent Opening Size: No. 40 sieve, maximum; ASTM D 4751.
 - 2. Permittivity: 0.5 per second, minimum; ASTM D 4491.
- E. Herbicide: Commercial chemical for weed control, registered with the EPA. Provide in granular, liquid, or wettable powder form.

2.4 MORTAR SETTING-BED MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type II.
- B. Sand: ASTM C 144.
- C. Water: Potable.

2.5 MORTAR AND GROUT MIXES

- A. General: Comply with referenced standards and with manufacturers' written instructions. Discard mortars and grout if they have reached their initial set before being used.
- B. Mortar-Bed Bond Coat: Mix neat cement and water to a creamy consistency.
- C. Latex-Modified, Portland Cement Setting-Bed Mortar: Comply with written instructions of latex-additive manufacturer and as necessary to produce stiff mixture with a moist surface when bed is ready to receive pavers.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
- B. Cut unit pavers with motor-driven masonry saw equipment to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible.
 - 1. For concrete pavers, a block splitter may be used.
- C. Joint Pattern: As indicated. Match and continue existing unit paver joint pattern.

- D. Tolerances: Do not exceed 1/16-inch unit-to-unit offset from flush (lippage) nor 1/8 inch in 24 inches and 1/4 inch in 10 feet from level, or indicated slope, for finished surface of paving.
- E. Provide edge restraints as indicated. Install edge restraints before placing unit pavers.

3.2 AGGREGATE SETTING-BED APPLICATIONS

- A. Compact soil subgrade uniformly to at least 95 percent of ASTM D 698 ASTM D 1557 laboratory density.
- B. Place aggregate base, compact by tamping with plate vibrator, and screed to depth indicated.
- C. Place drainage geotextile over compacted base course, overlapping ends and edges at least 12 inches.
- D. Place leveling course and screed to a thickness of 1 to 1-1/2 inches taking care that moisture content remains constant and density is loose and uniform until pavers are set and compacted.
- E. Set pavers with a minimum joint width of 1/16 inch and a maximum of 1/8 inch, being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines. Fill gaps between units that exceed with pieces cut to fit from full-size unit pavers.
- F. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 3500- to 5000-lbf compaction force at 80 to 90 Hz.
- G. Spread dry sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.

3.3 MORTAR SETTING-BED APPLICATIONS

- A. Saturate concrete subbase with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.
- B. Apply mortar-bed bond coat over surface of concrete subbase about 15 minutes before placing mortar bed. Limit area of bond coat to avoid its drying out before placing setting bed. Do not exceed 1/16-inch thickness for bond coat.
- C. Apply mortar bed over bond coat; spread and screed mortar bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated.
- D. Mix and place only that amount of mortar bed that can be covered with pavers before initial set. Before placing pavers, cut back, bevel edge, and remove and discard setting-bed material that has reached initial set.
- E. Wet brick pavers before laying if the initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested according to ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.
- F. Place pavers before initial set of cement occurs. Immediately before placing pavers on mortar bed, apply uniform 1/16-inch- thick bond coat to mortar bed or to back of each paver with a flat trowel.

- G. Tamp or beat pavers with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each paver in a single operation before initial set of mortar; do not return to areas already set or disturb pavers for purposes of realigning finished surfaces or adjusting joints.
- H. Spaced Joint Widths: Provide 3/8-inch nominal joint width with variations not exceeding plus or minus 1/16 inch.
- I. Grouted Joints: Grout paver joints complying with ANSI A108.10.
- J. Grout joints as soon as possible after initial set of setting bed.
 - 1. Force grout into joints, taking care not to smear grout on adjoining surfaces.
 - 2. Tool exposed joints slightly concave when thumbprint hard.
- K. Cure grout by maintaining in a damp condition for seven days unless otherwise recommended by grout or liquid-latex manufacturer.
- L. Cleaning: Remove excess grout from exposed paver surfaces; wash and scrub clean.
 - 1. Remove temporary protective coating as recommended by coating manufacturer and as acceptable to paver and grout manufacturers.

END OF SECTION

SECTION 32 8400

PLANTING IRRIGATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Piping.
 - 2. Pressure-reducing valves.
 - 3. Automatic control valves.
 - 4. Transition fittings.
 - 5. Sprinklers.
 - 6. Quick couplers.
 - 7. Drip irrigation specialties.
 - 8. Controllers.
 - 9. Boxes for automatic control valves.

1.3 DEFINITIONS

- A. Circuit Piping: Downstream from control valves to sprinklers, specialties, and drain valves. Piping is under pressure during flow.
- B. Drain Piping: Downstream from circuit-piping drain valves. Piping is not under pressure.
- C. Main Piping: Downstream from point of connection to water distribution piping to, and including, control valves. Piping is under water-distribution-system pressure.
- D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 PERFORMANCE REQUIREMENTS

- A. Irrigation zone control shall be automatic operation with controller and automatic control valves.
- B. Location of Sprinklers and Specialties: Design location is approximate. Make minor adjustments necessary to avoid plantings and obstructions such as signs and light standards. Maintain 100 percent irrigation coverage of areas indicated.
- C. Minimum Working Pressures: Refer to irrigation notes on Drawings.
- D. Install all valve boxes in discrete and non-visible locations at entries and pedestrian walkways.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories.

- B. Delegated-Design Submittal: For irrigation systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sprinklers, controllers, and automatic control valves, to include in operation and maintenance manuals.
- B. As-built drawings

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Refer to Section 01 4000.
- B. Electrical Components, Devices, and Accessories: Conform to the latest adopted version of the California Electrical Code (CEC).

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Comply with requirements in the piping schedule for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.
- B. PVC Pipe: ASTM D 1785, PVC 1120 compound, Schedules 40 and 80.
 - 1. PVC Socket Fittings: ASTM D 2466, Schedules 40 and 80.
 - 2. PVC Threaded Fittings: ASTM D 2464, Schedule 80.
 - 3. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket ends.
- C. PVC Pipe, Pressure Rated: ASTM D 2241, PVC 1120 compound, Schedule 80.
 - 1. PVC Socket Fittings: ASTM D 2467, Schedule 80.
 - 2. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket or threaded ends.

2.2 PIPING JOINING MATERIALS

- A. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.3 MANUAL VALVES

- A. Bronze Gate Valves: As indicated on Drawings.

2.4 AUTOMATIC CONTROL VALVES

- A. Plastic, Automatic Control Valves: As indicated on Drawings.

2.5 MISCELLANEOUS PIPING SPECIALTIES

- A. Water Hammer Arresters: ASSE 1010 or PDI WH 201, with bellows or piston-type pressurized cushioning chamber and in sizes complying with PDI WH 201, Sizes A to F.
- B. Pressure Gages: ASME B40.1. Include 4-1/2-inch- (115-mm-) diameter dial, dial range of two times system operating pressure, and bottom outlet.
- C. Harco Pipe Restraint (alternate): Shallow conditions, when thrust blocks can not be installed.
- D. HDPE Pipe (alternate): 3" or larger supply line, when thrust blocks can not be installed.

2.6 SPRINKLERS

- A. General Requirements: Designed for uniform coverage over entire spray area indicated at available water pressure.
- B. Plastic, Pop-up Spray Sprinklers:
 - 1. Manufacturers: As indicated on Drawings.
 - 2. Capacities and Characteristics: As indicated on Drawings.

2.7 QUICK COUPLERS

- A. Manufacturers: As indicated on Drawings.

2.8 DRIP IRRIGATION SPECIALTIES

- A. Manufacturers: As indicated on Drawings.
- B. Off-Ground Supports: Plastic stakes.
- C. Application Pressure Regulators: As indicated on Drawings.
- D. Filter Units: As indicated on Drawings.
- E. Air Relief Valves: As indicated on Drawings.
- F. Vacuum Relief Valves: As indicated on Drawings.

2.9 CONTROLLERS

- A. Manufacturers: As indicated on Drawings.

- B. Description:
1. Smart Controller Stations for Automatic Control Valves: As indicated on Drawings.
 - a. Provide Ethernet Modem.
 - b. 2-Wire system.
 - c. BaseManager Software: BL-BMGR-MAA
 - d. BaseManager Web: BL-BMWEB-SETUP
 2. Exterior Control Enclosures: As indicated on Drawings.
 3. Control Transformer: 120-VAC secondary, with primary fuse.
 4. Moisture Sensor: As indicated on Drawings.
 5. Wiring: 2-Wire system, UL 493, Type UF multiconductor, with solid-copper conductors; insulated cable; suitable for direct burial.
 - a. Feeder-Circuit Cables: No. 12 AWG minimum, between building and controllers.
 - b. Low-Voltage, Branch-Circuit Cables: No. 14 AWG minimum, between controllers and automatic control valves; color-coded different from feeder-circuit-cable jacket color; with jackets of different colors for multiple-cable installation in same trench.
 - c. Splicing Materials: Manufacturer's packaged kit consisting of insulating, spring-type connector or crimped joint and epoxy resin moisture seal; suitable for direct burial.

2.10 BOXES FOR AUTOMATIC CONTROL VALVES

- A. Plastic Boxes: As indicated on Drawings.
- B. Drainage Backfill: Cleaned gravel or crushed stone, graded from 3/4 inch (19 mm) minimum to 3 inches (75 mm) maximum.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."
- B. Provide minimum cover over top of underground piping according to the following:
 1. Irrigation Main Piping: Minimum depth of 18 inches below finished grade.
 2. Circuit Piping: 12 inches.
 3. Drain Piping: 12 inches.
 4. Sleeves: 24 inches (600 mm).

3.2 PREPARATION

- A. Set stakes to identify locations of proposed irrigation system. Notify Landscape Architect of field conflicts and resolve relocation in joint conference.

3.3 PIPING INSTALLATION

- A. Location and Arrangement: Drawings indicate location and arrangement of piping systems. Install piping as indicated unless deviations are approved on Coordination Drawings.
- B. Install piping at minimum uniform slope of 0.5 percent down toward drain valves.
- C. Install piping free of sags and bends.

- D. Install groups of pipes parallel to each other, spaced to permit valve servicing.
- E. Install fittings for changes in direction and branch connections.
- F. Install unions adjacent to valves and to final connections to other components with NPS 2 (DN 50) or smaller pipe connection.
- G. Install flanges adjacent to valves and to final connections to other components with NPS 2-1/2 (DN 65) or larger pipe connection.
- H. Install expansion loops in control-valve boxes for plastic piping.
- I. Lay piping on solid subbase, uniformly sloped without humps or depressions.
- J. Install PVC piping in dry weather when temperature is above 40 deg F (5 deg C). Allow joints to cure at least 24 hours at temperatures above 40 deg F (5 deg C) before testing.
- K. Install water regulators with shutoff valve and strainer on inlet and pressure gage on outlet. Install shutoff valve on outlet. Install aboveground or in control-valve boxes.
- L. Water Hammer Arresters: Install between connection to building main and circuit valves aboveground or in control-valve boxes.
- M. Install piping in sleeves under parking lots, roadways, and sidewalks.
- N. Install sleeves made of Schedule 40 PVC pipe and socket fittings, and solvent-cemented joints.

3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. PVC Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. PVC Pressure Piping: Join schedule number, ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 3. PVC Nonpressure Piping: Join according to ASTM D 2855.

3.5 VALVE INSTALLATION

- A. Install where shown on Drawings and group together where practical. Limit one remot control valve per box with no exceptions.
- B. Locate valve boxes 12" from and perpendicular to walk edges, buildings and walls. Provide 12" between valve boxes where valves are grouped together.
- C. Thoroughly flush main line before installing the valve.
- D. Install in shrub or ground cover areas where possible.
- E. Label control line wire at each valve with a 2 ½" x 2 ½" polyurethane I.D. tag, indicating identification number of the valve (controller and station number). Attach a label to control wire.

3.6 SPRINKLER INSTALLATION

- A. Install sprinklers after hydrostatic test is completed.
- B. Install sprinklers at manufacturer's recommended heights.
- C. Locate part-circle sprinklers to maintain a minimum distance of 4 inches from walls and 2 inches from other boundaries unless otherwise indicated.

3.7 DRIP IRRIGATION SPECIALTY INSTALLATION

- A. Install Netafim system per manufacturer's specifications.

3.8 AUTOMATIC IRRIGATION-CONTROL SYSTEM INSTALLATION

- A. Equipment Mounting: Install controllers on wall (final location to be determined by owner).
 - 1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Install control cable in same trench as irrigation piping and at least 2 inches (51 mm) below or beside piping. Provide conductors of size not smaller than recommended by controller manufacturer. Install cable in separate sleeve under paved areas.

3.9 CONNECTIONS

- A. Comply with requirements for piping specified in Division 22 Section "Facility Water Distribution Piping" for water supply from exterior water service piping, water meters, protective enclosures, and backflow preventers. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, valves, and devices to allow service and maintenance.
- C. Connect wiring between controllers and automatic control valves.

3.10 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

- B. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on each automatic controller.
 - 1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- C. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tapes over underground piping during backfilling of trenches. See Division 31 Section "Earth Moving" for warning tapes.

3.11 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Any irrigation product will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.12 ADJUSTING/ GUARANTEE

- A. Adjust settings of controllers.
- B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.
- C. Adjust sprinklers and devices, except those intended to be mounted aboveground, so they will be flush with, or not more than 1/2 inch above, finish grade.
- D. Contractor shall be responsible for any damage or defects in the irrigation system being installed. Repair and replace damaged or defective components of the system at no additional cost to the Owner, in a manner satisfactory to the Owner's Representative before final acceptance.
- E. Repair or replace any existing structures, materials, equipment, sidewalks, or landscaping, damaged during the course of the Work, in a manner satisfactory to Owner's Representative, at no additional cost to the Owner, before final payment is made.
- F. Contractor shall (at his expense) be responsible for a one-year period to repair all damage to landscape elements caused by settlement of trenches. Contractor will also be responsible to repair settlement of trenches.

- G. The Contractor shall guarantee all workmanship, materials, and equipment to be free of all defects in workmanship and materials; and shall replace, at his expense, all defects found for a one-year period.
- H. Damage from Leaks: The Contractor shall be responsible for any damages to property or work caused by water leaking from irrigation system being installed. The Contractor shall, at his own expense, repair in a manner satisfactory to the Owner's Representative, any damages resulting from leaks.
- I. Any damage resulting from any Irrigation failures occurring during a one (1) year period after date of final acceptance shall be repaired by the Contractor to the Owner's Representative's satisfaction without cost to owner. Such damage may include, but not be limited to, plant material, paving or other site improvement work.

3.13 CLEANING

- A. Flush dirt and debris from piping before installing sprinklers and other devices.

3.14 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain automatic control valves and controllers.
- B. Instruct Owner's personnel in operation and maintenance of system, including adjustment of sprinklerheads. Use operation and maintenance material as basis for demonstration.
- C. At time of system demonstration. Provide to Owner three each of operating and servicing keys and wrenches required for complete maintenance and operation of all heads and valves. Include wrenches necessary for disassembly of all heads and valves. Provide owner with two (2) keys for each enclosure pad lock and injectaflo pad locks.
- D. Clean-up area. Remove all debris, surplus material, and trash from site.
- E. The Contractor shall request in writing ten (10) days prior to completion of planting portion of work a review of the work by the Owner's Representative. If upon review the Owner's Representative finds the Irrigated portion of work to be completed, then written acceptance shall be given by Owner. If work is not acceptable then Owner's Representative shall prepare a 'punch list' of defective items. Acceptance will be given only after review and verification of completed punch list items by Owner's Representative.

3.15 PIPING SCHEDULE

- A. Refer to legend and details on drawings.

3.16 VALVE SCHEDULE

- A. Underground, Shutoff-Duty Valves: Refer to legend and detail on plan.
- B. Aboveground, Shutoff-Duty Valves: Refer to legend and detail on plan.

3.17 MAINTENANCE

- A. A. Make repairs and maintain the entire sprinkler system from the time of installation through the landscape maintenance period, beginning on date of Owner's Representative's review and acceptance of irrigation work.

- B. The Contractor will be responsible to maintain the irrigation system in a fully operational manner. Maintenance will include:
 - 1. The repair and replacement of damaged equipment, at Contractor's expense.
 - 2. Flush all systems by removing last head on each lateral run.
 - 3. Maintain proper coverage by repairing and adjusting all sprinklers.
 - 4. Provide supplemental watering to areas lacking full coverage by using sprinklers and hoses. Contractor shall supply sprinklers and hoses.
 - 5. Adjust time clock as necessary to account for weekly and seasonal weather changes.
 - 6. Provide owner As-Built drawings.

END OF SECTION 32 8400

SECTION 32 9119

FINISH GRADING AND SOIL AMENDMENT

(BID RFI on Bid Package 2)

PART 1 GENERAL

1.1. SECTION INCLUDES

- A. Soil Amendment process.
- B. Finish Grading of Topsoil, meeting curbs, paving, inlets and in preparation for all planting operations.

1.2. RELATED SECTIONS

- A. Section 32 8400 - Planting Irrigation.
- B. Section 32 9300 - Plants.

1.3 REFERENCES

- A. Geotechnical Investigation
- B. Drawings prepared by DES and the General Provisions of the contract, including General and Supplementary Conditions and Division 1 Specifications, apply to this Section.

1.4 DEFINITIONS

- A. Scrapings: Existing site topsoil suitable for reuse.
- B. Amended Soil: On-site soil, amended in place or in stockpile conditions.
- C. Soils Analysis: Recommendations developed as a result of the Soils Analysis.

1.5 QUALITY ASSURANCE

- A. Following incorporation of amendments the landscape architect reserves the right to confirm that the amended soil meets recommendations provided CIR Labs, Inc 650-574-6900, for all amendment work. Initial cost of test shall be by and reserves the right to request additional testing to confirm soil amendment work
- B. Cost of testing non-conforming conditions shall be paid by the Contractor.
- C. Protection of Property:
 - 1. Improvements: Protect existing structures, fences, roads, sidewalks, paving, underground utilities, and curbs designated to remain.
 - 2. Work of Others: Respect and maintain the work of others, such as grade stakes, until they are removed by those parties concerned.
 - 3. Noise: All internal combustion motors and compressors will have mufflers. Do not leave equipment running under trees.
 - 4. Damage and Repair: Replace damaged structures, materials, equipment, sidewalks, or landscaping designated to remain, in a manner satisfactory to Owner's Representative. Such work will take place at no additional cost to the Owner.

5. Store products in safe areas. Protect from deterioration and damage.
- D. Personnel: All operations associated with this Section shall be performed by personnel familiar with the drawings, details, supporting specifications and with soil amendment procedures.
- E. Supervision: All work shall be supervised by an experienced installation foreman who shall be on-site whenever work of this section is performed.
- F. Documents On-site: A copy of the drawings, details and specifications shall be available at the project site at all times during working hours
- G. Conflict Resolution: Do not proceed under conflicting conditions without direction from the Owner's Representative. Work performed that is in conflict with the design intent and project documents, will be corrected at no increased cost to the owner.
- H. Water Service: Water shall be provided by Owner.
- I. Layout: As indicated on the drawings is diagrammatic to facilitate location, the relationship between site features and orientation and are not to be construed as the complete and precise limits of this contract.

1.6 INSPECTIONS

- A. Progress Reviews: Notify Landscape Architect 5 days prior to the completion of each Stage of Work:
 1. Stage 1: Planting areas have been rough graded and are ready for the amendment work .
 - a. Equipment, labor and amendment materials are on site and work is ready to proceed using appropriate equipment for optimum efficiencies.
 - b. Soil amendment will be by the ripping and rototilling process, whereby planting areas will be traversed, both ways to a depth of 12 inches, incorporating: mulch, fertilizers, and such additives required by the most recent soils report.
 - c. Soil must be dry for incorporation process.
 2. Stage 2: Trees have been sited by landscape architect.
 3. Stage 3: Tree hole soils have been removed and amended in a stockpile area,
 4. Stage 4: Trees have been planted, soil has been graded below walks, pre-emergent herbicides have been incorporated, surface drain inlets, curbs, and the irrigation system has been installed according to the contract documents.
 5. Stage 5: Planting areas are being irrigated, cycling continually.
 - a. Testing: The amended soil will be tested prior to planting.
 - b. Submittal: Signed soils report that amended soils are ready for planting.

1.7 SUBMITTALS

- A. The contractor shall submit, a minimum of fourteen (14) days prior to installation, 6 copies of manufacturer's literature and analytical data on the following:
 1. Chemical additives.
 2. Organic amendment.
 3. Commercial fertilizers.

- B. The Contractor shall submit to the Owner's Representative written documentation listing quantities, composition, type, origin, and weight of all required amendments and chemicals, which the Contractor plans to use during the soil amendment process.
- C. Contractor shall submit copies of all delivery tags and records to verify quantities, and delivery of specified amendments.
- D. Submit Amended Soil Tests, from an approved soils laboratory, as directed under Quality Assurance, Section 1.11.
- E. Horticulture Soils Report is required should imported soils be required.

1.8 PROJECT CONDITIONS

- A. Protect landscaping and other features remaining as final work.
- B. Prior to beginning work, Contractor shall locate all underground utilities in order to avoid possible damage.
- C. Protect existing structures, fences, roads, sidewalks, paving, underground utilities, and curbs designated to remain.
- D. Review the use of heavy equipment with the General Contractor. Use hand excavations, as required, in order to minimize the possibility of damage to underground utilities.
- E. Maintain grade stakes set by others until removal is agreed upon by all parties concerned.
- F. Equip internal combustion motors and compressors with mufflers. Do not park or leave such equipment running under trees.
- G. Repair or replace existing structures, materials, equipment, sidewalks, or landscaping designated to remain, damaged during the course of landscape preparatory work, in a manner satisfactory to Landscape Architect, at no additional cost to the Owner.
- H. Store products in safe areas. Protect from deterioration and damage.

1.9 REGULATIONS AND STANDARDS

- A. Code and standards compliance
 - 1. All work shall be performed under the current State and Federal Occupational Safety and Health Acts.
 - 2. All State construction safety orders.
 - 3. Should the contract documents specify materials or construction methods, which exceed these regulations, and then the contract documents shall take precedence.
- B. Provide certificates of inspection, when applicable, from any authority having jurisdiction, indicating acceptance of this work.

1.10 COORDINATION

- A. Coordinate the placement and distribution of amended topsoil with installation of underground utilities, including electrical (lighting), and the sprinkler irrigation system.

1.11 QUALITY ASSURANCE

- A. Following completion of rough grading the installing landscape contractor shall contact Soils and Plant Lab representative to test soil samples from proposed planting areas. Test results shall form the basis for required amendments and incorporation procedures.
- B. Following amendment process Soil and Plant Labs shall be contacted to test representative samples of prepared topsoil to determine conformance with initial soil amendment recommendations.
- C. Contractor shall submit signed submittals of all test results to landscape architect.
- D. If soils, after testing are shown to conform with initial recommendations planting may proceed. If soils, after testing are shown to be in nonconformance additional amendments shall be incorporated. This process shall be repeated until such time as prepared topsoil is shown to be in conformance with initial test recommendations.
- E. Testing shall be at owner's expense for testing listed in paragraphs A and B. Cost of C testing due to nonconformance outlined in paragraph D will be at contractor's expense.
- F. The Soils Laboratory shall be directed to submit a copy of their report to the Project Administrator and the Landscape Architect for their review and file.
- G. Should import soil be required, and prior to placement of said topsoil, subgrade soil shall be horticulturally tested based on test results of subgrade soil. Specified amendments shall be incorporated prior to placement of import topsoil.

1.12 DEFINITIONS

- A. Project Administrator: The Owners Representative.
- B. Amended Soil: On-site soil treated with chemicals, inorganic fertilizers, organic amendments and cultivation to improve tilth, aeration, porosity and nutrient availability.

1.14 COORDINATION

- A. The window for Landscape Development around buildings is after the buildings exterior skin and glazing is complete, flatwork has been installed, and before occupancy, assuming interior improvements are being completed during the same period.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Pre-plant fertilizers: Commercial Fertilizer, as specified by the soils analysis, incorporated into the Strippings as part of the soil amendment process.
- B. Post-plant fertilizers: Commercial Fertilizer, as specified by the soils analysis, applied through the fertilizer injection system as planting operations are completed.
- C. Onsite, in-situ topsoil to be used in proposed planting areas shall be to a depth of 24" (twenty-four inches) and shall:
 - 1. Be free of all rocks and debris 1" in diameter or larger.
 - 2. Have minimal small rock/gravel content; which by volume shall not exceed 5% (five percent).

3. Be free of clay clods 1" in diameter and larger.
 4. Have a ph range from 5.5 to 7.5.
 5. Be fertile horticulturally suitable soil as determined through horticultural soil testing.
- D. In the event that in-situ soils do not meet the requirements of section 2.1C all planting areas shall be excavated to a depth of 2' (two feet). Rejected in-situ soils removed from planting area shall either be removed from the site or, with approval of the geotechnical engineer, used as fill in non-planting areas. Clean, approved import topsoil shall be placed in all affected planting areas. The import topsoil shall be tested to determine conformance with import topsoil requirements.
- E. Soil in all proposed planting beds shall, up to a twenty-four inch depth, be free of all deleterious material described in paragraph 2.1C. This also includes lime-treated soil, soil treated for winterization, and soil contaminated with base rock. Non-conforming soil shall be removed from planting areas. Reference paragraph 2.1D for procedures.
- F. If 24" (twenty-four inches) of in-situ soils is removed to accommodate import topsoil the existing sub-grade to remain shall be tested and amendments as specified in test results incorporated following amendment of subgrade topsoil may be placed and amended as described in this specification section.

2.2. SOIL AMENDMENT PROCESS

- A. Stockpiling Topsoil: Soil removed from tree planting holes will be stockpiled in an area designated by the construction manager and general contractor.
1. Shaping Stockpiles: Soil removed from designated tree holes will be placed in wide, flat berms, for cultivation and amendment efficiency.
 2. Debris: Care will be taken to remove all rocks larger than 1 inch, remove all foreign matter and deleterious material from the site.
- B. Process
1. Cultivating: Select equipment and procedures for optimum soil amending efficiencies.
 2. Test the soil in areas designated for planting, to determine the type and level of fertilizer (Nitrogen, Phosphates, Potassium, Iron and Trace Elements), fortified Organic Amendment (such as: Redwood sawdust, fir bark, rice hulls), material required for amending the soil chemistry (such as: Sulfur, Gypsum).
 3. Soil cannot be amended when in wet condition.
 4. Quantities of Admixtures: Ripping depth, determines the amount of organic matter, inorganic fertilizers and other amendment chemicals required to form a product that meets conditions determined as suitable for growing plant material
 - a. Conditions will be monitored through soils analysis scheduled by the landscaper to conform to their progress in the field.
 - b. Should the Contractor fail to acquire soil tests in a timely manner, the landscape architect reserves the right to arrange for such tests at the contractors expense.
 - c. Amended areas not meeting conditions determined through analysis, will be re-amended by the landscaper until such areas are determined by the Soils Laboratory as "meeting specified conditions." Re-amendment work will be provided by the landscaper at no increase cost to the Owner.

5. Amended Topsoil: Coordinate with the approved Soils Laboratory to test each designated area after amending is complete.
6. Stockpile Amended Soil: Place amended topsoil as backfill for trees in designated tree locations approved by the Contract Administrator.
 - a. Amended topsoil does not have to be protected from the elements.
 - b. Amended topsoil must be protected from equipment traffic, which may break down the tilth acquired from the amendment process.

2.3 AMENDMENTS: Required for on-site and imported soils

- A. As per Soils Analysis.
- B. Organic Matter.
 1. Material: Can be Fir sawdust, Fir bark, Pine bark, Cedar sawdust, Redwood sawdust, or hardwood bark.
 2. Redwood bark would not be acceptable.
 3. Wood products will be free of weed seed, dust or other noxious material.
 4. Chemistry:
 - a. Nitrogen: Required to offset that which is lost during breakdown, the content dry weight basis where required:
 - Fir or cedar sawdust: Minimum 0.56-0.84 percent.
 - Fir or pine bark: Minimum 0.56-0.84 percent.
 - Redwood sawdust: Minimum 0.4-0.6 percent.
 - Hardwood Bark: Minimum 0.8-1.2 percent.
 - b. Salinity (ECe): Maximum 3.0 mmhos/cm at 25 degrees C. (Saturation extract conductivity.).
 - c. Reaction (pH): Minimum 4.0; maximum 7.5.
- C. Inorganic Admixtures
 1. Fertilizer shall be commercially processed.
 2. All commercially produced fertilizers will be delivered to the site in their original containers, listing their weight and analysis by volume on the label.
 3. Fertilizers shall comply to applicable requirements to all laws and regulations for local agencies and the State of California.
 - a. Soil sulfur shall be a 99 percent elemental sulfur agricultural grade product.
 - b. Iron Sulfate: Agricultural grade product.
 4. For purposes of pricing bid the following amendments:

Material	Quantity/1,000 sq ft
Nitrogen fortified Organic Amendment (Fir Bark) Amendment (Fir Bark)	5 cubic yards
Commercial Pelletized Fertilizer (16-20-20)	15 lbs.
Soil Sulfur	30 lbs.
Iron Sulphate	2 lbs.

- a. Actual amendments required will be in accordance with latest horticultural test results. Adjustments to the list in 4a. will be based on the horticultural soil test

2.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products as recommended by the manufacture.

- 2.5 IMPORTED TOPSOIL (required to achieve finish grade or if as specified under this Section)
- A. Imported Topsoil will be amended to meet standards set forth in the soil report recommendations.
 - B. Imported Topsoil will have the following qualities and meet these conditions before importing:
 - 1. Import topsoil shall be friable sandy loam; free of subsoil, roots, grass, excessive amount of weeds, stone, and foreign matter; acidity range (Ph) of 5.5 to 7.5.
 - 2. Imported topsoil shall be free from toxic amounts of acid or alkaline chemicals and capable of sustaining plant life.
 - 3. Be tested by a Soils Laboratory, with results and recommendations submitted for review and approval by the Landscape Architect.

2.6 SUBSTITUTIONS

- A. Substitutions for soil amendments will be acceptable only if material is determined to be of equal or better quality.
- B. Contractor wishing to substitute materials for those specified, shall submit a list of proposed substitutions to Owner's Representative a maximum of thirty (30) days from notice of award of contract.

PART 3 EXECUTION

3.1. EXAMINATION

- A. Verify site conditions and note irregularities, which may adversely have an effect on work in this Section. Inform Landscape Architect of any discrepancies between plans and specifications, and existing conditions.
- B. Proceeding with Work without informing the Landscape Architect of perceived irregularities, indicates acceptance of existing conditions.

3.2. WORKING CONDITIONS

- A. Eliminate uneven areas and low spots. Slope away from buildings.
- B. Remove debris, roots, branches, stones, in excess of 1 inch in size.
- C. Displacement: Make allowance for soil replaced by plant materials and amendments.
- D. Allow for a ten percent settlement of berms and fill areas.
- E. Drainage: Correct drainage conditions which may be detrimental to plant material.
- F. Minimum slope in landscape areas is two percent (2%). Unless relief is approved by Landscape Architect.
- G. Grade Stakes: Locate and set grade stakes for finished grading of planting areas, including flow lines.

3.3. PLACING IMPORT TOPSOIL

- A. In the event conditions require that imported soil is required.
 - 1. Place imported topsoil in perimeter areas only.
 - 2. Place to a uniform depth of six inches with a relative compaction of 80% maximum relative compaction by Test Method No. California 216.
 - 3. Place topsoil in relatively dry state, during dry weather.
- B. Do not work soil when moisture content is so great that excessive compaction will occur, or when it is so dry that dust will form in air.

3.4. FINE GRADING for AMENDED SOILS, and (if required) IMPORTED TOPSOIL

- A. Standards
 - 1. Fine grade to eliminating rough or low areas.
 - 2. Maintain uniform finish levels, profiles, and contours true to the drawings.
 - 3. Remove all stone, 1" and larger, roots, grass, weeds, debris, and foreign material.
 - 4. By volume there shall be no more than five percent (5%) stone/rock under 1" diameter in the prepared topsoil.
 - 5. Manually grade topsoil around existing trees, plants, and structures to prevent damage.
 - 6. Lightly compact placed topsoil.
- B. Remove surplus subsoil and topsoil from site.
- C. Leave stockpile area and site clean and raked, ready to receive plant material.

3.5. AMENDMENTS

- A. Refer to the most recent soils report, for specific areas for post planting recommendations.
- B. Place only amended soil along sides and beneath plant root ball.
- C. Firm bottom of planting pits to minimize settlement.
- D. Post Planting: Specified amendments and rates shall meet but not exceed those recommended by the testing laboratory.

3.6. FINISH GRADING

- A. Conform to grades shown on grading and planting plan, after soil preparation and settlement.
- B. Finish off ground cover areas at 2 inches below curb and pavement.
- C. Finish grade all sod areas 1 inch below adjacent curbs and walks.
- D. Top surface of soil, after finish grading, shall be to within 0.10 of 1 foot of finish grades. Notify Landscape Architect 48 hours prior to completion of finish grades for review before any planting begins.

- E. Grades not otherwise indicated shall be naturalized slopes between points where elevations are given, and between points established by walks, paving, or curbs.
- F. Round off tops and toes of slopes to produce a gradual and natural appearing transition between relatively level areas and slopes, unless noted otherwise on Drawings.
- G. Provide 2 percent minimum slope in planting areas, draining away from buildings. Lawn berms shall not exceed a 4:1 slope.

END OF SECTION

SECTION 32 9200

TURF AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sodding.

1.2 DEFINITIONS

- A. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.
- B. Finish Grade: Elevation of finished surface of planting soil.
- C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- D. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- E. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- F. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- G. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.
- H. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- I. Surface Soil: Whatever soil is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Certification of grass seed.
 - 1. Certification of each seed mixture for turfgrass sod.

- B. Product certificates.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Refer to Section 01 4000.
- B. Soil Analysis: Refer to specification 32 9300, Section 1.8D.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.
- B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.

1.7 MAINTENANCE SERVICE

- A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable turf is established but for not less than the following periods:
 - 1. Sodded Turf: 90 days from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TURFGRASS SOD

- A. Turfgrass Sod: Approved complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.
- B. Turfgrass Species: As Shown on Drawings:

2.2 INORGANIC SOIL AMENDMENTS

- A. Commercial Grad Fertilizer:
 - 1. Complete fertilizer: Homogenous pellet, containing major nutrients specified plus iron, sulfur and zinc, Best's Fertilizer, J.R. Simplot Co., Lathrop, CA or accepted equal..
- B. Potassium Sulfate: 0-0-52; manufactured for horticultural use..
- C. Iron Sulfate: Ferric sulfate, containing minimum 20% iron expressed as elemental. Caution: Iron sulfate will stain concrete, granite, stucco and tile surfaces. Avoid contact between site surfaces and soil containing iron sulfate. After iron sulfate application, broom or air blow surfaces free of material before any water application, including impending rains..
- D. Soil Sulfur: Manufactured for horticultural use.
- E. Agricultural Gypsum: Manufactured for horticultural use.

2.3 ORGANIC SOIL AMENDMENTS

- A. Wood Residual Soil Amendment: Nitrogen and iron stabilized fir bark, 0x1/4 inch, form 404-A-SC.

1. Particle Size (dry weight basis):

<u>Sieve Size</u>	<u>Percent Passing</u>
9.51 mm (3/8 inch)	100
6.35 mm (1/4 inch)	95-100
4.76 mm (No. 4)	80-100
2.38 mm (No. 8, 8 mesh)	50-80
1.00 mm (No. 18)	20-70
500 micron (No. 35, 32 mesh)	0-30

2. Nitrogen: Minimum 0.8% nitrogen based on dry weight.
3. Salinity: Maximum saturation extract conductivity 4.0 millimhos per cm at 25 degrees centigrade.
4. Iron: Minimum 0.08% dilute acid soluble Fe based on dry weight.
5. Organic Matter: 425 pounds per cubic yard.

- B. Fire Bark for Soil Mixes: Raw, untreated ground fir bark, 0x1/8 inch size, Form 416 A specs.

1. Particle Size (dry weight basis):

<u>Sieve Size</u>	<u>Percent Passing</u>
9.51 mm (3/8 inch)	100
6.35 mm (1/4 inch)	95-100
4.76 mm (No. 4)	90-100
2.38 mm (No. 8, 8 mesh)	75-100
1.00 mm (No. 18)	
500 micron (No. 35, 32 mesh)	0-30

- C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent.
- D. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.
- E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

2.4 FERTILIZERS

- A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.

- B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.

2.5 PLANTING SOILS

- A. Planting Soil (PS01): Existing, in-place surface soil in all planting areas, to a depth of 12 inches, to be free of rocks over one inch in diameter, subsoil, refuse, plants or roots, clods, weeds, viable weed seeds, sticks, solvents, petroleum products, concrete, base rock, or other harmful substances. Submit sample to approved testing laboratory for recommendations for agricultural suitability, fertility, particle size analysis; including recommendations for soil amendment and backfilling, and fertilization during maintenance period.
 1. Provide soils report of amended PS01, from approved Testing Laboratory, to confirm amended soil meets specified recommendations, prior to planting.
 2. Amended areas not meeting conditions determined through analysis, to be re-amended until soil meets specified recommendations, at no increase cost to the Owner.
- B. Planting Soil (PS02): Imported topsoil to achieve finish grade. Form 430-C as determined by Testing Laboratory.
 1. Physical properties: USDA sandy loam, sandy clay loam or loam.

Particle Size	Range Percent
Course Sand .5-2.0 mm	0-15%
Silt Plus Clay <0.05 mm	25-50%
Silt 0.0002-0.05 mm	10-30%
Clay 0-0.002 mm	10-15%
Rock ½-<1 inch	0-10% by volume
Organic Matter	0-15%

2. Chemistry:
 - a. Salinity: Less than 3.0 mmhos
 - b. Sodium Absorption: Less than 6.0.
 - c. Boron: Less than 1.0 ppm
 - d. pH of saturated paste: 5.5-7.5.
3. Qualitative lime level shall be low in opinion of Testing Laboratory.
4. Fertility characteristics shall be modifiable by the incorporation of conventional fertilizers to provide fertility levels to sustain normal growth.

2.6 MULCHES

- A. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 2 to 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings.

2.7 PESTICIDES

- A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

PART 3 - EXECUTION

3.1 TURF AREA PREPARATION

- A. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 6 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Thoroughly blend planting soil off-site before spreading or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil per soil analysis' recommendations.
 - 2. Spread planting soil to a depth of 6 inches (150 mm) but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
 - a. Reduce elevation of planting soil to allow for soil thickness of sod.
- B. Unchanged Subgrades: If turf is to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:
 - 1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
 - 2. Loosen surface soil to a depth of at least 6 inches (150 mm). Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 6 inches (150 mm) of soil. Till soil to a homogeneous mixture of fine texture.
 - 3. Remove stones larger than 1 inch (25 mm) in any dimension and sticks, roots, trash, and other extraneous matter.
 - 4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.
- C. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.
- D. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- E. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.2 SODDING

- A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
 - 1. Lay sod across angle of slopes exceeding 1:3.
 - 2. Anchor sod on slopes exceeding 1:6 with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.

- C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

3.3 TURF MAINTENANCE

- A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
- B. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain height appropriate for species without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. This section does not apply to No-Mow turf type.
- C. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

3.4 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Architect:
 - 1. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
- B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

END OF SECTION

SECTION 32 9300

PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Plants.
2. Planting soils.
3. Tree stabilization.
4. Maintenance.
5. Weed control.

B. Related Sections:

1. Division 01 Section "Temporary Tree and Plant Protection" for protecting, trimming, pruning, repairing, and replacing existing trees to remain that interfere with, or are affected by, execution of the Work.
2. Division 31 Section "Site Clearing" for protection of existing trees and plantings, topsoil stripping and stockpiling, and site clearing.
3. Division 31 Section "Earth Moving" for excavation, filling, and rough grading and for subsurface aggregate drainage and drainage backfill materials.
4. Division 33 Section "Subdrainage" for below-grade drainage of landscaped areas, paved areas, and wall perimeters.

1.3 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.
- C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required.
- D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of plant required.
- E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

- F. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.
- G. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.
- H. Finish Grade: Elevation of finished surface of planting soil.
- I. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- J. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- K. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- L. Planting Area: Areas to be planted.
- M. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- N. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
- O. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.
- P. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.
- Q. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- R. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- S. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, including soils.
 1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
 2. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to the Project.

3. Copy of all nursery delivery recite.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified landscape Installer. Comply with requirements in Division 01.
- B. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
 1. Manufacturer's certified analysis of standard products.
 2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- C. Material Test Reports: For existing native surface topsoil, existing in-place surface soil and imported or manufactured topsoil.

1.6 QUALITY ASSURANCE

1. Installer Qualifications: Refer to Section 01 4000.
 2. Pesticide Applicator: State licensed, commercial.
- B. Soil-Testing Laboratory Qualifications: An independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
 - C. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of the soil.
 1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
 2. The soil-testing laboratory shall oversee soil sampling; with depth, location, and number of samples to be taken per instructions from Architect. A minimum of 2 representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
 3. Report suitability of tested soil for plant growth.
 - a. Based upon the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. (92.9 sq. m) or volume per cu. yd. (0.76 cu. m) for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
 - b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.
 - D. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
 1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches (150 mm) above the root flare for trees up to 4-inch (100-mm) caliper size, and 12 inches (300 mm) above the root flare for larger sizes.
 2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

- E. Plant Material Observation: Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
 - 1. Notify Architect of sources of planting materials 7 days in advance of delivery to site.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.
- B. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 - 3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.
- C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- D. Handle planting stock by root ball.
- E. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
 - 1. Do not remove container-grown stock from containers before time of planting.
 - 2. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly-wet condition.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

1.9 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
 - b. Structural failures including plantings falling or blowing over.
 - c. Faulty performance of tree stabilization, edgings, and tree grates.
 - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Periods from Date of Substantial Completion:
 - a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
 - b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.
 - c. Annuals: Three months.
 - 3. Include the following remedial actions as a minimum:
 - a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
 - b. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.

1.10 MAINTENANCE SERVICE

- A. Initial Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.
 - 1. Maintenance Period: 90 days from date of Substantial Completion.
- B. Initial Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
 - 1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch (19 mm) in diameter; or with stem girdling roots will be rejected.
 - 2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

- B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.
- C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.
- D. Labeling: Label each plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as shown on Drawings.
- E. If formal arrangements or consecutive order of plants is shown on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.
- F. Annuals: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery and that are in bud but not yet in bloom.

2.2 INORGANIC SOIL AMENDMENTS

- A. Per soils analysis.

2.3 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight.
 1. Organic Matter Content: 50 to 60 percent of dry weight.
- B. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.

2.4 FERTILIZERS

- A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 1. Composition: 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.
- B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.
- C. Planting Tablets: Tightly compressed chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
 1. Size: 21-gram tablets.

2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients. Applied per the following schedule:

Planting Tablet	Container Size
1	1 gallon
3	5 gallon
4	15 gallon
6	24 inch box
8	36 inch box
12	48 inch box

2.5 PLANTING SOILS

- A. Planting Soil (PS01): Existing, native surface topsoil formed under natural conditions with the duff layer retained during excavation process and stockpiled on-site or in-place surface soil. Verify suitability of native surface topsoil to produce viable planting soil. Clean soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
 1. Mix existing, native surface topsoil per horticultural soils report recommendation.
 2. Provide soils report of amended PS01, from approved Testing Laboratory, to confirm amended soil meets specified recommendations, prior to planting.
 3. Amended areas not meeting conditions determined through analysis, to be re-amended until soil meets specified recommendations, at no increase cost to the Owner.

- B. Planting Soil (PS02): Imported topsoil or manufactured topsoil from off-site sources required to achieve finish grade or as specified under this Section.
 1. Additional Properties of Imported Topsoil or Manufactured Topsoil: Screened and free of stones 1 inch (25 mm) or larger in any dimension; free of roots, plants, sod, clods, clay lumps, pockets of coarse sand, paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials harmful to plant growth; free of obnoxious weeds and invasive plants including quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and brome grass; not infested with nematodes; grubs; or other pests, pest eggs, or other undesirable organisms and disease-causing plant pathogens; friable and with sufficient structure to give good tilth and aeration. Continuous, air-filled pore space content on a volume/volume basis shall be at least 15 percent when moisture is present at field capacity. Soil shall have a field capacity of at least 15 percent on a dry weight basis.
 2. Provide horticultural soils report and amend to meet soils report's recommendations.

2.6 MULCHES

- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
 1. Type: Shredded hardwood, Ground bark, Wood and bark chips.
 2. Size Range: 2 inches (76 mm) maximum, 1/2 inch (13 mm) minimum.
 3. Color: Dark Brown (provide sample).

2.7 PESTICIDES

- A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

- B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

2.8 TREE STABILIZATION MATERIALS

- A. Stakes and Guys:
 - 1. Upright and Guy Stakes: Treated lodgepole pine, 2-inch diameter for 15 gallon trees and 3" diameter for 24" box trees and larger.
 - 2. Flexible Ties: Wide rubber or elastic bands or straps of length required to reach stakes. Refer to detail on Drawings.

2.9 MISCELLANEOUS PRODUCTS

- A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.
- B. Burlap: Non-synthetic, biodegradable.
- C. Planter Drainage Gravel: Washed, sound crushed stone or gravel complying with ASTM D 448 for Size No. 8.
- D. Planter Filter Fabric: Woven geotextile manufactured for separation applications and made of polypropylene, polyolefin, or polyester fibers or combination of them.
- E. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per lb (0.45 kg) of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb (0.45 kg) of ectomycorrhizal fungi, 33 percent hydrogel, and a maximum of 5.5 percent inert material.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.
 - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 - 2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
 - 3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Landscape Architect and replace with new planting soil.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Landscape Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.
- D. Lay out plants at locations directed by Landscape Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.
- E. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
 - 1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.
- F. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

3.3 PLANTING AREA ESTABLISHMENT

- A. Loosen subgrade of planting areas to a minimum depth of 24 inches (600 mm). Remove stones larger than 1 inch (25 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
 - a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.

- B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.
 - 1. Finish off shrub and groundcover areas 2" below curb and pavement, 1" below for sod.
- C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
 - 1. Excavate approximately three times as wide as ball diameter for container-grown stock.
 - 2. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
 - 3. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
 - 4. Maintain required angles of repose of adjacent materials as shown on the Drawings. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
 - 5. Maintain supervision of excavations during working hours.
 - 6. Keep excavations covered or otherwise protected after working hours when unattended by Installer's personnel.
 - 7. If drain tile is shown on Drawings or required under planting areas, excavate to top of porous backfill over tile.
- B. Obstructions: Notify Landscape Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
- C. Drainage: Notify Landscape Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.
 - 1. Fill excavations with water and allow to percolate away before positioning trees and shrubs. Contractor shall notify Owner's Representative if subsoil conditions prevent water from draining in a twenty-four (24) hour period.
 - 2. Contractor shall submit proposals to correct drainage problem prior to proceeding with work.
 - 3. Planting shall not proceed until drainage problem has been resolved to the satisfaction of the contract Administrator and General Contractor.

3.5 TREE, SHRUB, AND VINE PLANTING

- A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Set container-grown stock plumb and in center of planting pit or trench with root flare 1 inch (25 mm) above adjacent finish grades.
 - 1. Use planting soil shown on planting plan for backfill.

2. Carefully remove root ball from container without damaging root ball or plant.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole.
5. Continue backfilling process. Water again after placing and tamping final layer of soil.

3.6 TREE, SHRUB, AND VINE PRUNING

- A. Remove only dead, dying, or broken branches. Do not prune for shape.
- B. Prune, thin, and shape trees, shrubs, and vines as directed by Landscape Architect.
- C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Landscape Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.
- D. Do not apply pruning paint to wounds.

3.7 TREE STABILIZATION

- A. Install trunk stabilization as follows unless otherwise indicated:
 1. Upright Staking and Tying: Use a minimum of two stakes of length required to penetrate at least 18 inches (450 mm) below bottom of backfilled excavation and to extend to the dimension shown on Drawings above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.
 2. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree. Refer to detail on Drawings.

3.8 PLANTING IN PLANTERS

- A. Place a layer of drainage gravel at least 4 inches (100 mm) thick in bottom of planter. Cover bottom with filter fabric and wrap filter fabric 6 inches (150 mm) up on all sides. Duct tape along the entire top edge of the filter fabric, to secure the filter fabric against the sides during the soil-filling process. For planter pots only, refer to Drawings for raised planters.
- B. Fill planter with lightweight on-structure planting soil P04. Place soil in lightly compacted layers to an elevation of 2 (two) inches below top of planter, allowing natural settlement. For planter pots and raised planters on structure.

3.9 GROUND COVER AND PLANT PLANTING

- A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on planting plan in even rows with triangular spacing.
- B. Use planting soil (PS01) for backfill.
- C. Dig holes large enough to allow spreading of roots.

- D. For rooted cutting plants supplied in flats, plant each in a manner that will minimally disturb the root system but to a depth not less than two nodes.
- E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.10 PLANTING AREA MULCHING

- A. Mulch backfilled surfaces of planting areas and other areas indicated.
 - 1. Trees and Tree-like Shrubs in Turf Areas: Apply mulch ring of 2-inch average thickness, with 36-inch radius around trunks or stems. Do not place mulch within 6 inches of trunks or stems.
 - 2. Organic Mulch in Planting Areas: Apply 3-inch average thickness of organic mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within six (6) inches of trunks or stems.

3.11 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.
- B. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.12 MAINTENANCE

- A. Request for this inspection shall be by the Contractor to the Contract Administrator, 5 days prior to completing maintenance obligations.
- B. Conditions for Inspection
 - 1. All Designated Area(s) scheduled for Final Inspection shall be complete, weed-free, with no trash, containers, excess soil or deleterious material in evidence.
 - 2. The landscape material will be observed as healthy, vigorous and of good color.
 - 3. The Landscape Contractor will maintain all plants and planting areas from date of Owner's written acceptance of planting portion of work for a period of ninety (90) day.
 - 4. The Landscape Contractor, Landscape Architect, and the Owner or the Owner's Contract Administrator shall be present for this walk through.
 - 5. Unsatisfactory Conditions
 - a. If, in the opinion of the Owner's Representative, the landscaping in the Designated Area is not in presentable condition or in a healthy viable state, that area shall be determined to be unsatisfactory.

- b. A Punch List will be issued and the Notice of Acceptance and termination of plant Maintenance Period will be extended a minimum 10 working days.
 - c. The Landscape Contractor will notify Contract Administrator when the Punch List conditions have been completed, and schedule a re-inspection.
 - d. Maintenance will be continued for any extended periods caused by the Punch List, at no cost to the Owner.
 - e. Extensions of maintenance period will continue until such time as the Landscape or deficient elements is/are in an acceptable condition.
 - f. If additional site visits are required due to required extensions for non-conformance, the Contractor shall reimburse owner for the cost and expenses of additional site visits by Landscape Architect.
6. Satisfactory Conditions: Should the landscaped Designated Area(s) be determined in satisfactory condition.
- a. The Landscape Architect will issue a written Notice of Acceptance and recommendation to the Owner for Final Acceptance.
 - b. All Maintenance responsibilities will be transferred to the Owner on Final Acceptance.

3.13 WEED CONTROL

- A. Using approved herbicide, spray existing weeds.
- B. Following completion of the first weed removal operation, deeply till proposed seed/sod beds.
- C. Wet site and allow for new weed germination. When weeds reach 3-6 inches, repeat procedure in step 1. Irrigate soil sufficiently to remove residue from herbicide.
- D. Reseed all areas that fail to germinate due to misuse of herbicide.
- E. Verify that soil preparation is complete and ready for seeding.
- F. Prepare subsoil to eliminate uneven areas and low spots. Maintain lines, levels, profiles and contours. Make changes gradual and blend into level areas.
- G. Allow sufficient time in planting process to complete weed removal process.

3.14 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Pre-Emergent Herbicides (Selective and Non-Selective): Apply to tree, shrub, and ground-cover areas in accordance with manufacturer's written recommendations. Do not apply to seeded areas.
- C. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.15 CLEANUP AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.

- B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- C. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

3.16 DISPOSAL

- A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION 32 9300

SECTION 33 1110
DOMESTIC SITE WATER SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pipe and fittings for water piping.
- B. Valves and valve boxes.
- C. Accessories.
- D. Adjustment of existing water valve and valve box.
- E. Backflow preventors/pressure reducers.

1.2 RELATED SECTIONS

- A. Section 31 2316 – Trench excavation and backfilling.
- B. Section 33 1300 – Disinfection of potable water distribution systems.

1.3 REFERENCES

- A. California Test Method No. 216 (Dry Method).
- B. ANSI/ASTM D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- C. ANSI/AWWA C110 - Ductile Iron and Grey-Iron Fittings, 3 inch through 48 inch, for Water and Other Liquids.
- D. ANSI/AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
- E. ANSI/AWWA C500 - Gate Valves, 3 through 48 in NPS, for Water and Sewage Systems.
- F. ANSI/AWWA C900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 inch through 12 inch, for Water.
- G. ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and Class 200.
- H. ASTM D2855 - Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
- I. ASTM D3139 - Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 3000 - Submittals.

- B. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01 7800.
- B. Accurately record actual locations of piping mains, valves, connections, and appurtenances.
- C. Identify and describe discovery of uncharted utilities, or utilities found at locations different than indicated on plans.

1.6 QUALITY ASSURANCE

- A. Perform work in accordance with product manufacturer's recommendations and these Contract Documents.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Comply with corrosion protection recommendations by Corrosion Consultant.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle all products required.

1.8 COORDINATION

- A. Coordinate the work with the connection to domestic water service line and trenching.
- B. Coordinate any cutting and patching required for the Work of this Section with the Work of other trades.

PART 2 - PRODUCTS

2.1 WATER PIPE

- A. Ductile Iron Pipe (for iron pipe larger than 3 inches in diameter, above ground): ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51, thickness Class 50, with cement - mortar lining and seal coating per ANSI/AWWA C104/A21.4.
 - 1. Fittings: ANSI/AWWA C110/A21.10, ductile iron.
 - 2. Joints: Flanged.
- B. PVC Pipe (for pipe 3" and smaller, underground): ASTM D1785, Schedule 40; 1120 high impact.
 - 1. Fittings: ANSI/ASTM D2464, Schedule 80 PVC (Schedule 40 PVC for pipes 1 ½ inches and smaller).
 - 2. Joints: ASTM D2855, solvent weld.
- C. PVC Pipe (for pipe 4" and larger, underground): ANSI/AWWA C900 Class 200, 1120 high impact.
 - 1. Fittings: ANSI/AWWA C111, cast iron.
 - 2. Joints: ASTM D3139 compression gasket ring.

- 2.2 GATE VALVES - Up to 3 Inches (75 mm)
- A. Use ball valves for 1-1/2" and smaller and gates valves for 2" and larger size.
 - B. Brass or Bronze body, non-rising stem, inside screw, single wedge or disc, IPS ends.
- 2.3 GATE VALVES - 3 Inches (75 mm) and Over
- A. ANSI/AWWA C500, Iron body, bronze trim, non-rising stem with square nut or control handle wheel, single wedge, threaded or flanged.
- 2.4 VALVE BOXES
- A. Precast Reinforced Concrete traffic rated. Cast iron lid marked "WATER" for service. Old Castle G5 appropriately sized or approved equal.
- 2.5 BACKFLOW PREVENTORS/PRESSURE REDUCER ASSEMBLIES
- A. Backflow preventors/pressure reducer assemblies shall be as shown on the construction plans, and of type specified and approved by applicable agency having jurisdiction of these devices.
- 2.7 ACCESSORIES
- A. Concrete for Thrust Blocks and Valve Box Surface Collars: Concrete type specified in Section 32 1313.
 - B. Valve Boxes and Covers: Old Castle No. G5 appropriately sized traffic-rated traffic box with cast iron lid, or approved equal. Cover marking shall read "Water". A one piece PVC riser extension shall be provided as necessary to allow unobstructed access to valve operating nut.
 - C. Solvent Cement and Primer for PVC Pipe and Fittings: Per ASTM F656 and ASTM D2564.
 - D. Pipe Identification: Plastic Underground Warning Tapes: Polyethylene plastic tape 6 inches wide by 4 mills thick, solid blue in color, with continuous printed caption in black letters "CAUTION - WATER LINE BURIED BELOW". Use metallic lined plastic underground warning tape for non-metallic water pipes.
 - E. Mechanical Joint Restraints:
 - a. Conforming to ANSI/AWWA C111/A21.11 or ANSI/AWWA C153/A21.53
 - b. Ductile iron castings shall conform to ASTM A-536 Standard.
 - c. Bolts, nuts, washers and rods shall be Type 316 Stainless Steel.
 - d. Pressure rating of greater than or equal to the associated pipe, but no less than 150 psi.
 - e. Metallic portion shall have a factory-applied fusion epoxy coating per AWWA C213.
 - f. Entire restraining device, including associated adjacent fittings and valves shall be cathodically protected per Corrosion Consultant's recommendations.
 - g. Megalug Series 2000PV by EBBA IRON; or approved equal for PVC pipe. Mechanical joint restraints at pipe fittings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions. All plot dimensions are approximate. Before proceeding with any work, carefully check and verify all dimensions and report any variations to the Inspector.

- B. Due to the scale of the drawings, it is not possible to indicate all offsets, fittings, etc., which may be required. Carefully investigate the structural and finished conditions affecting all work, and plan 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 in the most direct and workmanlike manner, so that conflicts between water systems, planting, and architectural features will be minimized.
- C. Do not install the facilities as indicated on the drawings when it is obvious in the field that unknown obstructions might not have been considered in the engineering. Such obstructions or differences should be brought to the attention of the Inspector.

3.2 PREPARATION

- A. Prepare for pipe installation by assembling all needed materials.
- B. Cover all PVC pipes during storage.

3.3 BEDDING

- A. Excavate trench, pit or hole in accordance with Section 31 2316 for work of this Section.
- B. Where trench or pit has been over-excavated, place bedding material at bottom of excavations, level soil materials in continuous layers not exceeding 8 inches uncompacted depth.
- C. Backfill around sides and to a level one foot above the top of pipe with bedding soil, tamped in place.
- D. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 INSTALLATION - PIPE AND FITTINGS

- A. Install pipe at locations and depths indicated on plans.
- B. Install pipe, fittings, and associated materials in accordance with manufacturer recommendations.
- C. Route pipe in straight line, whenever possible. All changes in direction of pipes shall be made with fittings, not by bending.
- D. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- E. Form and place concrete for thrust blocks at each elbow, tee, angle or other significant change of direction in loose-joint pipe, per detail on plans.
- F. Establish elevations of buried piping to ensure not less than 24 inches of cover, except at connections to existing lines, which may be shallower or deeper, or where shown otherwise on plans.
- G. Then when two water pipes are to be installed in same trench, maintain 4-inch horizontal clearance between pipes. When both water pipe and sewer pipe are to be installed in same trench, maintain a maximum of 12 inches vertical and horizontal separation per UPC requirements.

- H. Backfill trench or other excavation in accordance with Section 31 2316.
- I. Install continuous warning tape during backfilling of trench for water piping. In paved areas, locate at top of sub-grade directly above piping. In all other areas, locate tape 8" below final finish grade.

3.5 INSTALLATION - VALVES

- A. Set valves on solid bearing.
- B. Where valves are installed below finish surface grade, center and plumb valve box and any necessary extensions over valve. Set box cover flush with finished grade.
- C. Pour concrete collar around top of valve box per detail on plans.
- D. Furnish and install valves and valve boxes in addition to those shown on plans as required for isolation of lines for construction and disinfection, while minimizing disruption of service to buildings, at no additional cost to Owner.

3.6 INSTALLATION - THREADED CONNECTIONS

- A. Assemble all plastic and galvanized steel threaded pipe and fittings using an approved teflon tape applied to the male threads only. A minimum of two (2) wraps and a maximum of three (3) wraps of an approved teflon tape will be required.
- B. At all plastic (PVC) pipe connections, work the ductile iron connections first. Connections shall always be plastic into steel, never steel into plastic.
- C. A non-hardening sealant and lubricant similar to Permatex #51 or LASCO blue pipe sealant may be used in lieu of teflon tape. Apply sealant to clean male threads brushing into grooves and to the first three threads of the female threads.

3.7 WATER VALVE AND VALVE BOX

- A. Adjust any and all existing water valves and valve boxes required to finish grade per detail drawings.

3.8 THRUST BLOCK

- A. Construct thrust block as required by local jurisdiction and as appropriate for soils indicated in the geotechnical report.
- B. Use 2500-psi concrete per specification Section 32 1313, Section 2.4.

3.9 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Disinfect all new and modified domestic water piping systems in accordance with Section 33 1300.

3.10 SALVAGE OF MATERIALS

- A. Salvage and deliver to location specified by Owner all materials desired by Owner. Dispose of all materials not desired by Owner.

3.11 FIELD QUALITY CONTROL

- A. Field inspection will be performed under provisions of Section 01 4000.
- B. Compaction testing will be performed in accordance with ANSI/ASTM D1557.
- C. If compaction tests indicate Work does not meet specified requirements, recompact and retest at no additional cost to Owner.
- D. If tests indicate that Work does not meet specified requirements, remove work, replace and retest at no additional cost to Owner.

END OF SECTION

SECTION 33 1113

RECLAIMED SITE WATER SYSTEMS

(BID RFI on Bid Package 2)

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pipe and fittings for reclaimed water piping.
- B. Valves and valve boxes.
- C. Accessories.
- D. Backflow preventors/pressure reducers.

1.2 RELATED SECTIONS

- A. Section 31 2316 – Trench excavation and backfilling.

1.3 REFERENCES

- A. All offsite and onsite recycled water facilities must conform to the requirements of the Design Guidelines for Distribution of Nonpotable Water developed by the AWWA California-Nevada Section, and the DHS' Guidelines for Use of Recycled Water. Any recycled-water improvements must also comply with the requirements, conditions, and standards set forth in the current edition of the Standard Specifications for the City of Pleasanton Public Works Construction, the Standard Drawings for the City of Pleasanton and the Rules and Regulations for the Reclaimed Water Use and Distribution within City of Pleasanton, and the latest edition of the City's Reclaimed Water Program Manual and other related design standards and construction specification guidelines.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 3000 - Submittals.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01 7800.
- B. Accurately record actual locations of piping mains, valves, connections, and appurtenances.
- C. Identify and describe discovery of uncharted utilities, or utilities found at locations different than indicated on plans.

1.6 QUALITY ASSURANCE

- A. Perform work in accordance with product manufacturer's recommendations and these Contract Documents.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Comply with corrosion protection recommendations by Corrosion Consultant.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle all products required.

1.8 COORDINATION

- A. Coordinate the work with the connection to domestic water service line and trenching.
- B. Coordinate any cutting and patching required for the Work of this Section with the Work of other trades.

PART 2 - PRODUCTS

2.1 RECLAIMED WATER PIPE

- A. Purple (Pantone 522) colored pipe with the words; CAUTION: RECYCLED WATER DO NOT DRINK, embossed or integrally stamped or marked on the pipe every three feet. PVC Pipe (for pipe 3" and smaller, underground): ASTM D1785, Schedule 40; 1120 hig impact.
 - 1. Fittings: ANSI/ASTM D2464, Schedule 80 PVC (Schedule 40 PVC for pipes 1 ½ inches and smaller).
 - 2. Joints: ASTM D2855, solvent weld.

2.2 GATE VALVES - Up to 3 Inches (75 mm)

- A. Use ball valves for 1-1/2" and smaller and gates valves for 2" and larger size.
- B. Brass or Bronze body, non-rising stem, inside screw, single wedge or disc, IPS ends.

2.3 GATE VALVES - 3 Inches (75 mm) and Over

- A. ANSI/AWWA C500, Iron body, bronze trim, non-rising stem with square nut or control handle wheel, single wedge, threaded or flanged.

2.4 VALVE BOXES

- A. Precast Reinforced Concrete traffic rated. Cast iron lid marked "RECLAIMED WATER" for service. Old Castle G5 appropriately sized or approved equal.

2.5 BACKFLOW PREVENTORS/PRESSURE REDUCER ASSEMBLIES

- A. Backflow preventors/pressure reducer assemblies shall be as shown on the construction plans, and of type specified and approved by applicable agency having jurisdiction of these devices.

2.7 ACCESSORIES

- A. Concrete for Thrust Blocks and Valve Box Surface Collars: Concrete type specified in Section 32 1313.
- B. Valve Boxes and Covers: Old Castle No. G5 appropriately sized traffic-rated traffic box with cast iron lid, or approved equal. Cover marking shall read "Water". A one piece PVC riser extension shall be provided as necessary to allow unobstructed access to valve operating nut.
- C. Solvent Cement and Primer for PVC Pipe and Fittings: Per ASTM F656 and ASTM D2564.
- D. Pipe Identification: Plastic Underground Warning Tapes: Polyethylene plastic tape 6 inches wide by 4 mills thick, solid purple in color, with continuous printed caption in black letters "CAUTION -RECLAIMED WATER LINE BURIED BELOW". Use metallic lined plastic underground warning tape for non-metallic water pipes.
- E. Mechanical Joint Restraints:
 - a. Conforming to ANSI/AWWA C111/A21.11 or ANSI/AWWA C153/A21.53
 - b. Ductile iron castings shall conform to ASTM A-536 Standard.
 - c. Bolts, nuts, washers and rods shall be Type 316 Stainless Steel.
 - d. Pressure rating of greater than or equal to the associated pipe, but no less than 150 psi.
 - e. Metallic portion shall have a factory-applied fusion epoxy coating per AWWA C213.
 - f. Entire restraining device, including associated adjacent fittings and valves shall be cathodically protected per Corrosion Consultant's recommendations.
 - g. Megalug Series 2000PV by EBBA IRON; or approved equal for PVC pipe. Mechanical joint restraints at pipe fittings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions. All plot dimensions are approximate. Before proceeding with any work, carefully check and verify all dimensions and report any variations to the Inspector.
- B. Due to the scale of the drawings, it is not possible to indicate all offsets, fittings, etc., which may be required. Carefully investigate the structural and finished conditions affecting all work, and plan 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 in the most direct and workmanlike manner, so that conflicts between water systems, planting, and architectural features will be minimized.
- C. Do not install the facilities as indicated on the drawings when it is obvious in the field that unknown obstructions might not have been considered in the engineering. Such obstructions or differences should be brought to the attention of the Inspector.

3.2 PREPARATION

- A. Prepare for pipe installation by assembling all needed materials.
- B. Cover all PVC pipes during storage.

3.3 BEDDING

- A. Excavate trench, pit or hole in accordance with Section 31 2316 for work of this Section.
- B. Where trench or pit has been over-excavated, place bedding material at bottom of excavations,

level soil materials in continuous layers not exceeding 8 inches uncompacted depth.

- C. Backfill around sides and to a level one foot above the top of pipe with bedding soil, tamped in place.
- D. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 INSTALLATION - PIPE AND FITTINGS

- A. Install pipe at locations and depths indicated on plans.
- B. Install pipe, fittings, and associated materials in accordance with manufacturer recommendations.
- C. Route pipe in straight line, whenever possible. All changes in direction of pipes shall be made with fittings, not by bending.
- D. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- E. Form and place concrete for thrust blocks at each elbow, tee, angle or other significant change of direction in loose-joint pipe, per detail on plans.
- F. Establish elevations of buried piping to ensure not less than 24 inches of cover, except at connections to existing lines, which may be shallower or deeper, or where shown otherwise on plans.
- G. Where potable and recycled water lines cross, the potable service must be no less than 1 foot above the recycled service.
- H. Backfill trench or other excavation in accordance with Section 31 2316.
- I. Install continuous warning tape during backfilling of trench for water piping. In paved areas, locate at top of sub-grade directly above piping. In all other areas, locate tape 8" below final finish grade.

3.5 INSTALLATION - VALVES

- A. Set valves on solid bearing.
- B. Where valves are installed below finish surface grade, center and plumb valve box and any necessary extensions over valve. Set box cover flush with finished grade.
- C. Pour concrete collar around top of valve box per detail on plans.
- D. Furnish and install valves and valve boxes in addition to those shown on plans as required for isolation of lines for construction and disinfection, while minimizing disruption of service to buildings, at no additional cost to Owner.

3.6 INSTALLATION - THREADED CONNECTIONS

- A. Assemble all plastic and galvanized steel threaded pipe and fittings using an approved teflon tape applied to the male threads only. A minimum of two (2) wraps and a maximum of three (3) wraps of an approved teflon tape will be required.

- B. At all plastic (PVC) pipe connections, work the ductile iron connections first. Connections shall always be plastic into steel, never steel into plastic.
- C. A non-hardening sealant and lubricant similar to Permatex #51 or LASCO blue pipe sealant may be used in lieu of teflon tape. Apply sealant to clean male threads brushing into grooves and to the first three threads of the female threads.

3.7 WATER VALVE AND VALVE BOX

- A. Adjust any and all existing water valves and valve boxes required to finish grade per detail drawings.

3.8 THRUST BLOCK

- A. Construct thrust block as required by local jurisdiction and as appropriate for soils indicated in the geotechnical report.
- B. Use minimum 2500-psi concrete per specification Section 32 1313, Section 2.4.

3.9 SALVAGE OF MATERIALS

- A. Salvage and deliver to location specified by Owner all materials desired by Owner. Dispose of all materials not desired by Owner.

3.11 FIELD QUALITY CONTROL

- A. Field inspection will be performed under provisions of Section 01 4000.
- B. Compaction testing will be performed in accordance with ANSI/ASTM D1557.
- C. If compaction tests indicate Work does not meet specified requirements, recompact and retest at no additional cost to Owner.
- D. If tests indicate that Work does not meet specified requirements, remove work, replace and retest at no additional cost to Owner.

END OF SECTION

SECTION 33 1300

DISINFECTION OF POTABLE WATER SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Disinfection of potable water distribution system.
- B. Pressure testing of water system.
- C. Testing and reporting results.

1.2 RELATED SECTIONS

- A. Section 33 1110 – Domestic Site Water Systems.

1.3 REFERENCES

- A. ANSI/AWWA B300 - Standard for Hypochlorites.
- B. ANSI/AWWA B301 - Standard for Liquid Chlorine.
- C. ANSI/AWWA B303 - Standard for Sodium Chlorite.
- D. ANSI/AWWA C601 and C651 - Standards for Disinfecting Water Mains.

1.4 SUBMITTALS

- A. Test Reports: Indicate results comparative to specified requirements.
- B. Certificate: Certify that cleanliness of water distribution system meets or exceeds the following requirement: Coliform M.P.N./100 ML water is 1.1 or less.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01 7800.
- B. Disinfection report; record:
 - 1. Type and form of disinfectant used.
 - 2. Date and time of disinfectant injection start and time of completion.
 - 3. Test locations.
 - 4. Initial and 24 hour disinfectant residuals (quantity in treated water) in PPM for each outlet tested.
 - 5. Date and time of flushing start and completion.
 - 6. Disinfectant residual after flushing in PPM for each outlet tested.
- C. Bacteriological report; record:
 - 1. Date issued, project name, and testing laboratory name, address, and telephone number.
 - 2. Time and date of water sample collection.
 - 3. Name of person collecting samples.

4. Test locations.
5. Coliform bacteria test results for each outlet tested.
6. Certification that water conforms, or fails to conform, to bacterial standards of Section 02675/1.4B.
7. Bacteriologist's signature and authority.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with ANSI/AWWA C651.

1.7 QUALIFICATIONS

- A. Water Treatment Firm: Company experienced in disinfecting potable water systems specified in this Section with minimum three years experience.
- B. Testing Laboratory: Laboratory qualified in testing potable water, certified by the State of California.

1.8 REGULATORY REQUIREMENTS

- A. Conform to applicable codes and regulations for performing the work of this Section.

PART 2 - PRODUCTS

2.1 DISINFECTION CHEMICALS

- A. Chemicals: ANSI/AWWA B300, Hypochlorite, ANSI/AWWA B301, Liquid Chlorine, and ANSI/AWWA B303, Sodium Chlorite.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that piping system and appurtenances has been cleaned and inspected.
- B. Schedule disinfection activity to occur prior to pressure testing and pressurizing of installed system.

3.2 PREPARATION

- A. Limit contaminated materials from entering water piping and appurtenances during construction.
- B. Remove, by initial flushing with potable water, contaminated materials, which may have entered the system during construction.
- C. Provide sufficient number of suitable outlets to permit flushing of facilities at a velocity of at least 5.5 feet per second, to permit the obtaining of bacteriologic test samples, and to permit pressure testing.
- D. Outlets provided shall be in addition to these which may be shown on the plans, and shall conform to Section 33 1110: Domestic Site Water Systems.

- E. Provide sufficient number of valves (complete with valve boxes), as necessary, to isolate system for flushing, pressure testing and disinfection purposes.
- F. Valves and valve boxes shall be in addition to those shown on the plans, and shall conform to Section 33 1110: Domestic Site Water Systems.
- G. Provide drainage so that waters facilities cannot be contaminated by flushing outlets.
- H. Provide required equipment and facilities to perform the work of disinfection.

3.3 EXECUTION

- A. Water System, Pipelines, Pumps, Valves and Fittings.
 - 1. Disinfect at each water system improvement location where connection and/or alteration are made to the existing potable water system located downstream.
 - 2. Disinfect after initial flushing and prior to allowing the system at such location to be pressurized.
 - 3. Introduce chlorine gas or chlorine compound solution made with liquid chlorine, calcium hypochlorite in solution or sodium hypochlorite solution mixed with water into the water piping and appurtenances to form a chlorine concentration of approximately 100 parts per million (PPM), or that which will provide a minimum residual of 50 PPM in all parts of the water piping and appurtenances after 24 hours have elapsed.
 - 4. The placing of HTH capsules or tablets in pipe sections during the laying process will be considered an acceptable method of introducing chlorine for the test.
 - 5. During the sterilization period, all valves (except those isolating the system being disinfected) and other accessories shall be operated.
 - 6. After a minimum of 24 hours have elapsed since introduction of the chlorine, flush treated water from the water piping and appurtenances using potable water.
 - 7. After a minimum of 48 hours after flushing per Section Paragraph 3.3A6, have bacteriologic samples of water from the piping and appurtenances to be tested extracted from the system by testing laboratory.
 - 8. Have bacteriologic tests performed by testing laboratory per Section Paragraph 1.7.
 - 9. If the bacteriologic tests show a coliform M.P.N./100 ML water of 1.1 or less on all samples at a particular installation site, the water facilities tested will be considered clear.
 - 10. In the event the coliform number is above 1.1, the sterilization and testing procedure shall be repeated until the required standard is reached.
 - 11. Pressure test system to a hydrostatic pressure of 100 pounds per square inch gauge only after bacteriologic tests have passed, for each construction location. Maintain pressure test for 90 minutes. Pressure tests shall be performed in the presence of the health department or other applicable governing agency, and witnessed by a representative of the architect.
 - 12. Repair any leaks detected by hydrostatic pressure test and repeat disinfection and testing process.
 - 13. All costs of disinfection, bacteriologic testing and reporting, and pressure testing shall be borne by the Contractor, and including all additional outlets, valves and valve boxes necessary to accomplish the work.

3.4 QUALITY CONTROL

- A. Provide testing and reports under provisions of Paragraph 1.5 and Section 01 4000.

END OF SECTION

SECTION 33 3100

SITE SANITARY SEWER SYSTEMS

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install site sanitary sewer collection systems and associated accessory items as shown on the Drawings and as specified herein. Items include, but are not necessarily limited to, the following:
 - 1. Manholes.
 - 2. Sanitary Sewer pipe, fittings and appurtenances.
 - 3. Cleanouts.

1.2 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies
 - 1. Safety Regulations: Work shall comply with all Federal, State and Municipal regulations regarding safety, including the requirements of the following:
 - a. William-Steiger Occupational Safety & Health Act of 1970.
 - b. State of California, California Administrative Code, Title 8 Industrial Relations, Chapter 4, Subchapter 4, "Construction of Safety Orders" and other State and local agencies having jurisdiction.
 - c. All trenching work shall conform to Trench Construction Safety Orders of California State Industrial Accident Commission.
 - d. Retain the services of a Civil Engineer or Surveyor, licensed in the State of California, for pipe construction staking for location and grade, and as-built survey.

1.3 REFERENCES

- A. American Water Works Association (AWWA).
- B. American Society for Testing and Materials (ASTM):
 - 1. Designation D3034 - Polyvinyl Chloride (PVC) pipe.
 - 2. ASTM A74 - Cast Iron Soil Pipe and Fittings.
 - 3. 2001 Edition of the California Uniform Plumbing Code.
 - 4. Geotechnical Engineering Investigation prepared by TRC, Inc., for Roche Molecular Diagnostics, 4300 Hacienda Dr., Pleasanton, CA, 94566, Bldg 730, Report # 234269, July 13, 2015, and any subsequent addenda.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 3000.
- B. Submit manufacturer's data and/or fabrication drawings for all pipes, and appurtenances installed under this Section. No items shall be incorporated into the work until the Architect approves submittals.

1.5 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of pipe runs, connections, Cleanouts, manholes and invert elevations.

1.6 PROJECT CONDITIONS

- A. Comply with safety orders in effect at the construction site. Protect adjacent properties from damage.
- B. Protect open excavations and trenches with fences, covers or railings as required to maintain safe pedestrian and vehicular traffic.
- C. Verify that field measurements and elevations are as indicated.
- D. Comply with corrosion protection recommendations by corrosion consultant.

1.7 COORDINATION

- A. Coordinate the work with termination of sanitary sewer connection five feet outside the face of the building, and/or downstream end of settlement vault or flexible connection provided by the building plumbing consultant, and connection to on-site or off-site sanitary sewer service and trenching.
- B. Coordinate any cutting or patching required of the Work of this Section with the Work of the other trades.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Cleanout Boxes shall be heavy duty traffic-rated precast reinforced concrete with cast iron lid labeled "Sanitary", Old Castle "G" series of appropriate size, or approved equal.
- B. Site sanitary sewer pipelines shall be Polyvinyl Chloride (PVC) pipe for sanitary sewers conforming to ASTM Designation: D3034, SDR26 for 4" and larger.
- C. Cast Iron Pipe: ASTM A74; service type; bell and spigot end joints with ASTM C564 rubber gasket joint devices.
- D. Plastic Underground Warning Tapes: Use polyethylene plastic tape 6 inch wide by 4 mills thick, solid green in color with continuous printed caption in black letters "CAUTION - SANITARY SEWER LINE BURIED BELOW" for metallic piping. Use metallic-lined underground warning tape of same description for plastic piping.

E. PRECAST CONCRETE MANHOLES

- 1. Bases: Manhole bases shall be constructed on undisturbed native soil, if cast in place. Manhole bases may be precast or cast-in-place. If precast, they shall be placed on a minimum of 4 inches of crushed rock of 3/4 inch maximum size. Elevation differentials of inlets and outlets must conform to the plans. Channelization shall conform to the detail on the Drawings. Stubs or couplings provided in precast bases shall be of the same material as the pipe to which they connect unless otherwise approved by the Architect. Connection may be made using a resilient connector conforming to ASTM Standard C923 such as Kor-N-Seal, A-LOK or equal.
- 2. Cones: Standard concentric cones conforming to ASTM Designation: C478 shall be used on all manholes shown on the plans unless otherwise specified. Where

- depth is insufficient for cones, flat slab tops shall be used. Lifting holes in precast cones and grade rings shall be plugged with dry-packed mortar.
3. Joints: Joints in precast manhole shafts shall be made by buttering the joint space previously laid with mortar, or shall be made with preformed plastic sealing gaskets conforming to Federal Specifications SS-S-00210 and installed as recommended by the manufacturer. All joint surfaces shall be thoroughly cleaned prior to placing the sealing compound or buttering with mortar. Both the inside and outside of mortared joints shall be plastered with mortar and the inside brushed to a smooth finish with a wet brush. Special precautions shall be taken to see that the entire joint space is filled with mortar and is watertight.
 4. Frames and Covers: Manhole frames and covers shall be H20 traffic-rated, and of the type and size shown on the Drawings. Frames and covers shall be set flush with the finished grade unless otherwise herein specified or otherwise stated on the Drawings.
 5. Manhole sections shall be manufactured with provisions for steps of the type and size shown on the plans.

PART 3 – EXECUTION

3.1 TRENCH EXCAVATION

- A. Trench excavation and backfilling shall be in accordance with Section 31 2316, "Trench Excavation".

3.2 PIPE INSTALLATION

- A. Pipe Laying: Sewer pipe shall be laid in strict conformity to the prescribed line and grade, with grade bars set and each pipe length checked to the grade line. Three consecutive points on the same rate of slope shall be used at all times to detect any variation from a straight grade. In case any discrepancy exists, the work shall be stopped and the discrepancy immediately reported to the Architect. In addition, when requested by the Architect, a string line shall be used in the bottom of the trench to insure a straight alignment of the sewer pipe between manholes. The elevation of the pipe invert shall not deviate from the design elevation by more than +2 percent of the pipe size concerned, or 1-inch, whichever is greater. The rate of deviation from grade or returning to grade shall be limited to 1/16 inch per foot of pipe.
- B. Pipe laying shall proceed upgrade with the bell ends of bell and spigot pipe placed upstream. Each section of pipe shall be laid to line and grade as herein specified and in such a manner as to form a watertight, concentric joint with the adjoining pipe. The interior of the pipe shall be cleared of all dirt and debris and excess joint sealing material as the work progresses. Pipe shall not be laid when the condition of the trench or weather is unsuitable. All open ends of pipe and fittings shall be adequately and securely closed whenever the work is discontinued for more than one-half hour. If pipe with elliptical or quadrant reinforcement is used, care shall be taken to properly orient the axis. All pipes sloped at 1% or less, shall be staked by a licensed California Civil Engineer or Land Surveyor.
- C. Install continuous warning tape during backfilling of trench for sanitary sewer piping. In areas to be paved, locate tape at top of sub-grade. In all other areas, locate 8 inches below final finish grade.
- D. All joint surfaces shall be cleaned before joints are made.

- E. Sewer Systems Plugs: Temporary plugs of rubber, brick, or mortar shall be installed on all sewer projects at points of connection to existing facilities. These plugs shall remain in place until completion of the balling and flushing operation. The plugs, intended to prevent water from the balling and flushing operation, drainage, or any other condition from entering the existing system, shall be installed or removed in the presence of and under the direct supervision of the Engineer. Until the system has been pumped clear of accumulated water, the plugs shall not be removed. This water must not be allowed to enter adjacent sewer or drainage systems.
- F. Internal Inspection: Upon completion of construction and prior to final inspection, the Contractor shall clean the entire new pipeline of all dirt and debris. The Contractor shall also remove any dirt or debris in previously existing pipes or ditches in the area, which in the opinion of the Architect/Engineer/Owner, resulted from the new installation. Sewer pipes shall be cleaned by the controlled balling method. Temporary plugs shall be installed and maintained during cleaning operations at points of connection to existing facilities to prevent water, dirt, and debris from entering the existing facility. Temporary plugs for sewer systems shall also conform to Subsection B, above. Water from the drainage system operations shall be routed through a suitable trap to collect any dirt and debris prior to discharging into any downstream facility. The Contractor shall notify the Architect/Engineer immediately after completion of the pipe cleaning operations.
- G. No piping to be laid closer than 2 feet to building foundation or footings for other structures
- H. As soon as possible after the completion of the pipe cleaning, and prior to final acceptance, the Architect or Engineer may make a visual internal inspection of the new pipeline manually or with television equipment.

3.3 CLEANOUTS

- A. Install Cleanouts at end of lines, at changes of direction greater than 45 degrees, and at spacing not greater than 100 foot intervals. Locate Cleanouts in accessible locations and set flush with finished surface.

3.4 TESTING OF SANITARY SEWERS

- A. After cleaning per Section 3-02 C, each section of sewer constructed shall be tested in accordance with the following procedure:
 - 1. The Contractor may desire to make an air test prior to backfilling for his/her own purposes. However, the acceptance of the air test shall be made after backfilling and compaction has been completed to finish grade.
 - 2. The Contractor shall furnish all facilities and personnel for conducting the test under the observation of the Engineer. The equipment and personnel shall be subject to the approval of the Engineer. The pressure gauge used shall have minimum division of 0.10 psi and have an accuracy of 0.0625 psi (one ounce per square inch). All air used shall pass through a single control panel.
 - 3. The first section of pipe not less than 300 feet in length installed by each crew shall be tested in order to qualify the crew and/or material. Successful installation of this section shall be prerequisite to further pipe installation by said crew.
 - 4. All tees, and/or ends of side sewer stubs shall be plugged and banded, or acceptable alternate and securely fastened to withstand the internal test pressures. The Contractor shall clean the line before proceeding with the air test. All debris

shall be removed at the first manhole where its presence is noted. In the event cemented or wedged debris or a damaged pipe shall prevent cleaning, the contractor shall remove the obstruction.

5. Safety Provisions: The plugs must be firmly secured and care should be exercised in their removal. The total force on a 12" plug at 4.0 psi is over 450 pounds. Care must be exercised in not loading the sewer line with the full pressure of the compressor. Keep all personnel out of manholes until the pressure has been released. If water leaks into the line after the plugs are installed and floods the air inlet and the needle on the air pressure gage indicates zero, then possibly the water column has balanced the air pressure in this instance and care is necessary in releasing the pressure. If testing below ground water level, inject the air at the upper plug and/or turn the inlet up as with a water test apparatus.
6. The pipe or sections of pipe to be tested may be wetted before the air test is started. Immediately following the pipe cleaning and wetting, the pipe shall be tested with low pressure air. Air shall be slowly supplied to the plugged pipe installation until the internal air pressure reaches 4.0 pounds per square inch greater than the average back pressure of any ground water that may submerge the pipe.
7. At least two minutes shall be allowed for temperature stabilization before proceeding further. After the two minutes temperature stabilization period, disconnect the air supply.
8. The pipeline shall be considered acceptable, when tested for the calculated period of time at an average pressure of 4.0 pounds per square inch greater than the average back pressure of any ground water that may submerge the pipe; if: (1) the total rate of air loss from any section tested in its entirety between manhole and cleanout structures does not exceed 2.0 cubic feet per minute, or (2) the section under test does not lose air at a rate greater than 0.0030 cubic feet per minute per square foot of internal pipe surface.
9. If the Pipe installation fails to meet these requirements, the Contractor shall determine at his/her own expense the source or sources of leakage, and he shall repair or replace all defective materials and correct all faulty workmanship. The type of repairs proposed by the Contractor must be approved by the Engineer before the repair work is begun. The completed pipe installation shall meet the requirements of the air test before being considered acceptable.

3.5 ADJUSTMENT

- A. Adjustment of any existing sanitary sewer manhole or cleanout covers to proposed finish grade shall be to the proposed elevations shown on the utility plan. All work to be in accordance with the current edition of the Standard Plans for Public Works Construction, "Green Book," Section 2, 205-1, Sewer Manhole Adjustment.

3.6 CLEAN-UP

- A. Remove from the site all rubbish, debris, etc. resulting from Work in this Section. The clean up shall include the replacement and repair of any damaged or disturbed property.

3.7 FIELD QUALITY CONTROL

- A. Notify Geotechnical Engineer 48 hours in advance of backfilling to permit observation and testing of the placement and compaction of backfill. The cost for observation and initial testing will be borne by the Owner.
- B. Compaction testing will be performed in accordance with ANSI/ASTM D1557.

- C. If tests indicate Work does not meet specified requirements, remove Work, replace and retest, at no additional cost to owner.

END OF SECTION

SECTION 33 4000

STORMWATER POLLUTION PREVENTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. The goal of these requirements is to prevent the pollution of storm water runoff on construction projects by keeping pollution out of storm drains, reducing the exposure and discharge of materials and wastes to storm water, and by reducing erosion and sedimentation. Storm drains discharge runoff directly to municipal storm drains and local waters without treatment.

1.02 RELATED SECTIONS

- A. Section 01 5000: Temporary Facility and Controls
- B. Section 01 7419: Construction and Demolition Waste Management
- C. Section 31 1000: Clearing at Work Site
- D. Requirements of the Contract Documents
- E. Storm Water Pollution Prevention Report (SWPPP) for this Project.

1.03 GENERAL REQUIREMENTS

- A. The following general requirements shall be met on this project.
 - 1. Non-hazardous Material/Waste Management
 - a. Designated Area: The Contractor shall propose designated areas of the project site, for approval by the Owner's Representative, suitable for material delivery, storage, and waste collection that, to the maximum extent practicable, are near construction entrances and away from catch basins, gutters, drainage courses, and creeks.
 - b. Granular Material:
 - 1) The Contractor shall store granular material at least ten feet away from catch basin and curb returns.
 - 2) The Contractor shall not allow granular material to enter the storm drains or creeks.
 - 3) When rain is forecast within 24 hours or during wet weather, the Contractor will be required to cover granular material with a tarpaulin weighted or anchored in place, and to surround the material along the base with fiber rolls or silt fencing.
 - c. Dust Control: The Contractor shall use reclaimed water to control dust on a daily basis or as directed by the Owner's Representative.
 - d. Cleaning Paved Storage Areas: The Contractor shall thoroughly clean all on-site paved areas used for storage of materials or otherwise utilized or involved during the work immediately after the materials are removed from storage. Cleaning shall be accomplished by sweeping or vacuum and not with use of water.

- e. Recycling:
 - 1) The Contractor, to the extent practicable, shall recycle aggregate base material, asphalt concrete, and Portland cement concrete as described in these Specifications.
 - 2) In addition, to the maximum extent practicable, the Contractor shall reuse or recycle any useful construction materials generated during the project.
 - f. Disposal:
 - 1) The Contractor shall maintain the project site in a clean and orderly manner at all times. To the extent practicable, the Contractor shall collect all scrap, debris, and waste material, and dispose of such materials properly. The Owner's Representative may require the Contractor to clean and dispose of such materials at any time should the situation, in his opinion, constitute a danger.
 - 2) The Contractor shall inspect dumpsters for leaks and contact trash hauling contractors to replace or repair dumpsters that leak.
 - 3) The Contractor shall not discharge water on-site from cleaning dumpsters.
 - 4) The Contractor shall arrange for regular waste collection before dumpsters overflow.
2. Hazardous Material/Waste Management
- a. Storage:
 - 1) The Contractor shall label and store all hazardous materials, such as pesticides, paints, thinners, solvents, and fuels; and all hazardous wastes, such as waste oil and antifreeze; in accordance with the local County and/or other local applicable agencies, Hazardous Materials Storage Ordinances and all applicable State and Federal regulations.
 - 2) The Contractor shall store all hazardous materials and all hazardous wastes in accordance with secondary containment regulations, and it is recommended that these materials and wastes be covered, as needed, to avoid potential management of collected rainwater as a hazardous waste.
 - 3) The Contractor shall keep an accurate, up-to-date inventory, including Material Safety Data Sheets (MSDS), of hazardous materials and hazardous wastes stored on-site, to assist emergency response personnel in the event of a hazardous materials incident.
 - b. Usage:
 - 1) When rain is forecast within 24 hours or during wet weather, the Contractor should avoid applying chemicals in outside areas.
 - 2) The Contractor shall not over-apply pesticides or fertilizers and shall follow material manufacturer's instructions regarding uses, protective equipment ventilation, flammability, and mixing of chemicals. Over-application of a pesticide constitutes a "label violation" subject to an enforcement action by the local County Agriculture Department.
 - c. Disposal:
 - 1) The Contractor shall arrange for regular hazardous waste collection to comply with time limits on storage of hazardous wastes.
 - 2) The Contractor shall dispose of hazardous waste only at authorized and permitted Treatment, Storage, and Disposal Facilities, and use only licensed hazardous waste haulers to remove the waste off-site, unless quantities to be transported are below applicable threshold limits for transportation specified in State and Federal regulations.
 - 3) If the Contractor qualifies as a "Conditionally Exempt Small Quantity Generator" as defined under State and Federal regulation and if the Contractor's business office is located in East Palo Alto, Los Altos, Los Altos Hills, Mountain View, Palo Alto, or Stanford, then the Contractor may dispose of this waste through a city-sponsored program. Information this program may be requested by calling (415) 496-6980.

3. Spill Prevention and Control:
 - a. The Contractor shall keep a stockpile of spill cleanup materials, such as rags, or absorbents, readily accessible on-site.
 - b. The Contractor shall immediately contain and prevent leaks and spills from entering storm drains, and properly clean up and dispose of the waste and cleanup materials. If the waste is hazardous, the Contractor shall handle the waste as described in section A.2.c above.
 - c. The Contractor shall not wash any spilled material into streets, gutters, storm drains, or creeks and shall not bury spilled hazardous materials.
 - d. The Contractor shall report any hazardous materials spill to the local County Department of Environmental Health, and to the Owner's Representative.
4. Vehicle/Equipment Cleaning:
 - a. The Contractor shall not perform vehicle or equipment cleaning on-site or in the street using soaps, solvents, degreasers, steam cleaning equipment, or equivalent methods.
 - b. The Contractor shall perform vehicle or equipment cleaning, with water only, in a designated, beamed area that will not allow rinse water to run off-site or into streets, gutters, storm drains, or creeks.
5. Vehicle/Equipment Maintenance and Fueling:
 - a. The Contractor shall perform maintenance and fueling of vehicles or equipment in a designated, bermed area or over a drip pan that will not allow run-on of storm water or runoff of spills.
 - b. The Contractor shall use secondary containment such as a drip pan, to catch leaks or spills any time that vehicle or equipment fluids are dispensed, changed, or poured.
 - c. The Contractor shall keep a stockpile of spill cleanup materials, such as rags or absorbents, readily accessible on-site.
 - d. The Contractor shall clean up leaks and spills of vehicle or equipment fluids immediately and dispose of the waste and cleanup materials as hazardous waste, as described in section A.2.c above.
 - e. The Contractor shall not wash any spilled material into streets, gutters, storm drains, or creeks and shall not bury spilled hazardous materials.
 - f. The Contractor shall report any hazardous materials spill to the local County Department of Environmental Health (408) 299-6930 and to the Owner's Representative.
 - g. The Contractor shall inspect vehicles and equipment arriving on-site for leaking fluids and shall promptly repair leaking vehicles and equipment. Drip pans shall be used to catch leaks until repairs are made.
 - h. The Contractor shall recycle waste oil and antifreeze, to the maximum extent practicable.
 - i. The Contractor shall comply with Federal, State, and City requirements for above ground storage tanks.
6. Contractors Training and Awareness:
 - a. The Contractor shall train all employees/subcontractors on the Storm Water Pollution Prevention requirements contained in these Specifications.
 - b. The Contractor shall inform subcontractors of the storm water pollution prevention contract requirements and include appropriate subcontract provisions to ensure that these requirements are met.
 - c. The Contractor shall post warning signs in areas treated with chemicals.
 - d. The Contractor shall paint new catch basins, constructed as part of the project with a "No Dumping Drains to Bay" stencil.

1.04 ACTIVITY-SPECIFIC REQUIREMENTS

- A. The following activity-specific requirements shall be met on this project, and include the listed activities.
1. Paving Operations:
 - a. Project Site Management:
 - 1) When rain is forecast within 24 hours or during wet weather, the Owner's Representative may prevent the Contractor from paving.
 - 2) The Owner's Representative may direct the Contractor to protect drainage courses by using control measures, such as earth dike, silt fencing, fiber tubes, and sand bags to divert runoff or trap and filter sediment.
 - 3) The Contractor shall cover drip pans or absorbent material under paving equipment when not in use.
 - 4) The Contractor shall cover catch basins and manholes when paving or applying seat coat, tack coat, slurry seal, or fog seal.
 - 5) If the paving operation includes an on-site mixing plant, the Contractor shall comply with local County General Construction Activities Storm Water Permit requirements.
 - b. Paving Waste Management: The Contractor shall not sweep or wash down excess sand (placed as part of a sand seal or to absorb excess oil) into gutters, storm drains, or creeks. Instead, the Contractor shall either collect the sand or return it to the stockpile, or dispose of it in a trash container. The Contractor shall not use water to wash down fresh asphalt concrete pavement.
 2. Saw Cutting:
 - a. During saw cutting, the Contractor shall cover or barricade catch basins using control measures, such as filter fabric, "Dandy-Bags, sand bags, and fine gravel dams, to keep slurry out of both the sanitary and storm drain systems. When protecting a catch basin, the Contractor shall ensure that the entire opening is covered.
 - b. The contractor shall shovel, absorb, or vacuum saw cut slurry and pick up the waste before moving to the next location or at the end of each working day, whichever is sooner.
 - c. If saw cut slurry enters catch basins, the Contractor shall remove the slurry from the storm drain system immediately.
 3. Contaminated Soil Management
 - a. The Contractor is responsible for immediately notifying the Owner's representative if toxic soils, or even suspected toxic soils are encountered on this site. Contractor is responsible for complying with all local, county, state, and federal standards and appropriate regulations for the removal, treatment, and/or disposal of such soils.
 4. Concrete, Grout and Mortar Waste Management:
 - a. Material Management: The Contractor shall store and keep covered concrete, grout and mortar away from drainage areas and ensure that these materials do not enter the storm drain system.
 - b. Concrete Truck/Equipment Wash Out:
 - 1) The Contractor shall not wash out concrete trucks or equipment into streets, gutters, storm drains, or creeks.
 - 2) The Contractor shall perform washout of concrete trucks or equipment off-site or in a designated area on-site where the water will flow into a temporary membrane-lined pit. The Contractor shall let the concrete harden and dispose of it off site. The Contractor shall remove the wash water from the pit, treat it, and dispose of it off-site.

- c. Exposed Aggregate Concrete Wash Water:
 - 1) The Contractor shall avoid creating runoff by draining water from washing of exposed aggregate concrete to a landscape area. If a suitable landscape area is not available, then the Contractor shall filter the wash water through an ACF "Dirt Bag" or similar device before discharging to the storm drain.
 - 2) The Contractor shall collect and return sweepings from exposed aggregate concrete to a stockpile or dispose of the waste in a trash container.
- 5. Painting:
 - a. Painting Cleanup
 - 1) Designated Area:
 - a) The Contractor shall conduct cleaning of painting equipment and tools in a designated area that will not allow run-off of storm water or runoff of spills.
 - b) The Contractor shall not allow wash water from cleaning of painting equipment and tools into streets, gutters, storm drains, or creeks.
 - 2) Water-based Paint:
 - a) The Contractor shall remove as much excess paint as possible from brushes, rollers, and equipment before starting cleanup.
 - b) To the maximum extent practicable, the Contractor shall dispose of wash water from aqueous cleaning of equipment and tools to the sanitary sewer.
 - c) Otherwise, the Contractor shall direct wash water onto landscape area and spade in.
 - 3) Oil-based Paint:
 - a) The Contractor shall remove as much excess paint as possible from brushes, rollers, and equipment before starting cleanup.
 - b) To the maximum extent practicable, the Contractor shall filter paint thinner and solvents for reuse.
 - c) The Contractor shall dispose of waste thinner and solvent, and sludge from cleaning of equipment and tools as hazardous waste, as described in section A2.c above.
 - b. Material/Waste Management
 - 1) The Contractor shall store paint, solvents, chemicals, and waste materials in compliance with the local County Hazardous Materials Storage Ordinances and all applicable State and Federal regulations. The Contractor shall store these materials in a designated area that will not allow run-off of storm water or spills.
 - 2) The Contractor shall dispose of excess thinners, solvents, oil and water-based paint as hazardous waste.
 - 3) The Contractor shall dispose of dry, empty paint cans, buckets, old brushes, rollers, rags, and drop cloths in the trash.
- 6. Earthwork: The Contractor shall maximize the control of erosion and sediment by using the BMPs for erosion and sedimentation in the California Storm Water Best Management Practice Handbook—Construction Activity.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

*See California Storm Water Best Management Practice Handbook - Construction Activity published by CASQA, California Stormwater Quality Association, www.cabmphandbooks.com.

END OF SECTION

SECTION 33 4100
SITE STORM SEWER SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Site storm sewerage drainage piping, fittings and accessories.
- B. Connection of building storm water drainage system including roof drains and walk-off mat drains to on-site sewers.
- C. Catch basins, trench drains, manholes, bubble-up structures, overflow structures, and landscape area drains.
- D. Perforated sub-drains, free draining rock, filter fabric and non-permeable membranes.
- E. De-watering of excavations and trenches.
- F. Flexible couplings and settlement vaults (Not required for this project.)

1.2 RELATED SECTIONS

- A. Section 02 3200 – Geotechnical Investigation.
- B. Section 02 3100 – Site Sanitary Sewer Systems
- C. Section 31 2316 – Trench excavation and backfill.
- D. Section 31 2000 – Site Earthwork

1.3 REFERENCES

- A. ANSI/ASTM D2321 - Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.
- B. ANSI/ASTM D3034 - Type PSM polyvinyl Chloride (PVC) Sewer Pipe and Fittings.
- C. California Uniform Plumbing Code.
- D. ASTM C76- Reinforced Concrete Culvert, Storm Drain & Sewer Pipe.
- E. ASTM C150 – Portland Cement.
- F. ASTM C478 – Precast Reinforced Concrete Manhole Sections.
- G. ASTM C700 – Vitrified Clay Pipe, Extra Strength, Standard Strength.
- H. ASTM D2729 – Perforated PVC Drain Pipe.
- I. AASHTO M252 & M294, ASTM F2306 – HDPE Drain Pipe
- J. State of California D.O.T. Standard Specifications, current version.

1.4 DEFINITIONS

- A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01 3000.
- B. Product Data: Provide data indicating pipe type according to ASTM designations, pipe accessories, fittings, catch basins frames and grates, and area drains.

1.6 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of pipe runs, connections, catch basins, manholes, cleanouts, and invert elevations.
- B. Identify and describe unexpected variations in subsoil conditions or discovery of uncharted utilities.

1.7 QUALITY ASSURANCE

- A. Conform to applicable codes for installation of the Work of this section.
- B. Retain the services of a Civil engineer or surveyor licensed in the State of California, for pipe construction staking for location and grade, and as-built survey.

1.8 PROJECT CONDITIONS

- A. Comply with safety orders in effect at the construction site. Protect adjacent properties from damage.
- B. Protect open excavations and trenches with fences, covers, or railings as required maintaining safe pedestrian and vehicular traffic.
- C. Verify that field measurements and elevations are as indicated.
- D. Comply with corrosion protection recommendations by Corrosion Consultant.

1.9 COORDINATION

- A. Coordinate the Work with termination of storm sewer connection five feet outside the face of the building, connection to on-site storm sewer service, and trenching.
- B. Coordinate any cutting and patching required for the Work of this Section with the work of other trades.

PART 2 - PRODUCTS

2.1 SEWER PIPE MATERIALS

- A. Reinforced Concrete Pipe: ANSI/ASTM C76, Class III, or IV, as designation on plans; bell and spigot end joints unless noted otherwise.
- B. Reinforced Concrete Pipe Joint Device: ANSI/ASTM C443, rubber compression gasket joint.
- C. Plastic Pipe and Fittings: ANSI/ASTM D3034, SDR-26, Poly Vinyl Chloride (PVC) material; bell and spigot style rubber ring sealed gasket joint; "Green-Tite" as manufactured by Johns-Manville Corp. or approved equal.
- D. High-density Polyethylene Pipe and fittings: H.D.P.E. Pipe, Hancor Sure-Lok WT pipe or approved equal, with smooth interior and annual exterior corrugations. Pipe shall meet AASHTO M252, Type S, for 4"-8" pipe and AASHTO M294, Type S for 12" to 42" pipe. Fittings shall conform to AASHTO M252, AASHTO M294, or ASTM F2306. Bell and spigot connections shall utilize a spun-on or welded bell and valley or saddle gasket meeting the watertight joint performance requirements of AASHTO M252, AASHTO M294 or ASTM F2306.
- E. Perforated plastic sub-drain pipe: Per Caltrans standard specifications, sub-surface drainage, per Section 68-1.02K, smooth wall P.V.C. plastic pipe or corrugated P.V.C. pipe with smooth interior surface.

2.2 PIPE ACCESSORIES

- A. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, wyes, cleanouts, reducers, traps and other configurations required, as described in Section 2.1.
- B. At catch basins, manholes, or similar "drainage structures, connect pipe using an "Inserta Tee" or approved equal per manufacturer's requirements.
- C. Area Drains: Area drains as specified on landscape architecture plans, P6 and P8 Dura-Drains by Kristar, or approved equal. All area drains to be equipped with bolt down galvanized steel grates for landscape areas and bolt down A.D.A. compliant closed mesh grates for paved areas, including all necessary fittings.
- D. Filter Fabric: Mirafi 140N or approved equal, in conformance with Caltrans standard specifications 6B-1.028.
- E. Plastic Underground Warning Tapes: Use metallic lined polyethylene plastic type 6" wide by 4 mills thick, solid green in color with continuous printed caption in black letters – "CAUTION – STORM SEWER BURIED BELOW".
- F. Trench Drains: Polycast 600 Series with pre-sloped system or approved equal with bolt down grates and A.D.A. compliant galvanized steel perforated grates, and all necessary fittings.
- G. Backwater Valves for Pipes: Smith, model 7070 or approved equal. See plans for size.

- H. Permeable material for sub-drains: Conforming to Caltrans Standard Specifications, per Section 68-1.025, Type A, Class 2.
- I. Waterproof liner for bioretention basins:

2.3 CATCH BASINS, MANHOLES, LANDSCAPE AREA DRAINS, BUBBLE-UP AND OVERFLOW STRUCTURES

- A. Catch Basins, Manholes, Area Drains, and Adjusting Extension Rings: Reinforced precast concrete; square minimum 4 inch thick side walls; shall conform to Sections 70-1.02H of the CDT Standard specifications and ASTM C478 and shall be of the size and shape shown on the drawings. Equivalent cast-in-place structures may be used at Contractor's option. Minimum opening-to-depth, measured from grate to invert, shall be as follows:

Opening Width or Diameter	Depth
12 inches	Less than 18 inches
24 inches	18 inches to 6 feet
36 inches	6 feet to 9 feet
48 inches	Greater than 9 feet

- B. In no case shall the width or diameter is less than 6 inches larger than the largest pipe entering the catch basin, manhole, or area drain.
- C. Provide catch basins and manholes with steel steps or rungs when the depth exceeds 3 feet unless noted otherwise on Drawings.

2.4 TRAFFIC GRATES AND DRAINS

- A. Open grates shall be welded steel grates that are hot dipped galvanized after fabrication.
- B. Grate Size: See chart in section 2.3-A.
- C. Frames: Shall be welded steel angles with drilled fasteners appropriate to connect to catch basin section. Hot dip galvanized after fabrication.
- D. Frames and grates for manholes and catch basins shall be match-marked in pairs before delivery to the job site. The grates shall fit into their frames without rocking. All grates in pedestrian accessible areas shall meet A.D.A requirements with a maximum opening of 1/2" between bars and shall be positioned in field such that the bars are perpendicular to the path of travel.
- E. Manhole covers shall have a 24" clear opening with the words "storm sewer" with letters not less than 2" high cast into the cover.

2.5 CLEANOUTS

- A. Cleanout: Threaded PVC inserts for PVC piping.
- B. Reinforced Concrete Valve Box: Traffic valve box with cast iron lid, model number to be appropriate to size of pipe, as manufactured by OldCastle Precast Concrete Products, or approved equal.

2.6 FLEXIBLE COUPLINGS

- A. Refer to Plumbing plans, specifications and details.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on Drawings.
- B. Verify locations of existing underground utilities that are to be crossed or paralleled.

3.2 PREPARATION

- A. Hand trim excavations to required elevations. Correct over excavation with fine aggregate.
- B. Remove large stones or other hard matter which could damage piping or impede consistent backfilling or compaction.
- C. Use ductile iron pipe in locations where roof drains or their laterals pass through or under building slabs or footings, or where top of pipe to finish grade is less than 18 inches.

3.3 TRENCHING

- A. Excavate subsoil required for storm sewer piping connections to municipal utilities.
- B. Cut trenches sufficiently wide to enable installation of storm sewer and allow inspection.
- C. Trenching shall not interfere with normal 45 degree bearing splay of foundations, or as required by Geotechnical Report/Engineer.
- D. Place bedding material at trench bottom; level materials in continuous layers not exceeding 8 inches compacted depth.
- E. Maintain optimum moisture content of bedding material to attain required compaction density.
- F. Dewater trenches as required to facilitate pipe installation.

3.4 INSTALLATION - PIPE

- A. Pipe Laying: Sewer pipe shall be laid in strict conformity to the prescribed line and grade, with grade bars set and each pipe length checked to the grade line. Three consecutive points on the same rate of slope shall be used at all times to detect any variation from a straight grade. In case any discrepancy exists, the work shall be stopped and the discrepancy immediately reported to the Architect. In addition, when requested by the Architect, a string line shall be used in the bottom of the trench to insure a straight alignment of the sewer pipe between manholes. The elevation of the pipe invert shall not deviate from the design elevation by more than +2 percent of the pipe size concerned, or 1-inch, whichever is greater. The rate of deviation from grade or returning to grade shall be limited to 1/16 inch per foot of pipe.

- B. Pipe laying shall proceed upgrade with the bell ends of bell and spigot pipe placed upstream. Each section of pipe shall be laid to line and grade as herein specified and in such a manner as to form a watertight, concentric joint with the adjoining pipe. The interior of the pipe shall be cleared of all dirt and debris and excess joint sealing material as the work progresses. Pipe shall not be laid when the condition of the trench or weather is unsuitable. All open ends of pipe and fittings shall be adequately and securely closed whenever the work is discontinued for more than one-half hour. If pipe with elliptical or quadrant reinforcement is used, care shall be taken to properly orient the axis. All pipes sloped at 1% or less, shall be staked by a licensed California Civil Engineer or Land Surveyor.
- C. Install continuous warning tape during backfilling of trench for storm drain piping. In areas to be paved, locate tape at top of sub-grade. In all other areas, locate 8 inches below final finish grade.
- D. All joint surfaces shall be cleaned before joints are made.
- E. Storm Drain Systems Plugs: Temporary plugs of rubber, brick, or mortar shall be installed on all storm drain projects at points of connection to existing facilities. These plugs shall remain in place until completion of the balling and flushing operation. The plugs, intended to prevent water from the balling and flushing operation, drainage, or any other condition from entering the existing system, shall be installed or removed in the presence of and under the direct supervision of the Engineer. Until the system has been pumped clear of accumulated water, the plugs shall not be removed. This water must not be allowed to enter adjacent drainage systems.
- F. Internal Inspection: Upon completion of construction and prior to final inspection, the Contractor shall clean the entire new pipeline of all dirt and debris. The Contractor shall also remove any dirt or debris in previously existing pipes or ditches in the area, which in the opinion of the Architect/Engineer/Owner, resulted from the new installation. Sewer pipes shall be cleaned by the controlled balling method. Temporary plugs shall be installed and maintained during cleaning operations at points of connection to existing facilities to prevent water, dirt, and debris from entering the existing facility. Temporary plugs for sewer systems shall also conform to Subsection B, above. Water from the drainage system operations shall be routed through a suitable trap to collect any dirt and debris prior to discharging into any downstream facility. The Contractor shall notify the Architect/Engineer immediately after completion of the pipe cleaning operations.
- G. No piping to be laid closer than 2 feet to building foundation or footings for other structures.
- H. As soon as possible after the completion of the pipe cleaning, and prior to final acceptance, the Architect or Engineer may make a visual internal inspection of the new pipeline manually or with television equipment.

3.5 INSTALLATION - CATCH BASINS AND CLEANOUTS

- A. Form bottom of excavation clean and smooth to correct elevation.
- B. Establish elevations and pipe inverts for inlets and outlets as indicated.
- C. Place pipes and hold firmly in place.
- D. Form and place cast-in-place concrete base pad, around storm sewer pipe end sections.

- E. Level top surface of base pad to receive concrete shaft sections.
- F. Mount lid and frame level in grout, secured to top section to elevation indicated.

3.6 CAST-IN-PLACE CONCRETE

- A. All concrete shall be mixed in accordance with applicable provisions of Section 90 of the CDT Standard Specifications.
- B. Construction of concrete structures shall conform to applicable provisions of Section 51 of the CDT Standard Specifications. Unless otherwise noted herein, all exposed surfaces of structure shall have a Class 1 surface finish.
- C. Curing shall conform to applicable portions in Section 90 of the CDT Standard Specifications. No pigment shall be used in curing compounds. All work shall be subject to inspection. No concrete shall be placed until the Architect / Engineer / I.O.R. has approved the forms and reinforcement.
- D. Concrete shall not be dropped freely where reinforcing bars will cause segregation, nor shall it be dropped freely more than six feet (6'0"). Spouts, elephant trunks, or other approved means shall be used to prevent segregation.

3.7 BACKFILLING

- A. Backfill trenches in conformance with Section 31 2316, Trench Excavation. Do not backfill until installation is inspected.
- B. Support pipe and conduit during placement and compaction of bedding fill.

3.8 ADJUSTMENT

- I. Adjustment of any existing storm drain manhole or cleanout covers to proposed finish grade shall be to the proposed elevations shown on the utility plan. All work to be in accordance with the current edition of the Standard Plans for Public Works Construction, "Green Book," Section 2, 205-1, Sewer Manhole Adjustment.

3.9 FIELD QUALITY CONTROL

- A. Notify Geotechnical Engineer 48 hours in advance of backfilling to permit observation and testing of the placement and compaction of backfill. The cost for observation and initial testing will be borne by the Owner.

- B. Compaction testing will be performed in accordance with ANSI/ASTM D1557.
- C. If tests indicate Work does not meet specified requirements, remove Work, replace and retest, at no additional cost to owner.

3.9 PROTECTION

- A. Protect finished Work under provisions of Division 1.
- B. Protect pipes and aggregate cover from damage or displacement until backfilling operation is in progress.

3.10 COMPLETION

- A. Prior to final acceptance, provide videotaping of the entire storm drainage system to owner to ensure proper installation and drainage without obstructions, debris, infiltration and sags in pipe.
- B. After completion of the Work, remove excess earth, rubbish and storm drain materials from the site.

END OF SECTION